Carnegie Mellon University

Undergraduate Catalog
2004-2006
Carnegie Institute of Technology
The College of Fine Arts
The H. John Heinz School of Public Policy and Management
The College of Humanities and Social Sciences
Mellon College of Science
The School of Computer Science
Tepper School of Business
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Inquiries concerning application of these statements should be directed to the Provost, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-6684 or the Vice President for Enrollment, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-2056.

Carnegie Mellon University publishes an annual campus security report describing the university’s security, alcohol and drug, and sexual assault policies and containing statistics about the number and type of crimes committed on the campus during the preceding three years. You can obtain a copy by contacting the Carnegie Mellon Police Department at 412-268-2323. The security report is available through the World Wide Web at www.cmu.edu/security/stats.html.


Carnegie Mellon University reserves the right to change its programs, policies and procedures without notice.
Foreword

This catalog was primarily assembled to meet the needs of current undergraduate students, faculty, and administrators regarding the University’s academic programs, policies and services. We have tried to present in a readable format the current information available at press time.

While the audience for this catalog is the campus community, we recognize that applicants, prospective students, and many other people will read this material. This publication should give them an understanding of the University.

Since this is a two-year catalog, an addendum will be bound in the back of catalogs distributed after August of 2005. The addendum will be an update of changes in University academic programs, policies and services. Separate copies of the addendum will be published for distribution to undergraduate students who have already obtained this catalog during enrollment in September 2004 and to faculty and administrators during the fall by means of campus mail.

In the interim, new courses will be announced in the course schedules which are usually available in November and April and on the World Wide Web (http://www.cmu.edu/hub). I will be happy to receive updated information from any member of the campus community so that this catalog will maintain its usefulness until 2006.

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Look at Carnegie Mellon
Excellence In Practice and Learning for Life

Carnegie Mellon provides an education that emphasizes a deep connection between theoretical knowledge and practice; the university’s interdisciplinary approach to education stresses the practical application and analysis of knowledge in institutional, social, and historical contexts. "On a campus of one hundred and ten acres, research and teaching are conducted in more than thirty different fields of the arts, humanities, engineering, sciences, social sciences, management and public policy. Students and faculty in these areas are in daily contact with one another, pursuing interdisciplinary projects, re-defining fields of knowledge, pushing their own visions of the possible, and contributing to the world around them" writes Jared Cohon, the eighth president of Carnegie Mellon in The Innovative University, a volume of writings that celebrates Carnegie Mellon’s centennial in 2000. Carnegie Mellon graduates are excellent practitioners in their chosen fields. The university is in the process of enriching and complementing this education; we want to ensure that our students also gain broader, well-informed perspectives that are necessary to grow and change with their professions, to interact wisely with the natural environment, and to be responsible and informed citizens in an increasingly technological world and a complex global culture.

From Technical School to Renowned University

In a letter written in 1900, industrialist and philanthropist Andrew Carnegie offered to give the city of Pittsburgh one million dollars in bonds to found a technical institute. The city provided 32 acres of land near Schenley Park, and the institution became known as the Carnegie Technical Schools. According to Carnegie’s plans, the Schools were to train the sons and daughters of working class families; they included a school of Science and Technology to train draftsmen and engineer’s assistants, a school of Fine and Applied Arts for designers and art workers, a school of Apprentices and Journeymen for mechanics in manufacturing and construction, and Margaret Morrison Carnegie College for students who aspired to become home economists or secretaries. Within two decades, bachelor’s, master’s and doctor’s programs had been organized and the name was changed to Carnegie Institute of Technology.

In 1967, the trustees of the Mellon Institute and the Carnegie Institute of Technology merged the two institutions and adopted the name Carnegie Mellon University. In 1968, Margaret Morrison College was closed and a new College of Humanities and Social Sciences was organized. On the graduate level, other new colleges and schools also flourished: the Graduate School of Industrial Administration (GSIA), the Heinz School of Public Policy and Management, and the School of Computer Science. New research centers and institutes developed on and off campus in such areas as software engineering and robotics. In 2004, GSIA was renamed the Tepper School of Business after alumnus David A. Tepper.

The Carnegie Institute of Technology has developed from a regional, technical college into Carnegie Mellon University, a selective, international research university, an institution that is a far cry from that envisioned by its founder. Carnegie Mellon is made up of seven colleges, and undergraduate students can pursue majors through the college in which they are enrolled, students may decide to pursue a double major or a minor (frequently in a different college). They may even design their own majors, drawing on university offerings. In a community rich with seven colleges, the academic options can be as varied as the students who pursue them.

Excellence in Pr cellence in Practice and Learning for Lifeactice and Learning for Lifeactice and Learning for Lifeactice and Learning for Lifeactice and Learning for Life

Communication and reflective practice are common threads connecting these skills. In order to excel in any field and to lead a life of social responsibility and life-long learning, students must be able to understand the theoretical basis and the practical implications of knowledge and action, to convey ideas and information effectively, and to be reflective practitioners. An educational environment of learning by doing, a strong analytical background, and a habit of doing and making, are all intended to offer to the students a breadth of perspective and opportunities.

Currently, we are engaged in discussions regarding the design of a new type of general education. This uniquely Carnegie Mellon education would integrate the many dimensions of liberal learning to complement the intense professional learning. Goals of this new general education would include wide, historically informed appreciation of the arts, humanities, and sciences, a broad understanding of mathematics and the experimental method, a critical openness to ethical reflection and social responsibility, and an acute global and environmental awareness. The School of Humanities and Social Sciences will pilot a version of this new scheme of general education in the Fall of 2004.

Strength in Research and Artistic Creation

Carnegie Mellon faculty conducts original research, scholarship, and artistic creations and, at the same time, are devoted classroom teachers. The faculty are continuously innovating and the new knowledge and methods they discover routinely benefit classroom learning. Each college and dozens of special centers focus on issues and developments that affect the world beyond Carnegie Mellon. For example, four faculty members from the Physics Department recently participated in the LEP (large electron-positron) project near Geneva, Switzerland, where over 1,000 researchers from around the world hope to discover at least one of the last two missing particles in the Standard Model of Particle Physics. In the College of Humanities and Social Sciences, members of the Psychology Department aim for improving the level of scientific knowledge in America through the Literacy in Science Center. The engineering college is the only institution in the country that has been awarded two National Science Foundation engineering research centers. Researchers in the Field...
Robotics Center of the university's Robotics Institute continue to develop robots that can function in unpredictable and hazardous environments for such uses as nuclear maintenance, mining, and space exploration. Faculty members in the School of Music have worked with colleagues in the School of Computer Science to develop a program called PIANO TUTOR. These are just a few examples of the innovative work at Carnegie Mellon.

Exploring Research and Creative Projects

Undergraduate research is a vital part of Carnegie Mellon education for students who would like to take advantage of the opportunity. Students can initiate projects of their own or become involved with existing projects on campus. The Department of Biological Sciences, for example, assigns each student a faculty mentor who will help him or her find appropriate opportunities. Drama students participate in every facet of stage productions. Students across campus are encouraged to work with faculty in pursuing their particular interests. Most departments offer courses for independent study, which allow undergraduates to work on projects of their own design, overseen by professors.

Many sources of funding are available to aid students conducting independent research and creative projects. For instance, students may apply for grants through the Undergraduate Research Initiative’s Small Undergraduate Research Grant (SURG) program. For more information, please see the Undergraduate Research Initiative section in this catalog under “University Services.”

The World of Carnegie Mellon

Carnegie Mellon students will sometimes proudly count on one hand the number of hours they slept the previous night. You may assume that they were struggling with a problem set, perfecting a paper, putting the finishing touches on a piece of sculpture, and often they were. But many students spend free hours simply taking advantage of the company they share. Whether talking about individual interests and experiences or planning for the coming weekend, Carnegie Mellon students discover Fascinating people and often develop some of the strongest friendships they have known.

Carnegie Mellon is often described as a competitive place, and it is. The university selects students from among the best in the world, so coming to Carnegie Mellon means that you may no longer necessarily be at the top of your class. The university also stresses collaboration and teamwork, often across disciplines, where students experience sharing common goals and tasks while still bringing something of unique value to the interaction. Carnegie Mellon students are serious students who want to excel. The atmosphere is intense and demanding, but also encouraging and rewarding. Carnegie Mellon graduates enter society with a very special kind of education prepared to assume even greater challenges and equipped with an awareness of their own strengths and abilities.

In this atmosphere, students develop not only a strong work ethic, but also a strong sense of community. Through Residence Hall living, community work, project work and numerous recreational activities and clubs, students find they can belong to a range of communities. Carnegie Mellon also has the tradition of “Spring Carnival”, with its buggy race and booths. Every Spring, numerous students and alumni participate in this three-day event.

Carnegie Mellon Affects the World Beyond Campus

As a graduate of the university, you join a highly respected group of productive individuals. Whether pursuing further education or entering the work force, Carnegie Mellon alumni consistently achieve the goals they have set for themselves.

Carnegie Mellon alumni don’t fit neatly into one category. Carnegie Mellon alumni wrote the songs for Godspell, Pippin and The Magic Show. One alumna won the Helen Hayes Award as best actress for her role in a touring production of Cats. Alumna Holly Hunter received a Best Actress Oscar for her role in “The Piano.” Carnegie Mellon alumni created and starred in the popular television series Hill Street Blues, L.A. Law and NYPD Blue. Over 2,000 of our graduates are chairmen, presidents or vice presidents of corporations, including Standard Oil and Dansk International Design. More than 1,400 alumni teach as professors at universities and 30 are deans. Most major symphonies around the country include our alumni. Carnegie Mellon graduates in government include a former White House staff assistant, a U.N. delegate and a former first deputy chairman of the Presidium of the USSR. An Apollo 14 Astronaut who walked on the moon holds a degree from Carnegie Mellon as does the project director of NASA’s Pioneer Interplanetary Probe. Astronaut Judith Resnik, who died in the explosion of the space shuttle Challenger, was a Carnegie Mellon graduate as is Nobel laureate John Nash. In addition, the works of many former art students, including Andy Warhol, hang in the permanent collections of over 50 international museums. This is the variety that marks our university and our graduates.

Mission

Our mission is:

To create and disseminate knowledge and art through research and artistic expression, teaching and learning; and to transfer intellectual products to society.

To serve students by teaching them problem-solving, leadership and teamwork skills, and the value of a commitment to quality, ethical behavior, society and respect for one another.

To pursue advantages provided by a diverse and relatively small university community, open to the exchange of ideas, where discovery, creativity, and personal and professional development can flourish.

A Carnegie Mellon undergraduate education aims to prepare students for life and leadership. In a continually changing world, the most important qualities we can help our students develop are the ability to think independently and critically, the ability to learn and the ability to change and grow. As future leaders they must have courage to act, be sensitive to the needs and feelings of others, understand and value diversity, and honor the responsibilities that come with specialized knowledge and power.

Carnegie Mellon’s undergraduate educational programs are designed to help students acquire:

Depth of knowledge in their chosen areas of specialization and genuine intellectual breadth in other fields.

Creativity and intellectual playfulness, moving beyond established knowledge and practice to create imaginative ideas and artifacts.

Skilled thoughtfulness and critical judgment, which allow them to evaluate new ideas; identify and solve or explore problems; and appreciate a variety of different forms of analysis and thought.

Skills of independent learning, which enable them to grow in wisdom and keep abreast of changing knowledge and problems in their profession and the world.

A considered set of values, including commitment to personal excellence and intellectual adventure, a concern for the freedoms and dignity of others, and sensitivity to the special professional and social responsibilities that come with advanced learning and positions of leadership.

The self-confidence and resourcefulness necessary to take action and get things done.

The ability to communicate with others on topics both within and outside their chosen field of specialization.

Most instruction at Carnegie Mellon is focused on fundamentals useful in later learning, rather than on particulars of knowledge and techniques that may soon become obsolete. Advanced courses provide students with the opportunity to refine their skills by applying and exercising the fundamentals they have acquired in earlier courses and by exploring new analytical and creative directions. We are committed to bring together the traditions of liberal and professional education. In a world which has sometimes placed too little emphasis on “skill,” we take pride in educating students who display excellence in application, students who can do useful things with their learning.

Values, including a sensitivity to the feelings, needs and rights of others, are learned in part through example. To this end, the faculty and staff of Carnegie Mellon work to provide a supportive and caring environment that values and respects intellectual, philosophical, personal and cultural diversity. The faculty strive to identify and discuss with their students, both in formal classroom settings and in a variety of informal contexts, their responsibilities as professionals, citizens and human beings, and to teach through example.

The undergraduate programs at Carnegie Mellon are designed to help our students become accomplished professionals who are broadly educated, independent and humane leaders.
Degrees Offered

Carnegie Institute of Technology

- Biomedical Engineering
  B.S. in an engineering discipline and Biomedical Engineering
  M.S. in Bioengineering
  M.S. in an engineering discipline and Bioengineering
  Ph.D. in an engineering discipline and Bioengineering

- Chemical Engineering
  B.S. in Chemical Engineering
  M.S. in Chemical Engineering
  M.S. in Colloids, Polymers and Surfaces (jointly with the Department of Chemistry)
  Ph.D. in Civil Engineering

- Civil and Environmental Engineering
  B.S. in Civil Engineering
  M.S. in Civil Engineering
  M.S. in Environmental Engineering
  Ph.D. in Civil Engineering

- Electrical and Computer Engineering
  B.S. in Electrical and Computer Engineering
  M.S. in Electrical and Computer Engineering
  Ph.D. in Electrical and Computer Engineering

- Engineering and Public Policy
  B.S. in an engineering discipline and Engineering and Public Policy
  M.S. in an engineering discipline and Engineering and Public Policy
  Ph.D. in Engineering and Public Policy

- Information Networking Institute
  M.S. in Information Networking (jointly with the School of Computer Science and the Tepper School of Business)
  M.S. in Information Security Technology Management (jointly with the School of Computer Science and the Tepper School of Business)

- Mechanical Engineering
  B.S. in Mechanical Engineering
  M.S. in Mechanical Engineering
  M. of Product Design (jointly with the School of Design)
  Ph.D. in Mechanical Engineering

- Matherials Science and Engineering
  B.S. in Materials Science and Engineering
  M.S. in Materials Science and Engineering
  Ph.D. in Materials Science and Engineering

College of Fine Arts

- Architecture
  B.Arch in Architecture (5 year program)
  M.S. in Architecture - Engineering - Construction Management
  M.S. in Building Performance and Diagnostics
  M.S. in Computational Design
  M.S. in Sustainable Design
  M. of Urban Design
  Ph.D. in Building Performance and Diagnostics

- Art
  B.F.A. in Art
  M.F.A. in Art

- Design
  B.F.A. in Communication Design
  B.F.A. in Industrial Design
  M. Design in Interaction Design
  M.A. in Communication Planning and Information Design (jointly with Department of English)
  M. of Product Design (jointly with Department of Mechanical Engineering)
  Ph.D. in Design

- Drama
  B.F.A. in Drama
  M.F.A. in Combined Design Programs
  M.F.A. in Costume Design
  M.F.A. in Directing
  M.F.A. in Dramatic Writing
  M.F.A. in Lighting Design
  M.F.A. in Performance Technology/Management
  M.F.A. in Production
  M.F.A. in Scene Design

- Music
  B.F.A. in Composition
  B.F.A. in Music Performance
  M. Music in Composition
  M. Music in Conducting
  M. Music in Music Education
  M. Music in Performance

College of Humanities and Social Sciences

- Interdepartmental
  B.A. in Ethics, History, and Public Policy (jointly with the Departments of History and Philosophy)
  B.S. in Ethics, History, and Public Policy (jointly with the Departments of History and Philosophy)
  B.A. in European Studies*
  B.S. in Information Systems*
  B.A. in International Relations
  B.A. in Russian Studies*

  *jointly by the Departments of Modern Languages and History

- Economics
  B.A. in Economics
  B.S. in Economics
  Ph.D. in Economics

- English
  B.A. in Creative Writing
  B.A. in English
  B.A. in Professional Writing
  B.S. in Technical Writing and Communication
  M.A. in Literary and Cultural Theory
  M.A. in Rhetoric
  M.A. in Professional Writing
  M. of Communication Planning and Information Design (jointly with the School of Design)
  Ph.D. in Literary and Cultural Studies
  Ph.D. in Rhetoric

- History
  B.A. in Anthropology and History
  B.S. in Anthropology and History
  B.A. in History and Policy
  B.S. in History and Policy
  B.A. in Social and Cultural History
  B.S. in Social and Cultural History
  M.A. in History
  M.A. in History (fifth-year program along with Chatham College Secondary School Pennsylvania State Teacher Certification Program)
  M.S. in History and Policy
• Modern Languages
  B.A. in French and Francophone Studies
  B.A. in German
  B.A. in Japanese
  B.A. in Hispanic Studies
  B.A. in Modern Languages (with a concentration in English as a Second Language)
  M.A. in Teaching English as a Second Language
  Ph.D. in Second Language Acquisition

• Philosophy
  B.A. in Philosophy
  B.S. in Logic and Composition
  M.A. in Philosophy
  M.S. in Logic and Composition
  Ph.D. in Pure and Applied Logic (jointly with the Department of Mathematics and the School of Computer Science)
  Ph.D. in Philosophy

• Social and Decision Sciences
  B.S. in Decision Science
  B.S. in Policy and Management
  B.S. in Political Science
  Ph.D. in Behavioral Decision Theory
  Ph.D. in Organizational Science
  Ph.D. in Social and Decision Sciences

• Statistics
  B.S. in Statistics
  M.S. in Statistics
  Ph.D. in Statistics and Public Policy (jointly with the H. John Heinz III School of Public Policy and Management)

Tepper School of Business
  B.S. in Business Administration
  M.B.A. in Industrial Administration
  M.S. in Industrial Administration
  M.S. in Civil Engineering and Management (jointly with the Carnegie Institute of Technology)
  M.S. in Computational Finance (jointly with the College of Humanities and Social Sciences, Mellon College of Science, and School of Computer Science)
  M.S. in Electronic Commerce (jointly with the School of Computer Science)
  M.S. in Information Networking (jointly with the Carnegie Institute of Technology and the School of Computer Science)
  M.S. in Software Engineering and Business Management (jointly with the School of Computer Science)
  Ph.D. in Accounting
  Ph.D. in Economics
  Ph.D. in Financial Economics
  Ph.D. in Industrial Administration
  Ph.D. in Information Systems
  Ph.D. in Manufacturing and Operations Systems
  Ph.D. in Marketing
  Ph.D. in Operations Research
  Ph.D. in Organizational Psychology and Theory
  Ph.D. in Algorithms, Combinatorics, and Optimization (jointly with the School of Computer Science)
  Ph.D. in Robotics (jointly with the School of Computer Science)

The H. John Heinz III School of Public Policy and Management
  M. of Entertainment Industry Management (jointly with the College of Fine Arts)
  M. of Arts Management (jointly with the College of Fine Arts)
  M. of Educational Technology Management
  M. of Medical Management
  M. of Public Management
  M.S. in Health Care Policy and Management
  M.S. in Public Policy and Management
  Ph.D. in Public Policy and Management
  Ph.D. in Statistics and Public Policy

Human Computer Interaction
  B.S. in a discipline and Human Computer Interaction

Humanities and Arts
  B. of Humanities and Arts (jointly with the College of Humanities and Social Sciences and the College of Fine Arts)

Information Systems
  M.S. in Information Technology
  M. of Information Systems Management

Mellon College of Science
  • Biological Sciences
    B.A. in Biological Sciences (and a discipline the Humanities and Social Sciences)
    B.S. in Biological Sciences
    B.S./M.S. in Chemical Biology
    B.S. in Biological Sciences and Psychology (offered jointly with the College of Humanities and Social Sciences)
    M.S. in Computational Biology
    Ph.D. in Biological Sciences
    Ph.D. in Biological Sciences/Biophysics and Biochemistry

  • Chemistry
    B.A. in Chemistry
    B.S. in Chemistry
    B.S. in Chemistry/Computational Chemistry Track
    M.S. in Chemistry
    M.S. in Polymer Science
    M.S. in Colloids, Polymers, and Surfaces (jointly with the Department of Chemical Engineering)
    Ph.D. in Chemistry
    Ph.D. in Chemistry/Biophysics and Biochemistry

  • Mathematical Sciences
    B.S. in Mathematics
    B.S. in Computational Finance
    B.S. in Mathematical and Statistical Sciences (offered jointly with the College of Humanities and Social Sciences)
    D.A. in Mathematics
    M.S. in Computational Finance (offered jointly with the Tepper School of Business)
    M.S. in Mathematical and Statistical Sciences (offered jointly with the College of Humanities and Social Sciences)
    M.S. in Mathematics
    M.S. in Applied Mathematics
    Ph.D. in Algorithms, Combinatorics, and Optimization
    Ph.D. in Pure and Applied Logic (jointly with the Department of Philosophy and the School of Computer Science)

  • Physics
    B.A. in Physics
    B.S. in Physics
    M.S. in Physics
    Ph.D. in Physics
    Ph.D. in Physics/Biophysics and Chemistry

School of Computer Science
  B.S. in Computer Science
  M. of Human-Computer Interaction
  M.S. in Computer Science (5th Year Scholars Program only)
  M.S. in Electronic Commerce (jointly with TSB)
  M.S. in Human-Computer Interaction
  M.S. in Knowledge Discovery and Data Mining
  M.S. in Language Technologies
  M.S. in Robotics
  M.S. in Robotic Technology
  M. of Software Engineering
  M. of Software Engineering
  M.S. in Computational Finance (offered jointly with the Tepper School of Business and College of Humanities and Social Sciences)
  M.S. in Electronic Finance (offered jointly with the Tepper School of Business)
  M.S. of Entertainment Technology (jointly with the College of Fine Arts)
  M. in Information Technology
  Ph.D. in Computational and Statistical Learning
  Ph.D. in Computer Science
  Ph.D. in Human-Computer Interaction
  Ph.D. in Language and Information Technologies
  Ph.D. in Robotics
  Ph.D. in Software Engineering

Science and Arts
  B.A. of Science and Arts (jointly with the College of Fine Arts and the Mellon College of Science)
  B.S. of Science and Arts (jointly with the College of Fine Arts and the Mellon College of Science)
Admission

Admission Application as a Freshman Freshman Application Instructions Transfer Application Instructions Application as an International Student Requirements for the College of Fine Arts Exploring Carnegie Mellon Summer Opportunities

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Undergraduate Admission

Michael A. Steidel, Director of Admission
Office: Warner Hall, Room 101

Application as a Freshman

Applicants As Individuals
Evaluating the talented and bright students who apply to Carnegie Mellon each year is a challenging and exciting process. Each year, Carnegie Mellon enrolls the most qualified freshman class possible. We treat every application individually and take great care in making our admission practices fair, thorough and sensitive. We are interested in students who can be successful at Carnegie Mellon who can take full advantage of all the university has to offer while contributing to and enriching the campus community.

Determinants of Success
Our admission process is designed to identify students who will be successful at Carnegie Mellon. High school performance weights most heavily in our admission decision because it is the most meaningful measure of a student's abilities. We pay close attention to the type of courses taken and to the grades received, and to the challenges you've given yourself in the classroom.

Standardized test scores add to our knowledge of a student's ability, but we cannot make decisions simply on the basis of test scores alone. The high school record and standardized test scores (SAT I or ACT and SAT II: Subject Tests) work together to make up the academic portion of a student's evaluation.

Carnegie Mellon is an exciting campus because of the positive qualities and experiences our students bring with them. For this reason, we're interested in the kinds of things students do beyond the classroom, whether they participate in extracurricular activities, work part-time or pursue hobbies. Knowing what students like to do on their own time gives us a feeling for each student's personality, motivation and sense of responsibility. All of this is an important part of the admission process.

Expressing an interest in learning more about Carnegie Mellon can only enhance a student's application. We strongly recommend that students come to the Carnegie Mellon campus to interview with a member of our staff, although it's not required. This adds a personal touch to our evaluation and gives students a chance to ask questions.

If you cannot make it to campus, consider talking with a local Carnegie Mellon alumni representative. There are a number of other ways to show interest and learn more about Carnegie Mellon, too. Students can come to one of our Sleepover Weekend events, attend an area information program in or near their town, interview in their hometown with one of our staff members or enroll in one of our summer programs. Information about a number of these events is included at the end of this section.

Different Criteria for Different Colleges
Each college at Carnegie Mellon has special admission criteria specifically related to each course of study.

Admission to the Schools of Drama and Music is based primarily on an audition or portfolio showing. Applicants to the Schools of Art and Design will be evaluated not only on the basis of their portfolio but also on their academic performance.

Candidates for Architecture will be evaluated on the basis of academic performance. The same holds true for students interested in the Carnegie Institute of Technology, the Mellon College of Science, and the School of Computer Science, but we will look additionally for strength in mathematics and science.

Academic performance is also the main criteria we use to evaluate applicants to the College of Humanities and Social Sciences, the Information Systems program and to the Tepper School of Business' undergraduate business program. In these cases, we emphasize reading and comprehension abilities as well as mathematics courses.

No one single grade, factor or score will automatically grant or deny a student admission to Carnegie Mellon. Students should be aware of all the admission requirements—secondary school preparation, standardized test requirements, nonacademic information, counselor, teacher and interview recommendations—when submitting applications. We will use the sum total of these different factors when making our admission decisions.

Because we want to have a sense of who the student is as a person, we look closely at the essay and personal statement the student is asked to write, the guidance counselor's evaluation and the teacher's recommendation.

Freshman Application Instructions
Carnegie Mellon uses the Common Application exclusively. Before your Common Application will be processed, you must submit the Common Application Supplement.

1. Apply for admission to the specific college(s) in which you are interested.
   - Indicate college by checking proper box on Common Application Supplement
   - Write the name of the program that interests you

2. If applying to more than one college or program, please rank your choices on the line provided.
   - You do not have to submit two applications, and there is no additional cost. Simply indicate on the Common Application Supplement the colleges to which you are applying
   - Make sure to meet the admission requirements for each college or department

3. Follow these guidelines for your specific area of interest:
   - Carnegie Institute of Technology (CIT) College of Humanities and Social Sciences (H&SS)
   - Information Systems (IS) Mellon College of Science (MCS)
   - School of Computer Science (SCS)
   - Tepper School of Business (TSB)
   - Bachelor of Humanities and Arts (BHA) – see “Intercollege Degree Programs”
   - Bachelor of Science and Arts (BSA) – see “Intercollege Degree Programs”

   We strongly urge you to indicate a program preference at the time you apply. Although you won't declare a major until the end of your freshman or sophomore year, Carnegie Mellon limits access to certain departments, including Electrical and Computer Engineering and Computer Science.

   College of Fine Arts: You must apply specifically to one of the following schools: Architecture, Art, Design, Drama or Music. (See specific instructions to follow.)

4. Enclose with your application the non-refundable $60 application fee (and audition fees if applicable) as specified in our application packet.

   We require this fee of all applicants except in extenuating family financial circumstances. A College Entrance Examination Board Application Fee Waiver, an ACT Application Fee Waiver, or a letter from a high school guidance counselor or principal requesting an application for a waiver must be submitted.

   If you are applying to Music or Drama, the additional audition fee is $45. Student should submit all fees with his/her application.

5. Plan to visit our campus or interview with a Carnegie Mellon alumni, if possible. (See section on “Exploring Carnegie Mellon.”)
6. Send all of your high school transcripts to the Office of Admission. An updated transcript, which includes senior year courses and midyear grades must be submitted as close to February 1 as possible. The Office of Admission does not acknowledge receipt of these items. We do not confirm fax or FedEx materials for up to 48 hours during our peak times. However, after March 1 we will let students know if something is missing.

7. Take the SAT I or ACT preferably by December, but no later than January. In certain disciplines, you must also take SAT II subject tests by January. The results of the March test arrive too late to receive proper consideration. (If you are applying to Art, Design, Drama or Music, SAT II: Subject Tests are not required.)
   • Scores must be official scores from the Educational Testing Service (ETS). Copies should not be sent. When registering for the tests, request an official CEEB Report be sent directly to Carnegie Mellon. This request can also be made later by getting an Additional Report Request Form from your guidance office. The Carnegie Mellon code number is 2074.
   • Register for your tests at least six weeks prior to the test date.

8. The Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS) should be taken if your native language is not English and your SAT I verbal score is less than 600. Carnegie Mellon requires TOEFL scores of 250 or better and IELTS scores of 7 and above.

9. If you are applying to the College of Fine Art’s Schools of Art, Design, Drama or Music, you must complete the portfolio or audition requirements. Before you can arrange an audition or review, the application must be submitted by December 1 (November 1 for Early Decision).

10. You must sign and return the “Confidentiality Statement” on the Personal Evaluation Form and give it to your guidance counselor for completion. Your counselor should return this form, along with the application for admission, directly to the Office of Admission as soon as possible.

11. Complete Part I of the Teacher Recommendation Form and give it to a teacher to complete. You should also provide your teacher with an addressed, stamped envelope to return the form to Carnegie Mellon’s Office of Admission by January 1.

12. The application deadline is January 1. Student or counselor should be sure to return the application and supplement, Personal Evaluation Form and complete transcripts by this date.

   Important: Carnegie Mellon prefers that all forms and documents be submitted at the same time. If they must be sent separately, student should be sure to print full name and social security number at the top of each document.

13. If you are applying for financial aid, request a Free Application for Federal Student Aid (FAFSA) from your high school guidance counselor. Complete the form and return it to the appropriate federal processor listed in the FAFSA instructions. Send a copy of your completed FAFSA directly to Carnegie Mellon. Carnegie Mellon’s Title IV code is 003242.

Application Notification

• Students applying under the Early Decision I Plan will be notified of our decision by December 15.

• Students applying under the Early Decision II Plan will be notified of our decision by January 15.

• Students applying under the Regular Decision Plan will be notified of our decision by April 15.

• Students who are applying for financial aid will also receive financial aid decisions by April 15 provided they submitted their financial aid forms by the appropriate deadlines.

If you are offered admission and wish to enroll at Carnegie Mellon, you are required to pay a $500 non-refundable enrollment deposit by May 1 (Candidate's General Reply Date), even if you are receiving financial aid, in order to reserve places in the freshman class and in university housing. This deposit will be credited to your first semester’s charges.

The admission staff assumes that a student’s deposit to Carnegie Mellon is his or her only deposit. We reserve the right to cancel our offer of admission if a student posts a tuition deposit at another university.

During the summer, information concerning registration, enrollment, insurance, orientation, housing and dining services, etc., will be sent to all students.

Deferred Admission

If you are admitted to Carnegie Mellon and wish to defer your admission for one year, you must submit a request in writing to the Office of Admission. If permission is granted, your enrollment deposit must be paid in order to confirm enrollment for the following year. You cannot enroll in a degree program at another institution in the interim.

Application Plans

Early Decision Plans

If Carnegie Mellon is your first choice, you may want to consider applying through our early decision plans. Under these plans, applicants are notified of our admission decision early in the senior year. If you are accepted early decision, we expect you to enroll in Carnegie Mellon. If you are not admitted under early decision, your application will either be rejected or deferred to our regular decision process and we will re-evaluate it in the spring.

Under the early decision plans, we encourage you to submit applications to other schools. However, if you are accepted to Carnegie Mellon, we require you to withdraw your applications from other schools.

Carnegie Mellon will meet the full demonstrated need as calculated by the university for all students admitted under early decision. However, we do not guarantee to meet full need for students who are deferred or denied admission under early decision and later admitted under regular decision.

The early decision plans are available in all areas of study with the exception of Drama and Music - Vocal and Flute Performance. If you’d like to apply through the early decision plan:

1. Check the appropriate box on the application supplement.

2. If you are applying under Early Decision I, submit your application by November 15 of your senior year. Applicants to Architecture, Art, Design and Music should submit the application by November 1. (Please note there is no early decision option for Drama and Music - Vocal and Flute Performance applicants.)

3. If you are applying under Early Decision II, submit your application by December 15 of your senior year. (This option is not available to fine arts applicants.)

4. Submit all forms and credentials that are available (high school transcript, SAT I or ACT results, SAT II: Subject Test results), preferably by November 15 of your senior year (for Early Decision I) or by December 15 (for Early Decision II) of your senior year. Note: You may apply for early decision without having taken the required SAT II: Subject Tests.

5. Arrange to have a campus visit that includes a group information session or an interview with a member of the admission staff, if possible.

6. Fulfill the portfolio, audition or interview requirements if applying to the College of Fine Arts.

Early decision applicants will be notified of our admission decision by December 15 (Early Decision I) or January 15 (Early Decision II).

If you are admitted under early decision, you are required to withdraw all admission applications to other colleges or universities and post a non-refundable enrollment deposit of $500 within two weeks of your admission notification.

Regular Decision Plan

Regular decision is our most popular application option. The deadline is January 1 (December 1 for Fine Arts). You will be notified of our decision by April 15. Admitted students will have until May 1 (Candidate’s General Reply Date) to accept our offer of admission.
Early Admission

Through the process of early admission, the university admits certain highly qualified applicants at the end of their junior year in high school. In general, early admission candidates are highly mature and responsible students who have usually exhausted the courses offered at their high schools without receiving a high school diploma. We expect students who apply for early admission to follow the same procedures as regular freshman applicants. We also strongly encourage applicants to have a personal interview with a member of the Admission staff. It is important to note that the College of Fine Arts very rarely accepts early admission applicants.

Secondary School Preparation and Required Tests

<table>
<thead>
<tr>
<th>College</th>
<th>High School Preparation</th>
<th>Tests</th>
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</thead>
<tbody>
<tr>
<td>Carnegie Institute of Technology</td>
<td>4 years English</td>
<td>SAT I or ACT</td>
</tr>
<tr>
<td>Mellon College of Science</td>
<td>4 years Mathematics *</td>
<td>SAT II: Subject Tests (3)</td>
</tr>
<tr>
<td>School of Computer Science</td>
<td>1 year Biology</td>
<td>English Composition</td>
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<tr>
<td></td>
<td>1 year Chemistry</td>
<td>Math Level I, Ic or IIC</td>
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<tr>
<td></td>
<td>1 year Physics</td>
<td>Physics, Chemistry or Biology****</td>
</tr>
<tr>
<td></td>
<td>1 year Computer Science (preferred)</td>
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</tr>
<tr>
<td></td>
<td>2 years Foreign Language (preferred)</td>
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<tr>
<td></td>
<td>3 electives</td>
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| Tepper School of Business             | 4 years English         | SAT I or ACT                               |
|                                       | 4 years Mathematics *   | SAT II: Subject Tests (3)                  |
|                                       | 1 year Biology          | English Composition                        |
|                                       | 1 year Chemistry        | Math Level I, Ic or IIC                    |
|                                       | 1 year Physics          | Any third test, Physics, Chemistry or Biology preferred |
|                                       | 1 year Computer Science (preferred) |                               |
|                                       | 2 years Foreign Language (preferred) |                               |
|                                       | 3 electives             |                                            |

| College of Humanities and Social Sciences Information Systems | 4 years English | SAT I or ACT |
|                                                               | 3 years Mathematics** - H&SS applicants | SAT II: Subject Tests (3) |
|                                                               | 4 years Mathematics* - IS applicants | English Composition |
|                                                               | 1 year Science (2 or more years preferred) | Math Level I, Ic or IIC |
|                                                               | 2 years Foreign Language | One additional test selected by applicant |
|                                                               | 6 electives             |                                            |

| School of Architecture                 | 4 years English         | SAT I or ACT                               |
|                                       | 4 years Mathematics*    | SAT II: Subject Tests (3)                  |
|                                       | 1 year Physics          | English Composition                        |
|                                       | 2 years Foreign Language (preferred) | Math Level I, Ic or IIC |
|                                       | 5 electives             | Physics or Chemistry                       |

| School of Art                          | 4 years English         | SAT I or ACT                               |
| School of Drama                        | 2 years Foreign Language |                                            |
| School of Music                        | 10 electives ***        |                                            |
| School of Design                       | 4 years English         | SAT I or ACT                               |
|                                       | 2 years Mathematics     |                                            |
|                                       | 2 years Science         |                                            |
|                                       | 2 years Foreign Language (preferred) |                               |
|                                       | 6 electives             |                                            |

* The four years of mathematics should include algebra, geometry, trigonometry, analytic geometry and elementary functions (pre-calculus).

** For H&SS applicants, three years should include at least algebra, geometry and trigonometry.

*** Music: Some prior training in solfege is helpful.

**** The Biology SAT II: Subject Test is not acceptable for CIT applicants: junior or senior test results only.
While a high school diploma is not required for admission to Carnegie Mellon, it is to your advantage to make arrangements to eventually receive one. Consult your high school for more advice, or for special arrangements, contact your state Board of Education for information about the General Education Diploma (GED).

**Advanced Placement Consideration**

**CEEB Advanced Placement Program**
Carnegie Mellon recognizes the CEEB Advanced Placement program and may grant advanced placement and credit for test scores of four or five. We encourage eligible students to take the AP examinations. We will receive the test scores in early summer for those students who have requested that their results be sent to Carnegie Mellon. The appropriate academic deans will evaluate your scores, and in late summer, you will be informed of the AP credit awarded.

**College level course work**
The university may also award placement and credit for college work completed during high school. Applicants who have taken college courses should arrange to have their college transcripts along with course catalogs or descriptions sent to the Carnegie Mellon Office of Admission for transfer credit evaluation and advanced placement.

**International Baccalaureate Program**
Carnegie Mellon also recognizes the International Baccalaureate Examination and may grant advanced standing and/or credit in various fields if scores on the higher level examination range from six and seven. The results of the IB exams should be sent to Carnegie Mellon, where the appropriate dean will evaluate the scores. In late summer, you will be notified of the credit that has been awarded.

**Attention Transfer Applicants**
Transfer students are admitted to Carnegie Mellon under policies which vary from college to college. In order to transfer to the Carnegie Institute of Technology, the School of Computer Science, the Mellon College of Science or the Tepper School of Business, there must be space available in the particular department to which you are applying. If there is space in the requested program, we will base our decision on your college grades, college recommendations, high school grades and test scores (SAT 1 or ACT and SAT II: Subjects).

In the College of Fine Arts, most transfer applicants compete with freshman applicants for a place in the entering class.

**Transfer Application Instructions**

1. **Apply for admission to the specific college of interest, noting departmental preference.** If interested in Music or Drama, student should specify the option. Transfer students will be considered only to their first-choice college. Please do not apply to more than one college.

CIT, MCS, SCS and TSB:
- fall transfer possible if space is available
- spring transfer limited
H&SS and IS:
- fall and spring transfer available
CFA:
- fall transfer possible
- no spring transfer opportunities (except for advanced students in the School of Music)
BHA and BSA:
- no transfer available

2. **Enclose a non-refundable fee of $60 (and audition fees if applicable).** This application fee is required, except in extenuating family financial circumstances. To request a waiver, student should send us a letter from a college advisor or dean requesting an application fee waiver in place of the application fee. Make all checks or money orders payable to Carnegie Mellon University. Do not send cash.

If applying to Music or Drama, the additional audition fee is $45. Submit all fees with your application.

3. **Send all transcripts which reflect secondary school and college/university studies to the Office of Admission.** Include a catalog (labeled with your name) listing course descriptions from each college/university attended.

**IMPORTANT:** If you have applied to Carnegie Mellon within the past three years, you must resubmit an updated application with fee (and audition fee if appropriate) and all other materials required of transfer students. You do not have to submit high school records.

4. If you are applying to the Schools of Art, Design, Drama or Music, you must complete the portfolio or audition requirements. Before an audition or review can be arranged, however, you must complete and submit the application for admission by December 1.

5. **Sign the "Confidentiality Statement" on the Personal Evaluation Form.** Give this form and your completed application for admission to a dean or an advisor at the college you attended (or are currently attending). Your dean or advisor should complete and return the form and application directly to the Office of Admission.

**IMPORTANT:** Carnegie Mellon prefers that all forms and documents be submitted at the same time. If they must be sent separately, make sure to print your full name and social security number at the top of each document.

6. Transfer application deadlines are as follows:
- **Spring transfer:** November 1
- **Fall transfer:** March 15 (December 1 for CFA applicants)

7. **If you are applying for financial aid, request a Free Application for Federal Student Aid (FAFSA) from your current college Financial Aid Office.** Complete the form and return it to the appropriate federal processor listed in the FAFSA instructions. Send a copy of your completed FAFSA directly to Carnegie Mellon. Carnegie Mellon’s Title IV code is 003242.

**If planning on:**
- File FAFSA by this date:
  - Spring transfer: November 1
  - Fall transfer (CFA): February 15
  - Fall transfer (all other colleges): May 1

Admission and financial aid award notification dates for transfer students:
- **Spring transfer:**
  - Fall transfer (CFA): December 15 or soon after
  - Fall transfer (all other colleges): during month of June
- **Fall transfer:**

8. Make arrangements to have a final copy of your college transcript(s) sent to Carnegie Mellon.

**Deposit Information**
If you are offered admission for the spring semester, Carnegie Mellon does not require a tuition deposit (due to the short time interval between December 15 and the start of the second semester).

If you are offered admission to the College of Fine Arts for the fall semester, you must pay a non-refundable deposit of $500 by May 1, even if you are receiving financial aid.

If you are offered admission to CIT, MCS, H&SS, SCS or TSB for the fall semester, you must pay a non-refundable $500 deposit by June 15, even if you are receiving financial aid.

The enrollment deposit will reserve your place at the university and a place in university housing if available. It will be credited to the first semester charges.

**IMPORTANT:** If you accept our offer of admission, Carnegie Mellon assumes that the tuition deposit to Carnegie Mellon is your only tuition deposit. We reserve the right to cancel your offer of admission if you post a tuition deposit at more than one university. Enrollment deposits received after the deadline may be returned if space is no longer available.
University housing for transfers
Carnegie Mellon expects to accommodate most transfer students who request university housing. University housing is not guaranteed, however, for transfer students. The Off-campus Housing Advisory and Referral Service is available to help you locate housing accommodations in the local area.

Transfer credit evaluated on individual basis
Carnegie Mellon’s departmental faculty will determine transfer credit for courses you’ve taken at other universities. Transfer credit is considered on an individual basis. We may award elective credit for courses with no Carnegie Mellon equivalent. In some instances, the College Council may recommend a special program of study for you to meet the university’s graduation requirements.

Transfer credit for courses you are taking while we review your existing college record depends upon successful completion of each course. Grades are not transferred — only credit is. You may receive transfer credit for elective courses you’ve taken but will still have to take Carnegie Mellon courses to fulfill the elective space in your chosen degree program. Sometimes transfer students have to take specific courses and accumulate a larger total number of credits than the normal amount required for graduation. The time it takes for you to graduate will depend on the time you need to complete the full university degree requirements — not on class standing at a previous institution.

If you transfer into CIT, MCS, TSB, or SCS in the fall semester, you will receive an estimate of the additional academic work that you must complete in order to fulfill the university degree requirements.

If you transfer into CIT, MCS, TSB, or SCS in the spring semester, you will have the opportunity to meet with a dean or department head in order to outline the additional academic work that you must complete in order to meet the university degree requirements.

If you transfer into H&SS in the fall or spring semester, you’ll receive a credit and requirement review of the work you’ve completed at your previous institution(s).

If you transfer into the College of Fine Arts, you will not receive credit for technical subjects until after you complete the first semester at Carnegie Mellon. Under this policy, the student may lose a significant amount of credit. It is best for transfer students in the fine arts to assume freshman status.

Application as an International Student
International students should apply to Carnegie Mellon using the same procedures outlined for either freshmen or transfer students. Also note this additional information:

• A preliminary application form will be sent to you for completion. Return it to the Office of Admission as soon as possible. Because Carnegie Mellon does not offer financial aid to international students, we use this form to verify each student’s ability to pay for a Carnegie Mellon education. This form is also available on the Carnegie Mellon web site at: <http://www.cmu.edu/enrollment/admission/process/international.html>.

• The test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS) should be taken if your native language is not English and your SAT I verbal score is less than 600. Carnegie Mellon requires TOEFL scores of 250 or better and IELTS scores of 7 and above.

• Financial aid and installment payment plans are unavailable to international students.

Intercollege Degree Programs

Bachelor of Humanities and Arts (BHA)
The Bachelor of Humanities and Arts (BHA) Program is an intercollege degree granting program. It is designed for students who would like to combine and blend their interests in fine arts and humanities/social sciences rather than pursue a conventional major and degree in either the College of Fine Arts (CFA) or the College of Humanities and Social Sciences (H&SS). To be considered for the BHA Program, a student must apply to and be admitted to both CFA and H&SS. Not all students admitted to both colleges are selected for the BHA program. In addition, you must include with your application a statement of intent (essay) describing your interdisciplinary goals in both the fine arts and humanities/social sciences and how the BHA Program would provide the opportunity and framework for you to accomplish these objectives. This statement of intent is a central component in the selection process. In your essay: (1) tell us about your past and present forms of recognition for academic achievement (2) note past and present involvement in arts-related activities and artistic achievement (3) note the area(s) of the fine arts that you intend to pursue as a BHA student (4) articulate your educational objectives, discuss why you feel that the BHA program is uniquely suited to achieve these objectives and how your two areas of study will reinforce each other. The BHA statement of intent fulfills the essay requirement on the application. You do not need to complete another essay. If you are selected for this program, you will be notified in a separate admission decision letter.

Bachelor of Science and Arts (BSA)
The Bachelor of Science and Arts (BSA) Program is an intercollege degree granting program. It is designed for students who would like to combine studies in both the fine arts and natural sciences/mathematics rather than pursue a conventional major and degree in either the College of Fine Arts (CFA) or the Mellon College of Science (MCS). To be considered for the BSA Program, a student must apply to and be admitted to both CFA and MCS. Not all students admitted to both colleges are selected for the BSA program. In addition, you must include with your application a statement of intent (essay) describing your interdisciplinary goals in both the fine arts and natural sciences/mathematics and how the BSA Program would provide the opportunity and framework for you to accomplish these objectives. This essay is a central component in the selection process. In your essay: (1) tell us about your past and present forms of recognition for academic achievement (2) note past and present involvement in arts-related activities and artistic achievement (3) note the area(s) of the fine arts that you intend to pursue as a BSA student (4) articulate your educational objectives, discuss why you feel that the BSA Program is uniquely suited to achieve these objectives. The BSA statement of intent fulfills the essay requirement on the application. You do not need to complete another essay. If you are selected for this program, you will be notified in a separate admission decision letter.

Application components vary somewhat for BHA and BSA candidates depending on your intended focus in the College of Fine Arts. You must complete the specific application requirements (portfolio review or audition) for your particular CFA focus. Please note: Students interested in drama may select from three options in the School of Drama: directing, design or production technology and management. There is no acting or musical theatre option. Also, there is no School of Music voice performance option. If an audition or portfolio review is necessary for your BHA/BSA Program focus in the College of Fine Arts, please follow the instructions in the application materials.

Requirements for the College of Fine Arts
To arrange an audition or portfolio review, you should:

• Follow the instructions in the application materials.

• Submit your application by December 1 (November 1 for Art, Design and Music early decision consideration), so we can make arrangements for audition/review.

• Expect to receive instructions from us, after we receive your application, for completing the audition/review.

• Do not expect a final admission decision at the time of the audition/review; we’ll consider the results of the audition/review along with your other credentials and notify you by April 15 (January 15 for Art, Design and Music early decision applicants).

School of Architecture

High school preparation
Because attrition in architecture programs nationwide is currently very high, Carnegie Mellon’s School of Architecture has developed guidelines to help students determine their sincere interest and potential success in the field. We strongly encourage you to follow these guidelines if you’re considering the study of architecture:

• At a minimum, you should visit the architecture departments of each college you are seriously considering. Talk with faculty and enrolled students to “get a feel” for each program. At Carnegie Mellon, we’ll make every effort to set up opportunities for you to talk with our students and faculty.
• If you are seeking admission to Carnegie Mellon’s School of Architecture, we encourage you to take the highest level course available at your high school in mathematics (calculus), science (physics), English (advanced literature courses) and history (courses in western and non-western history).
• If you are seeking admission to Carnegie Mellon’s School of Architecture we also encourage you to pursue artistic and architectural experiences (for example, part-time employment with a local, practicing architect).
• If you are seeking admission to Carnegie Mellon’s School of Architecture, we also encourage you to participate in one of the many summer programs offered by architecture departments at colleges around the country. (Carnegie Mellon offers a program for students who have completed their junior year of high school—an excellent opportunity for you to gauge your interest in architecture and for our faculty to assess your potential for success.)

Admission to the School of Architecture is based primarily on academic credentials. Portfolios are not reviewed as part of the admissions process for architecture at Carnegie Mellon. We look closely at a student’s performance in mathematics and physics, as well as art, humanities and social science courses.  Painting, sculpture and drawing skills help prepare students for Architecture at Carnegie Mellon. We prefer these courses to high school courses in mechanical drawing.

Pre-College Summer Program
The department offers a pre-college program to students who have completed their junior year in high school. The program is a great opportunity for you to sample the Bachelor of Architecture program at Carnegie Mellon and to explore and assess your interest in the field. Full-time university professors teach all courses.

Transferring Into The School of Architecture
Whether you are transferring from another university or from one of Carnegie Mellon’s other colleges, you will be classified as a freshman in the architecture program unless a program equivalent to the School of Architecture’s freshman year has been completed. If you are not sure whether or not the program is equivalent, it’s best to assume freshman status.

School of Art Admission Procedure
We’re seeking a class of Art students with a wide range of talents, aptitudes and backgrounds. In most cases, we give equal weight to academic performance and artistic ability when we evaluate art applicants.

Art Portfolio Guidelines
The School of Art is seeking a class of art students with a wide range of talents, aptitudes and backgrounds. Artistic ability, academic performance and leadership capabilities are all important factors in evaluating applicants for admission. These capabilities are evaluated through a review of a portfolio of your creative work, high school grades, standardized test scores, extracurricular activities, recommendations and personal statements.

With regard to your portfolio, the faculty are more interested in your creative potential than your technical skills. Design your portfolio to reveal and/or highlight your creative potential. We encourage you to include pieces that show both your ability to work on a wide range of artistic concerns and your ability to work in depth or in sequence on a topic. Your portfolio should also demonstrate work done independently or outside of classroom assignments.

For both on-campus and by-mail portfolio reviews, your portfolio should include as many of the following categories as your background allows:
• Drawing and painting, on a variety of subjects, done from observation and/or imagination
• Photography, printmaking projects, collage, mixed media (etc.)
• Sculpture in any medium or any size
• Environmental or site-specific installation (work made for a particular location either indoors or outdoors)
• Computer-generated imagery
• Work that changes with time such as kinetic sculpture, animation, installation, performance and digital media, including live action video and interactive work or other time-based works (submitted on VHS format, zip disk, or CD)

You are strongly encouraged to bring your portfolio to campus. You will have the opportunity to tour the School of Art’s studios while your portfolio is being reviewed. You may also view student exhibitions and classes. If you can’t come to campus, follow the procedures for portfolio review by mail.

On-campus portfolio review guidelines:
Applicants should bring 15 to 20 recent works in one or more of the following formats:
• Actual two-dimensional work rather than photographs of those works (except large or bulky pieces)
• A sketchbook (or equivalent)
• A photograph, slide or other documentation of any work too large or bulky to transport (such as sculpture, large framed painting, etc.) or of work no longer in the possession of the applicant (on exhibit, under consideration for an award, etc.)
• Computer work (Mac format only)
• Original computer graphics: GIF or JPEG format, 800 x 600 maximum image size
• Original computer animation: Mac format zip disk or CD
• Interactive: self-contained (must play in projector/player mode without resident application)
• WWW: Web site on CD or zip disk

To register for an on-campus portfolio review, student should:
• Follow the instructions in the application materials
• Submit your application by November 1 (for early decision consideration) or by December 1 (for regular decision consideration)
• Expect a confirmation of review date and time two weeks before the event

Transfer Into The School of Art
Whether transferring from another university or from one of Carnegie Mellon’s other colleges, you will be classified as a freshman in the Art program unless a program equivalent to the School of Art’s freshman year has been completed. If you would like to be considered for advanced standing, indicate the level of entry on the application for admission in the space provided. All applicants must complete the admission requirements as listed above for freshman applicants. Transfer applicants are considered for fall semester only.

School of Design Admission Procedure
The School of Design is seeking a class of students with a wide range of backgrounds, creative talents and interests. We have found that successful design students have a variety of qualifications. We look closely at students’ qualifications in the following three categories:
• Academics: high school transcript, class rank and SAT I or ACT scores
• Visual and design ability: portfolio and Design Project (See details on the following page.)
• Interpersonal skills as demonstrated through extracurricular activities and letters of recommendation
Submitting your portfolio (work) for review
The School of Design offers two ways for your work to be reviewed; (1) An on campus review or (2) A mail-in-review. Choose one or the other, but not both.

Our design faculty is an integral part of the admission process in determining incoming classes. The faculty gain a deeper understanding of portfolio work and the applicant from an interview. We strongly emphasize the importance of an on-campus review.

On-campus portfolio options
The School of Design provides three options for presenting your work on-campus. With each option a faculty committee will independently review your portfolio and a faculty member will conduct an interview with you. The options are:

1. Traditional portfolio – an organized presentation of original work. Work may include: sketchbooks, drawings, 2-D and 3-D work, examples of color work, and supplemental work. If the scale of your work is too large to transport then a good quality photo is permissible. This on-campus option typically provides faculty the greatest insight to the quality of your work, your thinking and developmental process.

2. Digital portfolios and work - We will review work presented in digital formats. This work should not be a duplication of work already presented. To have this work reviewed you must bring a laptop computer with the work already prepared for showing. Otherwise it cannot be reviewed. Also keep in mind that a presentation of final work alone is not helpful in understanding your design process. Inclusion of process work/sketches is important.

3. Design Project – offered as an option for applicants who have a limited portfolio or none at all. See full description of design project below.

Mail-in portfolio options
The School of Design offers two options for presenting your work through the mail. With each option a faculty committee will review your portfolio and a faculty member may conduct a phone interview with you. The options are:

1. Slide portfolio – an organized presentation of work. Sample sketches, drawings, 2-D and 3-D work, examples of color work, and supplemental work are helpful to include. In addition, a slide key containing a short description of corresponding pieces must be included. Slides should be shot with proper lighting so as to depict subtle details in your work. In ADDITION, if you are submitting your work by mail, you must complete a Design Project. Together the slides and Design Project will help faculty gain insight into the quality of your work and thinking.

2. Digital portfolios and work - We will review work presented in digital formats. The work must be submitted in CD or DVD format. This work should not be a duplication of work already presented (i.e., if it is accompanying slides). Also keep in mind that a presentation of final work alone is not helpful in understanding your design process. Inclusion of process work/sketches is important. In ADDITION, if you are submitting your work by mail, you must complete a Design Project. Together the digital work and Design Project will help faculty gain insight into the quality of your work and thinking.

Mail your portfolio to the address below no later than January 15 (November 15 for early decision applicants):
Office of Admission
Design Portfolio
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890

General portfolio guidelines
1. Actual work rather than photographs of work is preferred.
2. Attempt to limit your portfolio through careful editing to 15 - 20 items (a sketchbook counts as one item).
3. Projects should be as varied as possible, while emphasizing the strongest work. Acceptable work includes, but is not limited to, 2-D and 3-D design, drawing, painting, sculpture, digital, and inventions.
4. Design faculty encourages all applicants to include examples of drawing. Drawings can be from life or from the imagination, but they should not be copied from a photo or other two-dimensional image. Matting and mounting of works is not necessary. Applying fixative to works that smudge is highly recommended.

Mail-in portfolio guidelines
1. If submitting slides the format is 35mm. Slides should be numbered and sequenced in a standard 9” x 12” clear plastic slide page.
2. A slide key containing a short description of corresponding items must be included. Slides should be shot with proper lighting so as to depict the details in your work.
3. If submitting digital media, the format is CD or DVD. You should test your data to ensure its ability to be opened and reviewed.
4. DO NOT mail original work (drawings, paintings, 3D, etc.) or sketchbooks.
5. Place your name on all materials
6. Include a self addressed and postage paid envelope to return your materials.

Design Project
If you are submitting slides or are choosing to meet your portfolio requirements by completing the Design Project, check the appropriate box on the application form. The university admission office will forward the Design Project to you with instructions for completing it. Applications that are received before November 15 have a quicker mail-out. You also have the option of downloading the project from the design website <www.cmu.edu/cfa/design/admissions/>. In this case you will need to pay particular attention to items that you will need to acquire in order to properly complete the project.

Complete the project and bring it with you to your scheduled on-campus faculty interview. Or, if you choose the mail-in option, return it by mail along with your slides or digital portfolio.

Transfer into The School of Design
Whether the student is transferring from another university or from one of Carnegie Mellon’s other colleges, you will be classified as a freshman in the design program unless you have completed a program equivalent to the School of Design’s freshman year. If you would like to be considered for advanced standing, you should indicate the level of entry on the common application in the space provided. You must also interview with a member of the Design faculty and submit a portfolio to qualify for advanced standing consideration; we will determine your standing through the portfolio review, the interview and transferable program credits. Plan to come to campus on the portfolio review date specially scheduled for transfer applicants. If you plan to enter at the freshman level and do not seek consideration for advanced standing, follow the procedures for application as a freshman. Only fall semester transfer applicants are considered.

School of Drama
Admission Procedure
The School of Drama at Carnegie Mellon is a member of the Consortium of Conservatory Theatre Training Programs.

To apply to the School of Drama:
• Follow the instructions in the application materials.
• Submit application and supplement by December 1 (no early decision consideration available for admission into Drama).
• In addition to the $60 application fee, there is a $45 audition fee due at the time of registration.
• Expect a confirmation of the time and place of your audition/portfolio review two weeks before the event. If you need to make travel arrangements, make sure your application for admission is on file at least six weeks prior to your selected audition.
• Allow at least four hours for your audition and one hour for your portfolio review.
• Transfers follow same procedures as freshman applicants.
• Transfer students in Acting and Music Theater will be classified as freshman within the program.
• There are no auditions by mail for domestic students. International applicants must make arrangements for submitting a videotape of their audition by contacting the School of Drama.
• Drama design applicants, particularly international candidates, may submit a portfolio by mail. Contact the School of Drama directly to arrange this.

**Acting Option**

If you are applying to the Acting Option, you must fulfill an audition requirement, which is the main basis for admission.

Pay close attention to these audition guidelines:

• You will be required to perform two contrasting monologues.
• Each monologue should be no longer than two minutes.
• One monologue should be from a play written before 1900 with an emphasis on language (e.g., Shakespeare, Shaw, the Greeks, etc.), the other a contemporary piece written in the 20th or 21st century.
• Both pieces should be within your natural age range.
• Be sure to read the entire play so you can demonstrate an understanding of the character and situation involved.
• You should not have been coached, as coaching often obscures natural ability and instinct. We do not recommend it.
• You may use hand props but not costumes.
• Be prepared to perform a third monologue if asked.
• Bring a resume and a recent photograph to leave with the audition team.

Some contemporary pieces have become overused, and we urge you not to audition with pieces from the following plays: Slow Dance on the Killing Ground, I Hate Hamlet, Star Spangled Girl, Runaways, Nuts, A My Name is Alice, Talking With, Identity Crisis and Quilters.

**Music Theater Option**

We admit students to this option based mainly on their talent demonstrated through an audition. During the student’s audition, he/she will:

• Perform two contrasting songs
  — bring your own music (an accompanist is provided)
  — one ballad and one “up tempo” song
• Learn and perform two dance combinations taught by a faculty member (wear appropriate dance attire)
• Perform two contrasting monologues
  — See “Acting Option” section for important guidelines.

**Drama Design Option**

If you are applying to the Drama Design Option, you must demonstrate basic proficiency in drawing, painting and design by submitting a portfolio of your work. The portfolio should include about 15 items of work in several art media and techniques. Not all samples of your work have to pertain to the theater.

The portfolio should include examples of:

• Use of color
• Line drawing
• Drafting or
• Mechanical drawing

Also, please send two letters of recommendation from people capable of describing your work and evaluating your professional promise. You should ask those who write letters of recommendation for you to send them by February 1 directly to:

Office of Admission
Drama Design Option - Drama
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
Fax (412)268-7838

**Production Technology and Management Option**

If you are applying to the Production Technology and Theatre Management Option, you should already have practical experience in the theatre as well as some background in mathematics and physics, organization and management or both. You must demonstrate basic proficiency in project planning and execution by submitting a portfolio of your work. The portfolio should include up to 15 examples of work. Not all samples of your work have to pertain directly to the theatre.

We would like to see examples of:

• evidence of your thought process for technical or management solutions
• drafting, drawing or CAD
• paperwork you have used/developed for schedules, reports, budgets, estimates, etc.
• Photos of your work both finished and in process

We expect you to also submit:

• a resume
• a letter describing your training, experience, and ambitions in theatre
• two letters of recommendation from people capable of describing your work and evaluating your professional promise

You should ask those who write letters of recommendation for you to send them by February 1 directly to:

Office of Admission
Production Technology Management Option - Drama
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
Fax (412)268-7838

**Directing Option**

To apply to the Directing Option, follow the audition guidelines outlined in the “Acting Option” with one major change — plan to perform only one monologue. Bring to the audition a statement explaining why you are interested in pursuing this line of study, explaining your choice of monologue and including a critical analysis of the play. Bring any director’s scripts, design portfolio, dramatic writing, photography or any other evidence of your creative life.

**School of Music - Admission Procedure**

To apply to the School of Music, you should:

• Follow the instructions in the application materials.
• Go to www.cmu.edu/cfa/music to print a PDF copy of the Undergraduate Audition Form. Submit this form by December 1 to hold your audition date.
• Plan to audition in Pittsburgh if you live within 300 miles of the city (auditioning in Pittsburgh is recommended).
• Submit your application by December 1 (November 1 for early decision consideration).
• In addition to the $60 application fee, there is a $45 audition fee due at the time of registration.
• Expect a confirmation of the time and date of the audition two weeks before the event. If you need to make travel arrangements, make sure your application for admission is on file at least six weeks prior to your selected audition and contact the School of Music directly at (412) 268-4118.
• If you do not receive a written confirmation within two weeks of your preferred date(s), please contact the School of Music directly at (412) 268-4118 to ensure your audition.
• Plan at least four hours for your audition.
• Transfers should follow same procedures as freshman applicants.
To be considered for admission into music, the student must fulfill the following two requirements (both take place on your audition date):

- audition in a performance area (see requirements below)
- tests in sight-singing, melodic dictation and theory

**Requirements for Performance Areas**

**Keyboard Options Performance-Piano**

1. A suite (selected contrasting movements acceptable) or prelude and fugue by Bach (by memory)
2. One or more contrasting movements of a piano sonata by Haydn, Mozart or Beethoven (by memory)
3. A romantic, impressionistic or 20th century composition (by memory)
4. An elementary composition to be read at sight

**Performance-Organ (in Pittsburgh only)**

1. One of the Eight Little Preludes and Fugues by Bach (by memory)
2. A movement of a sonata by Mendelssohn (by memory)
3. An elementary composition to be read at sight

**Voice Option Performance-Voice**

Candidates are expected to have a voice with professional potential and some experience in solo singing. A preliminary CD is required to determine those who will be invited for an audition. Details are listed in the Carnegie Mellon Application booklet. Students must be prepared to sing:

1 selection – originally written in English in the classical style
1 selection – originally written in Italian in the classical style
1 selection – of your choice in the classical style (This selection may be in a foreign language.)

If selected for a live audition, submit by mail or before January 1, copies of the three selections that you intend to sing. These copies must have all cuts clearly marked and be in the key that you will sing at the audition. Original copies of your intended selections must be brought to the audition. There are no voice auditions for early decision.

**Performance-Instrumental Options Violin**

1. Scales: any major or minor scale in three octaves as requested
2. One etude by Bruni, Kreutzer Campagnoli or Maza’s “Brilliant Studies”
3. Movement of a concerto or sonata by Bach, or a representative work of the romantic or contemporary period

**Viola**

1. Scales: any major or minor scale in three octaves as requested
2. One etude by Mazas, Kreutzer or Fiorillo
3. A movement, concerto or sonata by Bach or Telemann or a representative work of the romantic or contemporary period

**Violoncello**

1. Scales: any major or minor scale in three octaves as requested
2. One etude by Duport, Popper or Piatti
3. A movement of a concerto by Haydn or Boccherini or a representative work of the romantic or contemporary period

**String Bass (auditions scheduled in Pittsburgh only)**

1. Scales: any major or minor scale in two octaves as requested
2. An etude or equivalent technical exercise
3. A solo composition of the applicant’s choice that will demonstrate the musical and technical level of achievement on the instrument

**Harp**

1. Etude No. 1, from “Cinquante Etudes,” Op. 34, Book 1, by Bochsa
2. Two contrasting works: one classical and one by a twentieth-century composer, such as an etude from Bach-Grandjany Etudes for Harp and Natac Sonatine
3. Two orchestral excerpts, including the harp cadenza from Waltz of the Flowers, by Tchaikovsky

**All Woodwinds and Brass (Flute auditions scheduled in Pittsburgh only)**

1. Scales: any major or minor scale as requested
2. A technical etude
3. A solo composition of the applicant’s choice that will demonstrate the musical and technical level of achievement on the particular instrument
4. Two orchestral excerpts

**Flute requirements: (There are no flute auditions for early decision)**

1. Mozart Concerto – complete
2. Work of the Twentieth Century
3. One etude and major and minor scales
4. Four orchestral excerpts of contrasting styles (from Jeanne Baxtresser Book of Orchestral Excerpts)

**Performance-Percussion Option (auditions scheduled in Pittsburgh only)**

Percussion auditionees are expected to demonstrate a superior ability in one of the six categories listed below. All students are required to play from categories I, II and V for admission into the Percussion Department. Competency in one additional category must be demonstrated. Auditions in all categories are not required. Auditionees will be evaluated on the basis of techniques, a prepared piece, sight reading and ear test. Memorization of a piece is optional. Sticks and mallets are to be brought by the auditionee. Instruments will be provided by the Percussion Department. Copies of prepared pieces must be provided for the jury.

Specific audition requirements in the various categories:

**I. Timpani**

- Demonstrate the various types of rolls (fp, p, f, ff, etc.), rhythms and interval tuning
- Solos and/or etudes (Hochrainer, Delecluse, Goodman, etc.)
- Orchestral excerpts (Beethoven, Brahms, Mozart, Hindemith, etc.)

**II. Keyboard Percussion**

- Perform two octave scales and arpeggios in major and minor keys
- Four-mallet solo (marimba)
- Two-mallet solo (xylophone or marimba)
- Orchestral excerpts (Bells, xylophone or vibraphone)
III. Drum Set

Demonstrate various styles: Swing, Bop, Rock, Latin, Funk
Play short solo incorporating all of the styles

IV. Latin Percussion

Techniques on Bongos, Congas, Timbales, Claves, Maracas, etc.

V. Snaredrum

Play various types of rolls from slow to fast (5-stroke, 7-stroke, 9-stroke, etc.)
Demonstrate other rudiments upon request
Solo (concert and rudimental style) Ex: Pratt, Wilcoxin, Cirone, Peters, Delecluse, etc.
Orchestral excerpts

VI. General Percussion

Demonstrate techniques on crash cymbals, tambourine, triangle, castanets, bassdrum, etc.

Taped Auditions:

Auditionees are expected to record some examples of the basic techniques as described above in the categories chosen. A prepared short piece is required. Group and/or piano accompaniment is optional. For several categories, do not exceed three minutes in each category. For specialization in one category only, five to eight minutes on tape will be sufficient. Every segment recorded must be announced. Copies of the music must be provided for the jury and mailed with the tape.

Performance-Guitar Option

Entering freshman guitarists should have at least one year of study on the classical guitar. They should be familiar with basic right hand techniques and should be able to read music on the guitar up to seventh position.

1. Scales: any major or minor scale as requested
2. Chords: any major, minor or dominant seventh chord as requested
3. An etude of your choice
4. 2 or 3 pieces from the suggested repertoire below

Suggested possible audition repertoire: (Suggested audition pieces are examples of what might be expected. Students should prepare 2 or 3 pieces.)

Leo Brouwer, Etudes Simples, (1-20)
Andrew York, 8 Discernments and 8 Dreamscapes
Gerald Garcia, 25 Esquisses
Hector Villa-Lobos, Preludes and Etudes
Matteo Carcassi, 25 Melodious and Progressive Etudes, Opus 60
Fernando Sor, Twenty Studies (edited by Segovia)
Mauro Giuliani, Allegro, p. 76 Classic Guitar Technique, Aaron Shearer
J.S. Bach, Prelude in D minor, BWV 999
J.S. Bach, Bourree in E minor, BWV 996
Francisco Tarrega, Lagrima or Adelita
Luis Milan, 6 Pavana

Composition Option

Please submit by December 1, three compositions and a CD of your music. Applicants should submit manuscripts of original compositions at least six weeks in advance of the audition date to the director of recruitment and enrollment in the School of Music.

Please submit at least three compositions, showing a range of genres. It is also important to include a CD recording; a live performance is preferable but an electronically generated CD will be acceptable.

Your audition will be in the form of an interview concerning your compositional process, background and goals. You may also demonstrate instrumental or vocal performance skills to the composition faculty during the audition, but this is not required. Your arrangements of works by other composers are welcome, but will be considered as supplementary to the basic requirements.

Music Education Certification:

Program begins in the sophomore year. Applicants must be enrolled in a music degree program with a required grade point average of 3.0 on a scale of 4.0. The program is taken along with the performance or composition option and requires five years of study for completion.

Music Audition by Mail

To audition by mail, student must follow the same guidelines outlined previously, and:

- Submit your unedited work on a VHS cassette of good fidelity. You may submit a CD in addition to the videocassette. Make sure the word “Music” and your name and address are included inside the audition package. Please include a list of pieces performed on the tape as well as a resume, the name of your current teacher, the number of years studied and any other applicable music experience.
- Those auditioning by mail must also submit the Undergraduate Audition form.
- If you’re a transfer applicant, include a description of your college studies, number of years of college, colleges attended and details of music courses studied.
- An audition fee of $45 must also be received before our faculty can evaluate your audition tape.

Send your audition tapes and materials to this address no later than January 1:

School of Music
Music Audition
Music Admissions - CFA, Room 108
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890

Transfer into The School of Music

Transfer candidates are admitted at the beginning of the fall and spring semesters.

- Spring semester transfer candidates should arrange an audition during the November audition date.
- All transfer candidates must complete the admission and audition requirements like freshman applicants.

Exploring Carnegie Mellon

Visiting a campus is one of the best ways for you to discover which school is right for you. At Carnegie Mellon, we strongly recommend that you attend a group information session or interview with a member of the Admission staff while on campus. Our interviews are viewed as an information exchange — we want to get to know you, just as you may want to learn more about us! During the interview, you’ll have the opportunity to ask questions about admission requirements, financial aid, student life, Pittsburgh — and much more!

If you’d like an interview, request an appointment at least three weeks prior to the date you’re coming to campus. Interviews are available Monday through Friday throughout the year. However, because we spend a great deal of time reviewing applications between late November and mid-May, we do not conduct interviews during this time period.

In the fall and early spring, we hold group information sessions on Saturday mornings. To schedule a group information session or an interview, call (412) 268-2082 on any weekday between 8:30 a.m. to 5 p.m. (eastern time).

On campus auditions and portfolio reviews usually include an interview with a member of the Fine Arts faculty and a campus tour. Therefore, only one campus visit is necessary. Students should plan to spend about three hours on campus during these events.
Campus Tours

Campus tours are conducted by student admission assistants and leave from the Office of Admission, 101 Warner Hall. On weekdays during the academic year, we conduct four tours daily at 9:30 a.m., 11:30 a.m., 1:30 p.m., and 3:30 p.m. Saturday tours and group sessions are held during the fall and early spring. Tours may not be available during university holidays, vacations or final exam periods in mid-December, late March, mid-April and early May. To be sure a tour is available on the day you’re coming to the campus, please call (412) 268-2082.

Hometown Interviews

Although we strongly recommend a campus visit, we realize that it is not always possible for you to come to campus. The Admission staff does travel to various parts of the country interviewing students in their hometowns. Information about making an appointment will be mailed to students prior to the time we arrive in your city. Students who interview on campus do not have to schedule another interview in their hometown.

If you are interested in interviewing with a member of CMAC, please call the Office of Admission or return the CMAC reply card enclosed with the application packet.

Alumni Interviews

We encourage students to talk with a member of the Carnegie Mellon Admission Council (CMAC). CMAC, a select group of alumni, helps the Admission staff reach out to prospective students. Alumni interviews are as valuable when making admission decisions as interviewing with the Admission staff.

If you are interested in interviewing with a member of CMAC, please call Carnegie Mellon for Assistance

Call Carnegie Mellon for Assistance

If a student will need assistance while visiting the campus, due to a physical or learning disability, he/she should call us at (412)268-2082, and we will help meet the student’s needs during his/her visit at Carnegie Mellon.

Directions to Campus

Carnegie Mellon’s campus is:

- located approximately five miles east of downtown Pittsburgh in the Oakland neighborhood
- accessible by ground, rail, or air transportation

To listen to a recorded message of directions to campus, please call (412) 268-8343.

Driving from the East:

- Take the Pennsylvania Turnpike West to Exit 57, Pittsburgh/ Monroeville
- Follow Interstate 376 West to Exit 7, Edgewood/Swissvale
- Turn right onto Braddock Avenue (at the end of the ramp)
- Continue to the Forbes Avenue intersection (Frick Park will be on the left)
- Turn left onto Forbes Avenue and follow Forbes Avenue approximately three miles to campus.
- Immediately after crossing the intersection of Forbes Avenue and Beeler Street, turn left into the East Campus Garage.

Driving from the West/North:

- Take the Pennsylvania Turnpike East to Exit 28, Perry Highway
- Follow Interstate 79 South to 279 South (Exit 72)
- Stay on 279 South toward Pittsburgh
- As you near the city, follow signs for 579 South and the Veterans Bridge
- After crossing the bridge, watch on the right for the 376 East / Oakland exit ramp
- Bear right onto this ramp, which will place you on the Boulevard of the Allies
- Continue on the Boulevard of the Allies
- Do not bear right at the 376 East/Monroeville ramp
- Stay on the Boulevard and exit at the Forbes Avenue off ramp, which will be marked with a small green sign
- Stay in right-hand lanes, following Forbes Avenue 1.3 miles through the Oakland business district to campus
- At the intersection of Forbes Avenue and Beeler Street, turn right into the East Campus Garage

Driving from the South:

- Take Interstate 79 North to 279 North (Pittsburgh)
- Follow 279 North toward Pittsburgh through the Fort Pitt Tunnel and onto the Fort Pitt Bridge
- Once on the bridge, stay in the far right lanes and follow signs for 376 East/ Monroeville
- Take 376 East to Exit 2A, Forbes Avenue/ Oakland
- Stay in the right hand lanes, following Forbes 1.3 miles through the Oakland business district to campus
- At the intersection of Forbes Avenue and Beeler Street, turn right into the East Campus Garage

Sleeping Bag Weekends

The more information you have, the better decisions about college you’ll make! The Admission staff invites you to learn more about Carnegie Mellon by living like a university student for a day and a half in our Sleeping Bag Weekend program. Visits begin on Sunday afternoon and last through Monday afternoon.

Sleeping Bag Weekends give you the opportunity to learn everything you may want to know about Carnegie Mellon. The weekend activities allow you to:

- meet current students, faculty members, deans and admission counselors
- attend information sessions about the university and specific programs
- stay overnight in a residence hall
- tour the campus
- attend classes
- eat at the dining facilities

There are four Sleeping Bag Weekends in the fall and winter. To reserve a place at a Sleeping Bag Weekend, either: expect to receive an invitation from us if you’re on our mailing list, or if you don’t receive an invitation, email cmsbw@andrew.cmu.edu or call us at (412) 268-2082.

The specific dates for fall Sleeping Bag Weekends are listed in the Carnegie Mellon application packet. In April, a Sleeping Bag Weekend and an Open House are held for admitted students only.

Area Information Programs

Each fall, the Admission staff travels across the country, meeting with groups of students and parents. We discuss the college selection process, admission requirements, financial aid and show a video about Carnegie Mellon. Prior to the event, you should receive an invitation stating the time and location of the program. No appointment is necessary, and we encourage students and parents to attend.

A list of locations and dates that we will be visiting this fall is available in the Carnegie Mellon application packet.
Summer Opportunities

The campus is in full operation during the summer, populated by students and faculty from a variety of programs. The university continues to have outstanding, innovative educational programs extending beyond regular involvement with its degree candidates. Seven such programs are offered during the summer for high school students: the Pre-College Programs in the Fine Arts (Architecture, Art, Design, Drama and Music), the Advanced Placement Early Admission Program and the Summer Academy for Mathematics and Science. Three sessions of summer school are held for college students who wish to make up or advance their degree program studies. Every service and support organization is available to summer students: the Computer Center, the Health Center, the Counseling Center, the libraries, the Office of Admission, the Career Center, Student Activities, etc.

Summer Pre-College Programs for High School Students

Office of Admission, Warner Hall 206

The Pre-College Programs are designed to preview an actual college experience. Our programs afford high school students many opportunities for personal growth and development within a university setting. A wide range of social, cultural, and recreational activities are planned by a staff of resident counselors to fully integrate the students’ lives on campus and in Pittsburgh. Movies, dances, museum and gallery visits, field excursions or attendance at professional theater productions, concerts, and Pittsburgh Pirates games are just a few of the sponsored activities.

Summer Academy for Mathematics and Science

Students with diverse backgrounds who are entering their junior or senior year and considering careers in engineering, science and other math-based disciplines are eligible to participate in this rigorous program. Traditional classroom instruction, along with creative "hands-on" projects will allow students to apply concepts and principles.

Advanced Placement Early Admission Program

The Advanced Placement Early Admission (APEA) Program is a challenging summer program intended for high school students who want to enrich their educational experience by taking college classes identical to those that a Carnegie Mellon freshman would take. The program is designed for mature, motivated students who seek to gain advanced placement credit and who are eager to sample college life early by living in a dormitory and participating in educational, social, and recreational activities.

The faculty teaches courses in biology, calculus, chemistry, engineering, computer science, philosophy, business, economics, modern mathematics, physics, history and writing during the six week program, and additional classes are added each year. Resident students are required to take two courses during the summer program. The two-course load is slightly less demanding than the typical five-course load during the regular semester; however, it remains close enough for a student to measure his ability to meet the pressure of college life.

All APEA classes meet daily. Class sizes are kept small, giving students a personal environment in which to learn. Although a substantial amount of homework is inherent in the program, it will naturally vary from course to course and from student to student. The program makes available tutorials in the more technical subjects.

Students who do exceptionally well in the APEA Program and who meet current admission standards are sometimes invited to apply for early admission to Carnegie Mellon if space is available. Carnegie Mellon is always interested in academically talented high school juniors who have the academic ability to skip their senior year entirely and accept early admission to college. This is especially true for capable students whose academic and career goals are clear. Students must take two courses in order to be considered for early admission to Carnegie Mellon. Depending on their academic interests, credentials, and space available, these students may enroll in the Carnegie Institute of Technology (engineering), Mellon College of Science, School of Computer Science, Tepper School of Business, or the College of Humanities and Social Sciences. Students who are accepted have the option of omitting their senior year and coming to campus in the fall as full-time students. It should be emphasized that space can be especially tight in engineering, and in particular Electrical and Computer Engineering and Computer Science. Participation in the APEA program does not guarantee early admission or even regular admission to Carnegie Mellon.

Whether students are admitted early or not, the credit earned in the APEA Program and the experience gained can be an advantage. For students who eventually enter Carnegie Mellon, the six credits form a head start, but these credits are also accepted as advanced placement credit at other universities. In order not to prejudice any application for admission in the future, no record of marginal or failing work is kept, much less released. In this regard, APEA is risk free.

Applications are also encouraged from very adventurous young students who are years away from college (ninth graders, for example) and reside in the Pittsburgh area. Aside from its strong academic orientation, the APEA Program affords both residents and commuters many other opportunities for personal growth and development within a university setting.

Tutorials are available as a part of the program. However, students should be aware that the calculus course assumes a knowledge of algebra, trigonometry, and geometry; that the physics course assumes a high school physics course has been taken, and recommends concurrent registration in calculus; and that the chemistry and biology courses assume a high school course in chemistry and/or biology has been taken.

The hard work, the independence, the pleasure of accomplishment, the interaction, the cultural and intellectual setting and, in a good way, the pressures of academic life, are combined in the APEA program to closely approximate the full rewards of a college experience.

Pre-College Architecture Program

The Pre-College Architecture Program is an opportunity for those high school students who have completed their junior year to discover whether they have the necessary aptitudes for further study at the college level. The students learn the nature of professional training, discover if they enjoy this type of concentration and most importantly, realize the degree of their individual talents. At the conclusion of the period of study, each student’s work is evaluated indicating the level of aptitude in this field.

The program of study is divided into two parts which occupy the entire day. In the morning, students have a free-hand drawing course which attempts to strengthen their abilities. The course assumes no prior student experience. In the afternoon, the design studio meets and tackles the problems at hand.

Lectures will be presented by faculty members in the School of Architecture and local practitioners. These lectures will cover such areas as design process and methodology, architectural history, technology, environment concerns, urban problems, professional registration and practice. Field trips will be to local construction sites in the Pittsburgh area. Design problems will range in length from one-hour models, group discussion, individual criticism and faculty review.

At the conclusion of the program, the student will receive a private consultation with faculty, as well as a written letter of evaluation on the student’s progress and aptitude.
Pre-College Art Program

The summer Pre-College Art Program gives interested and talented high school students an opportunity to discover whether they have the necessary aptitudes for studying art at the college level.

When we make art, we not only satisfy human need for personal discovery and communication, but we also engage in the privilege of question, to be different, to challenge the status quo as an exercise in self-expression and free speech.

Students will be able to choose three specific art studios to study in three-week modules during the program. The areas include two-dimensional (painting, drawing, computer animation/graphics and printmaking), and three-dimensional (sculpture, installation and materials) and includes art history and concept studio.

A written evaluation of each student's work is made at the conclusion of the six-week session. Students who intend to apply for admission to Carnegie Mellon for freshman admission to the department may schedule an interview with the Office of Admission. Students may request a portfolio review for admission or an informal critique during the last week of the program.

Pre-College Design Program

Design has an important influence on contemporary life. Nearly everything that has been manufactured or printed—packages, appliances, furniture, books, cars, magazines, etc. — has been influenced by a designer sensitive to social, aesthetic, technical and economic principles.

Full-time design faculty provide not only an integrated study program of graphic design, product design, drawing, photography and computer graphics, but also professional career counseling and guidance appropriate to students. A final positive review of individual student work by all faculty can fulfill the portfolio requirement for admission as freshmen to the department.

The six-week program consists of three-hour classes each morning and afternoon and includes homework assignments. During the registration period, all students will receive a list of required materials. Students may either bring materials from home or purchase them at the campus art store. Special activities could include visiting lectures or field trips to professional design studios. A written evaluation of each student’s work will be sent to the parents at the completion of the program.

Pre-College Drama Program

Carnegie Mellon’s drama program has an innovative and dynamic history that has produced graduates in every branch of theater, film, television and video.

If you’re a serious theater student, or debating whether to become one, you can come here with a good deal of experience or almost none at all, as long as you come ready to work hard and learn.

A Carnegie Mellon summer is a rich and exciting experience. The Pre-College program focuses on creative growth and preparation for actors, musical theater students and technical apprentices. Carnegie Mellon Drama faculty members will coach you, evaluate your work and help steer you into compatible studies, whether those studies take place at Carnegie Mellon or elsewhere. Outstanding students have a possibility of fulfilling the talent portion of our admission process through this program.

Pre-College Music Program

Carnegie Mellon’s School of Music is a stimulating, vibrant place where talented young performers, composers and conductors prepare for professional careers in music. At Carnegie Mellon, tradition and technology coexist. Building upon 75 years of excellence as a conservatory, turning out superb musicians who are known throughout the world as performers, composers, conductors and teachers, the School has become a leader in the field of computer music. New state-of-the-art computer music facilities challenge the most adventurous young musicians to learn more about acoustics and discover new sounds. Music theory software, developed at Carnegie Mellon, enhances the curriculum, and the finest composition software on the market is available to assist the young composer in creating new music. Expert instruction in sound recording provides yet another opportunity for young musicians interested in broadening their musical base. At Carnegie Mellon students are taught to appreciate, to understand, and to perform the music of the past, yet they are also expected to be comfortable with the innovative sounds of the future.

Becoming a professional musician requires extraordinary talent and versatility. The complete musician must be prepared to play jazz as well as classical and contemporary repertoire. Therefore, at Carnegie Mellon a full program of jazz studies is available to enhance the conservatory training. Singers learn to act, to dance, to perform in several languages. Composers learn to conduct, to prepare orchestral scores, to rehearse their own works. Pianists are expected to sight read, play chamber music, accompany singers, and play synthesizer. Music at Carnegie Mellon is more than practicing an instrument — it is an intense, exciting course of study, experienced side by side with other young musicians who share the same goals and aspirations.

The six-week Summer Music Program offers a unique taste of the life of a student musician at Carnegie Mellon in a low pressure environment of study and performance. This is an ideal opportunity to discover your potential for a career in music. Within the rich cultural life of the city of Pittsburgh and the varied activities on the Carnegie Mellon campus, the Summer Program is an extraordinary way for a young musician to spend the summer.

The Summer Program has four main concentrations: Performance, Composition, Jazz Studies and Music Technology. Each student follows an individual schedule designed to meet specific needs and interests. Private lessons are mandated for every student, and a group of music support courses is common to all four areas. Students are encouraged to explore courses outside their area of concentration to insure comprehensive music training.

Applicants to the Summer Music Program should send a statement describing their past musical training, and a recent audio recording (CD preferred) of two selections, representative of their level of performance, or copies of original compositions, with the application materials.

Requests for applications and further information should be addressed to:

Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
(412) 268-2082
FAX: (412) 268-7838

Office of Admission
Enrollment Services

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Enrollment Services

Linda Anderson and John Papinchak - Directors
Lower Level, Warner Hall
5000 Forbes Avenue Pittsburgh, PA 15213-3890
Phone (412) 268-8186
Fax (412) 268-8084
thehub@andrew.cmu.edu
www.cmu.edu/hub

The HUB
The HUB is our student services center. The Assistant Directors of Enrollment Services are available in The HUB Monday, Wednesday and Friday from 8:30 a.m. until 4:30 p.m., and Tuesday and Thursday from 10:30 a.m. until 4:30 p.m. to assist students with enrollment matters including registration, financial aid, student accounts, Carnegie Mellon Cards and CampusXpress. Parents and students are encouraged to contact the Assistant Directors by visiting The HUB, on the lower level of Warner Hall.

Undergraduate Enrollment
Enrollment is the process whereby eligible students notify Enrollment Services that they will be attending the university by registering for courses and settling their student accounts. Enrolled students are academically registered and financially cleared by The HUB. Enrollment must be completed before students may begin classes and before they may utilize university facilities.

Students who do not settle financially with The HUB on or before the first payment deadline (typically, the Monday prior to the beginning of classes) will be assessed a Late Enrollment Fee of $150.

Instructions for enrollment are available on The HUB Website. Scholastic credit will not be permitted for students who fail to fulfill registration or financial obligations to the university. Enrollment deadlines are listed on The HUB Website and on the official academic calendar.

Registration
Registration is the process of selecting courses for the upcoming semester and discussing those selections with an academic advisor. We strongly encourage you to meet with your academic advisor before you finalize your selection of courses and register for courses using On-Line Registration (OLR). OLR will identify your advisor for you and facilitate contact with your advisor via e-mail as part of the automatic registration process.

Registration for most entering freshmen is accomplished with the assistance of Associate Deans and department heads during the summer. Academic placement and elective choice information is collected by mail questionnaires during June and July. Most freshmen receive their schedules and enrollment information prior to the first day of classes.

Currently enrolled students select their courses for the upcoming semester during Registration Week, prior to the end of each semester. The Schedule of Classes is available on-line prior to Registration Week, listing available courses along with general enrollment information. The university reserves the right to make changes to hours, units or instructional staff when such changes seem necessary or advisable. A link to the on-line "Schedule of Classes" is provided on The HUB website. Although faculty advisors are provided, it is the responsibility of students to have clearly in mind what they intend to do, what elective courses they wish to pursue and what irregularities exist which may affect their present schedule. Failed and lower-level courses are to be given priority in planning a schedule.

Students enrolled in any curriculum leading to a degree who fail any required course more than once will not be permitted to re-register in that course without the approval of the Dean of their college, the head of their department and the head of the department offering the course in question.

Students are not permitted to register in courses for which the prerequisites have not been satisfied. Exceptions to the rule may be granted only upon the recommendation of the teaching department concerned. Unless the prerequisites are satisfied or special approval is obtained when the student enters the course, no credit can be allowed for the course.

Availability of Required Courses
In order to insure that students do not have to compete for access to their required courses, registration priority is given to students who are registering for courses in their primary major. Although the university encourages the exploration of other disciplines, access to courses outside a student's primary major (including those courses that fulfill requirements for an additional major, minor, etc.) is on a space-available basis and is not guaranteed.

Overloads
See Page 56.

Auditing
Auditing a course is defined to mean presence in the classroom without academic credit. The auditor may take part in class discussion and take examinations, subject to the agreement and requirements of the instructor. A student who successfully completes an audited course will have the course listed on the transcript with an "O" grade indicating audit. Auditing courses is permitted, without an additional tuition charge, to all students who are already paying full-time tuition and fees.

Part-time and non-degree students who are permitted to audit will be charged tuition for an audited course at the regular tuition rate.

To audit a course, follow these three steps by the Last Day to Add/ Audit a Course. You cannot choose to audit a course after this deadline, even if you're already registered for the course.

1. Complete a Course Audit Approval Form, available from The HUB (available for download from The HUB Website).
2. Have the course instructor sign the form.
3. Submit the Course Audit Approval Form to The HUB.

Once you submit the audit form, you cannot receive a grade other than "O" for the course.

The audit policy applies to all students.

Pass/Fail Option
Undergraduate students may elect to take a free-elective course pass/fail unless precluded by the course, the course's department or the student's home department/college. A student must submit a Pass/Fail Approval Form to Enrollment Services indicating the course they are electing as pass/fail before the last day to drop a class. This decision is irreversible thereafter. No information regarding the student's decision will be passed on to the instructor. Instructors will submit letter grades, which will automatically be converted to pass/fail.

A through D work will receive credit for units passed and be recorded as P on the student's academic record; below D work will receive no credit and will be recorded as N on the student's academic record. No quality points will be assigned to P or N units; P or N units will not be factored into the student's GPA.

The Pass/Fail Policy applies to all students.
Change in Schedule (Add/Drop)
To add or drop a course after Registration Week, follow the OLR instructions for Adding/Dropping a course.

Scheduling changes must be made within the period in the semester as established in the Official University Calendar. A student cannot drop a course by simply notifying the instructor(s) or by ceasing to attend class(es). A student dropping all of his/her courses (with the intent of leaving the university) must file an Application for Withdrawal or an Application for Leave of Absence (see the section on “Student Leave Policy” for more information).

Undergraduate students at Carnegie Mellon may drop a course by following the instructions for dropping a course in OLR on or before the appropriate deadline as published in the Official University Calendar. This applies to all courses with the exception of half-semester mini courses. The deadline to drop a half-semester mini course is the last day of the fourth week of the mini course. When a course is dropped by these deadlines, the course is removed and does not appear on the academic record. After the Add/Drop deadlines or to drop below 36 units, students must see their Associate Dean to facilitate schedule changes.

The Late Add Form is used for adding a course or switching sections after the established add period and during the semester in which the course is offered. Students can check Student Information On-Line to see if the appropriate schedule changes have been made. Undergraduate students who add a course or switch a section after the established add period are required to obtain the permission of their home Dean’s Office or the Head of their School. If adding a course would result in a schedule overload, the permission of the student’s advisor is also required. Graduate students must have the permission of their department.

- If adding a course would result in a schedule overload, the signature of the student’s advisor is also required if requested by Associate Dean/Department Head.
- Graduate students must have the permission of their department.
- International students who wish to drop below full-time must consult the Office of International Education.

The deadline to add a mini course is the end of the first week of classes for that course. The deadline to drop a mini course is one week after the mid-point for that course.

Full-Time Status
Undergraduates who are registered as full-time students as of the 10th day of classes are expected to remain full-time for the duration of the semester. Full time is defined by a minimum of 36 units. Permission to drop below the 36 unit minimum must be granted by the student’s Associate Dean. Undergraduates who are registered as part-time are also subject to the above deadlines to drop or withdraw from a course.

Students carrying a full-time course load as of the 10th regularly scheduled class day are not ordinarily permitted to drop below 36 units after that time. Exceptions must be authorized by the student’s Associate Dean.

Tuition Assessment
The tuition charged each student will be automatically adjusted on the 10th regularly scheduled class day (refer to the specific date noted in Official University Calendar as the “last day to add courses”) based upon each student’s schedule at that time. The tuition charged will be increased whenever the number of units added justifies tuition charges greater than those paid by the student at the time of fee settlement. After that time, no tuition adjustments will be made, with the exception of second minis for that particular semester.

Cross-College and University Registration
PCHE (Pittsburgh Council on Higher Education) Guidelines
Cross-registration provides opportunities for enriched educational programs by permitting full-time paying undergraduate and graduate students to cross register for one course at a Pittsburgh Council on Higher Education (PCHE) Institution. Students who are paying full-time Carnegie Mellon tuition (per the requirements of their home college) are eligible. The PCHE course may count towards full-time status. There is no additional tuition charge, except for special course or laboratory fees. Carnegie Mellon students do not acquire status at the Host Institution, but are given library and bookstore privileges. Credit and grades are transferred directly to the home institution. Cross-registration is not applicable during the Summer Session(s) or during intersessions.

There are nine approved PCHE Institutions in the Pittsburgh area:
- Carlow College (412-578-6084), Chatham College (412-365-1121), CCAC (412-237-2555), Duquesne University (412-396-5230), LaRoche College (412-367-9300), Pittsburgh Theological Seminary (412-362-5610), Point Park College (412-392-3861), Robert Morris College (412-262-8256), University of Pittsburgh (412-624-7600)

1. Each college or university accepts registration from the other institutions; however, first priority is given to students of the Host Institution, and not all departments or schools in all institutions are able to participate in this program. “PCHE Cross Registration Request” forms are available from The HUB.
2. In each case of a student cross-registration, the approval of the Dean or a designated individual from the home college or university must be obtained prior to registration.
3. In addition, the student’s advisor or Dean is responsible for assuring the student’s eligibility for the course in which he/she intends to enroll.
4. Full credit and grades for cross registered courses will be transferred to the appropriate institution; the academic regulations of the host university will prevail.
5. The academic honesty code and other rules of conduct of the institution providing instruction apply with respect to its courses and behavior on its campus. That institution also determines whether its rules have or have not been violated. The student’s own institution will impose such penalties as it considers proper when violations are reported to it.
6. Cross-registrants do not thereby acquire the status of students in the institutions in which they are receiving instruction (e.g., for purposes of participation in student activities, insurance programs, etc.). They do receive library privileges at the host institution and may purchase course texts at the host bookstore.
7. Each qualified student normally may enroll in no more than one course off campus in any one term or semester under this program. Students wishing to cross register for more than one course in a term must have approval from the appropriate academic offices at both schools.
8. No additional tuition charge is made to students who are participating in this program; however, the student who cross registers is responsible for paying any course or laboratory fees to the host.
9. Cross-registration does not apply to summer sessions or intersessions at any of the institutions.
10. Adding or dropping a course after the home institution’s deadline date requires permission from the home institution; adding or dropping a course after the host institution’s deadline date requires permission from the host institution.
11. Students enrolled in approved joint co-op programs between two PCHE institutions are exempt from the requirement of being full-time at either school in order to cross register. Students are bound by the requirements of that program.
12. Carnegie Mellon students may not cross register for required courses that are normally available at Carnegie Mellon. Exceptions may be made if courses are unavailable or legitimate schedule conflicts seriously hinder completion of degree requirements within the prescribed timeframe.
13. Students should not cross register in the semester in which they are graduating.
## Finances

### 2004-2005 Cost of Attendance

Estimated educational expenses at Carnegie Mellon for the 2004-2005 academic year are as follows:

<table>
<thead>
<tr>
<th>Residency</th>
<th>Undergrads who Entered Fall 2004</th>
<th>Undergrads who entered Fall 2000 &amp; prior to Fall 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resident</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuition</td>
<td>$30,650</td>
<td>$30,650</td>
</tr>
<tr>
<td>Activity Fee</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>PAT Fee</td>
<td>76</td>
<td>76</td>
</tr>
<tr>
<td>Technology Fee (New)</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Orientation Fee</td>
<td>190</td>
<td>0</td>
</tr>
<tr>
<td>Room (2)</td>
<td>4964</td>
<td>4964</td>
</tr>
<tr>
<td>Dining (3)</td>
<td>3590</td>
<td>3280</td>
</tr>
<tr>
<td>Books &amp; Supplies (5)</td>
<td>910</td>
<td>910</td>
</tr>
<tr>
<td>Personal &amp; Misc.</td>
<td>1280</td>
<td>1280</td>
</tr>
<tr>
<td>Transportation (4)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$41,970(6)</td>
<td>$41,470(6)</td>
</tr>
</tbody>
</table>

| **Commuter** |                                 |                                                  |
| Tuition   | 30,650                          | 30,650                                          |
| Activity Fee | 160                            | 160                                              |
| PAT Fee     | 76                              | 76                                               |
| Technology Fee (New) | 150                | 150                                              |
| Orientation Fee | 190                | 0                                                |
| Room (2)    | 4964                            | 4964                                             |
| Dining (3)  | 3590                            | 3280                                             |
| Books & Supplies (5) | 910                         | 910                                              |
| Personal & Misc. | 1280                       | 1280                                             |
| Transportation (4) | 0                            | 0                                                |
| **TOTAL**    | $35,176(6)                     | $34,986(6)                                      |

| **Off-Campus** |                                 |                                                  |
| Tuition   | 30,650                          | 30,650                                          |
| Activity Fee | 160                            | 160                                              |
| PAT Fee     | 76                              | 76                                               |
| Technology Fee (New) | 150                | 150                                              |
| Orientation Fee | 190                | 0                                                |
| Room (2)    | 4964                            | 4964                                             |
| Dining (3)  | 3590                            | 3280                                             |
| Books & Supplies (5) | 910                         | 910                                              |
| Personal & Misc. | 1280                       | 1280                                             |
| Transportation (4) | 0                            | 0                                                |
| **TOTAL**    | $41,160(6)                     | $40,970(6)                                      |

(1) The Commuter dining amount of $1200 is based upon a 2-meal/wk plan plus $10/wk DineXtra.
(2) Off-Campus Room Rate is Resident Room minus $500. Off Campus Dining is Resident Dining minus $310.
(3) Non-freshman Resident Dining is Freshman Resident Dining minus $310.
(4) Transportation for Resident & Off-Campus Students Varies per Home State.
(5) Design/Architecture/Art Students - Add an Additional $455 for Books.
(6) In addition, minimal health insurance coverage is required at a cost of $814 per year, unless a waiver is granted because you are covered under your family’s health plan, or you are a dependent undergraduate student, or you are an exchange student. This does not include Study Abroad students.

The three budgets depicted above reference a typical Resident, Commuter or Off-Campus Student. The university reserves the right to change its charges without notice.

The academic year tuition charges are for all full-time undergraduate students. A full-time student is one registered in a degree program and carrying a schedule of at least 36 units per semester. A student enrolled for less than 36 units per semester will be charged tuition on a unit basis of $426 per unit ($419 for students who entered Fall 2000 & prior to Fall 2003).

### Student Fee Information

- **Activity Fee**: $80 per semester - Charged to all students registered for a minimum of 18 units. This fee covers the cost of student activities and events.
- **Orientation Fee**: $190 - Charged to all first-time undergraduate students (fall semester only).
- **Port Authority (PAT) Fee**: $38 per semester - Charged to all degree-seeking students enrolled for at least one course. This permits full access to the Port Authority Transit System.
- **Health Insurance Fee**: $814 annually - Minimal health insurance coverage is required at a cost of $814 per year, unless a waiver is granted by Health Services, because you are covered under your family’s health plan.
- **Technology Fee**: $75 per semester - Charged to all students who are eligible to enroll. This includes distance education, non-degree and exchange students. This fee is nonrefundable.

### Financial Aid

- Prospective Student Financial Aid is coordinated by the Office of Admission, Warner Hall Room 101.
- Returning Student Financial Aid is handled by The HUB, Lower Level, Warner Hall.

Carnegie Mellon University administers an extensive financial aid program designed to bridge the gap between the family contribution and the cost of attending the university.

Tuition income does not meet the cost of educating students enrolled at the university. The remaining costs are met in part by income from our endowment and by annual gifts and grants from friends of the university.

### To Apply for Financial Aid

To receive financial aid consideration, follow these steps:

1. Prior to completing the FAFSA or Renewal FAFSA on the web, you need to request a Personal Identification Number (PIN) from the Department of Education. If you are a dependent undergraduate student, your parent must also request a PIN in order to electronically sign your FAFSA or Renewal FAFSA. Request a PIN by visiting http://pin.ed.gov. If you already have a PIN, you do not need to request a new one. If you have lost or forgotten your PIN, you need to request that it be sent to you again. If you think someone knows your PIN, select the Change PIN option to request a new PIN combination.

2. Complete a Free Application for Federal Student Aid (FAFSA). The FAFSA is available on-line at www.fafsa.ed.gov. This document is necessary if you wish to be considered for any student aid.

3. Complete the Carnegie Mellon Financial Aid Application. There are two options for completing this form:
   - On Line - You must have an Andrew User ID and password to complete this application.
   - PDF version - You may download this form from The HUB Website.

Additional information is published on The HUB Website, including specific instructions and required documents.

4. Parent(s)’ U.S. Federal Income Tax Return or Foreign Tax Return and W-2 Wage and Tax Statement(s)

Please send us a signed copy of your parent(s)’ actual Federal Income Tax Return, pages 1 and 2 only. We will not accept a tax preparer’s stamp in place of any signature(s). We will accept a tax preparer’s signature. We also require legible copies of all parental W-2 Wage and Tax Statement(s). Print your name and Student ID Number in the upper right corner of each tax document. Do not submit a copy of their prior year or an estimated tax return. If you file electronically or Telefile, you are...
required to submit to us a signed copy of your electronic tax return or a signed copy of your Telefile form(s). All documents listed above are due to us on or before April 15.

If your parent(s) are required to file a Federal Income Tax Return, you must provide us with a copy of their foreign tax return and provide tax information translated into U.S. dollars on a U.S. Federal Income Tax Return. This document must be signed by your parent(s) and a tax accountant.

5. Student’s/Spouse’s U.S. Federal Income Tax Return or Foreign Tax Return

We also require a signed copy of your actual Federal Income Tax Return. We will not accept a tax preparer’s stamp in place of any signature(s). We will accept a tax preparer’s signature. Do not submit a copy of the prior year or an estimated tax return. If you file electronically or Telefile, you are required to submit to us a signed copy of your electronic tax return or a signed copy of your Telefile form(s). All documents listed above are due to us on or before April 15.

If you are required to file a Federal Income Tax Return in a country other than the United States, you must provide us with a copy of your foreign tax return and provide tax information translated into U.S. dollars on a U.S. Federal Income Tax Return. This document must be signed by you and a tax accountant.

How Is Family Contribution Determined?

Eligibility for federal, state, Carnegie Mellon and most private aid programs is determined by using a Congressional formula called Federal Methodology. It uses your parent(s)’ and your income, and current equity in assets, reported on the Free Application for Federal Student Aid (FAFSA), to determine the amount you are expected to pay toward your education. This amount is called your Expected Family Contribution (EFC).

What Is Financial Need?

Financial need is the difference between your cost of attendance and your parent(s)’ and your ability to contribute.

Cost of Attendance is the expected dollar amount you will need to attend Carnegie Mellon for an academic year.

Noncustodial Parent Contribution (NCPC)

Carnegie Mellon believes that noncustodial parents have a responsibility to contribute to their child’s educational expenses. The noncustodial parent contribution is calculated using child support and noncustodial parent information from the Carnegie Mellon application and the Noncustodial Parent Information Form.

Financial Aid Award Package

To help meet your financial need, we offer you a combination of awards called a financial aid package. There are two components to most financial aid packages: gift aid and self-help. Gift aid awards include grants and scholarships and are monies given to you that you do not have to repay. Self-help awards are monies you must apply for and either repay (student loans) or work for (student employment).

Financial aid award packages are structured to meet the particular needs of our students. The amount of financial aid may vary with need as the student progresses through the undergraduate program. Returning students financial aid award packages are evaluated and renewed by the Assistant Directors in The HUB annually upon proper resubmission of application materials by April 15, continued evidence of financial need, and satisfactory academic progress.

Note: If your EFC is greater than the cost of attendance, you will not be offered need-based financial aid. You or your parent(s) may still apply for non-need-based aid, such as the Federal PLUS Loan and the unsubsidized Federal Stafford Loan.

Grants

Grants are awards you do not have to repay. All federal, state and other institutional grants and scholarships are awards based upon financial need.

Federal Pell Grant

A Federal Pell Grant is a grant awarded by the federal government to students with high financial need. The projected maximum grant awarded for the 2004-05 academic year is $4,050. If you become eligible for a Federal Pell Grant after your financial aid package is determined, a dollar-for-dollar reduction to your Carnegie Mellon need-based grant funds will occur.

Federal Supplemental Educational Opportunity Grant (Federal SEOG)

A Federal SEOG is a grant for undergraduates with exceptional financial need. Carnegie Mellon usually awards these grants to students who receive a Federal Pell Grant. If there is a change in your Federal SEOG eligibility, a dollar-for-dollar adjustment to your Carnegie Mellon need-based grant funds will occur.

State Grants

Some states provide educational grants to their residents who demonstrate financial need.

If you are eligible for grant assistance from your state but you do not apply, Carnegie Mellon will not provide additional grant assistance to replace your lost state grant funds. In addition, if you do not apply on time for State Grant assistance and you are a Pennsylvania resident; we will reduce your eligibility for the Carnegie Mellon Undergraduate Grant by $1,000 if you would have been eligible for a PHEAA State Grant. This is the amount of institutional grant assistance Carnegie Mellon would have received from the Pennsylvania Higher Education Assistance Agency (PHEAA) if you had applied on time.

If you are awarded a state grant after your financial aid package is determined, a dollar-for-dollar reduction to your Carnegie Mellon need-based grant funds will occur.

Carnegie Mellon Undergraduate Grant

A Carnegie Mellon Undergraduate Grant is a grant awarded by Carnegie Mellon to students who have financial need. Once you complete the Carnegie Mellon financial aid process, you are considered for this grant. Note: This grant is not automatically renewed each year.

Scholarships

Scholarships are awards that you do not have to repay. The Carnegie Mellon Institutional Academic Scholarships are awarded to students when they enter as freshmen and are renewed annually if the student meets the cumulative 2.0 GPA requirement.

Carnegie Mellon Academic Scholarship Program

Carnegie Mellon offers several academic scholarships to incoming freshmen. The scholarships are designed to recognize and reward outstanding academic, artistic and personal achievement. Financial need is not a requirement. These scholarships are renewable for eight
Student Loans

Student loans are self-help awards which must be repaid.

Federal Perkins Loan

A Federal Perkins Loan is a low-interest (5 percent) federal loan administered by Carnegie Mellon. Carnegie Mellon offers this loan to students who have exceptional financial need as determined by Federal Methodology and Carnegie Mellon. You receive consideration for a Federal Perkins Loan if you complete a FAFSA and a Carnegie Mellon Financial Aid Application. There is no separate application for this loan. Enrollment Services will automatically credit the loan to your student account (one-half in the fall, one-half in the spring).

If you are offered a Federal Perkins Loan, Enrollment Services will mail you a Promissory Note in mid to late summer. You must sign and return your Promissory Note to Enrollment Services. If you do not return a signed Promissory Note, your Federal Perkins Loan will be canceled.

Repayment of both principal and interest does not begin until nine months after you graduate or are no longer enrolled at least half-time (18 units per semester). No interest accrues on the loan until you begin repayment.

Federal Stafford Loan

A Federal Stafford Loan (FSL) is a loan given by a private lender (e.g., bank, credit union or other financial institution) to students. The interest rate is variable and is set annually on July 1. The interest rate cannot exceed 8.25 percent. There are two types of Federal Stafford Loans — subsidized and unsubsidized.

You may borrow up to the following annual loan limits (subsidized and unsubsidized FSL combined) based upon your year of study:

- first-year students $2,625; sophomores $3,500;
- juniors, seniors and fifth-year students $5,500.

The maximum is $23,000 for undergraduate study.

To apply for an FSL, you must complete and submit the following:

- FAFSA,
- Carnegie Mellon Financial Aid Application,
- Signed copy of your parent(s)’ Federal Income Tax Return or Foreign Income Tax Return
- Your parents’ W-2 Wage and Tax Statements,
- Signed copy of your Federal Income Tax Return or Foreign Income Tax Return.

You must complete a Stafford Master Promissory Note (MPN). If you previously borrowed a Federal Stafford Loan (FSL) and completed a Master Promissory Note, you do not need to complete another MPN for each subsequent academic year. Your FAFSA will serve as your application.

If you are a first-time borrower at Carnegie Mellon, you must complete a Stafford MPN on-line by visiting the American Education Services (AES) website: www.aessuccess.org. Complete instructions are available on The HUB website: www.cmu.edu/hub/mpn.html.

In most cases, your FSL funds will be electronically deposited into your student account at Carnegie Mellon on or about September 2 for the fall semester, and on or about January 2 for the spring semester.

In some cases, you may be required to sign your FSL check in The HUB before the loan proceeds can be credited to your student account. You should subtract approximately one-half of your annual FSL from the balance due appearing on your Fall and Spring Invoices.

If you are a first-time borrower, your fall Federal Stafford Loan credit will not appear on your student account until 30 days from the beginning of the fall semester (October 1).

No fees will be deducted from your loan if you are borrowing from a KeystoneBEST Lender. Our preferred Keystone Best Lenders are PNC Bank and Citizens Bank.

Subsidized Federal Stafford Loan

A subsidized Federal Stafford Loan (FSL) is a loan given by a private lender (e.g., bank, credit union or other financial institution) to students with financial need. You begin repaying the loan six months after you either graduate or cease to be enrolled at least half-time (18 units per semester). The interest on a subsidized FSL is paid by the federal government while you remain enrolled at least half time and during your six-month grace period. You have up to 10 years to repay your loan.

Unsubsidized Federal Stafford Loan

An unsubsidized Federal Stafford Loan (FSL) is available to students who do not qualify, in whole or in part, for a subsidized Federal Stafford Loan. It is not based on financial need. Unlike the subsidized FSL, you are required to pay the interest that accumulates on the unsubsidized FSL every three months while you are in school. It is possible to have the interest capitalized (instead of paying the interest every three months, it is added back to the principal). This will increase the amount you have to repay. We suggest you pay the interest as it accumulates, as you’ll repay less in the long run.

You may be eligible for additional unsubsidized FSL funds (beyond the FSL limits stated above) if your parent(s) apply for a Federal PLUS Loan and are denied. If this is the case, the maximum you may borrow annually in additional unsubsidized FSL funds based upon your year of study is as follows:

- first-year students $4,000; sophomores $4,000;
- juniors, seniors and fifth-year students $5,000.

The aggregate total (subsidized, unsubsidized and additional unsubsidized FSL combined) is $46,000 for undergraduate study; however, only $23,000 of this total can be in subsidized FSL funds.
Federal Entrance Loan Counseling

Federal regulations require that all first-time federal student loan borrowers complete an entrance counseling session prior to their Federal Student Loan funds being credited to their student accounts. During the entrance counseling session, you will be informed of your rights and responsibilities as a borrower.

CARNEGIE MELLON WILL NOT PROCESS YOUR FEDERAL STAFFORD LOAN UNTIL YOU COMPLETE THE ENTRANCE COUNSELING SESSION.

Complete the loan counseling requirements electronically on our Federal Entrance Loan Counseling Website www.cmu.edu/hub. Follow the instructions, answer the questions and complete the appropriate electronic submission form. We recommend that you print a copy of the "Rights and Responsibilities Checklist." Prior to the form appearing in the browser, you will need to log into the server by entering your Andrew UserID and Password. Use Netscape Navigator version 4.0 or newer or Microsoft Internet Explorer version 4.0 or newer. America Online's browser will not work. If you have questions regarding your account information, please contact Computing Services at 412-268-4357.

Federal PLUS Loan

A Federal PLUS Loan is a non-need-based loan given by a private lender (e.g., bank, credit union or other financial institution) to creditworthy parent(s). The interest rate is variable and is set annually on July 1. The interest rate cannot exceed 9 percent. Repayment of principal and interest begins 60 days after the last disbursement for the loan period and the maximum repayment period is 10 years. Parent(s) may apply for a Federal PLUS Loan for up to the annual cost of attendance minus any financial aid. Approval for this loan and the amount a parent is eligible to borrow is determined by the lender. If the Federal PLUS Loan is not approved by the lender, the student may borrow additional unsubsidized FSL funds (see Unsubsidized Federal Stafford Loan).

If the Federal PLUS Loan is approved by the lender, insurance and guarantee fees (2 to 3 percent) are deducted from the loan proceeds each semester before being sent to Carnegie Mellon. The proceeds will be sent to us via electronic funds transfer (EFT) or by check. If the funds are disbursed via EFT, they will be electronically deposited into your student account at Carnegie Mellon. If the funds are sent to us by check (made co-payable to your parent and Carnegie Mellon), Enrollment Services will send the check to your parent to be endorsed and returned to Enrollment Services to be deposited into your student account at Carnegie Mellon.

All parents wishing to borrow a Federal PLUS Loan for the first time are required to complete a Federal PLUS Master Promissory Note (MPN). If the parent who will be a first-time borrower of a Federal PLUS Loan has a U.S. Department of Education PIN, he or she may complete the Federal PLUS MPN online by visiting the AES Website www.aessuccess.org. Additional Information is available at www.cmu.edu/hub/plus_mp.html.

Parents who previously borrowed through the Federal PLUS Loan Program and wish to reapply must complete the Federal PLUS pre-approval process at www.aessuccess.org.

Carnegie Mellon Gate Student Loan

Our Carnegie Mellon Gate Student Loan Program offers you a low interest rate, requires no payments during enrollment, and has a graduated repayment schedule. It is a supplemental student loan program. You are the borrower and you are not required to have a cosigner. You may be eligible to borrow an annual maximum of $10,000. You may access the information regarding the Carnegie Mellon Gate Student Loan Program on The HUB Website. Before considering the Carnegie Mellon Gate Loan, we encourage you and your parents to investigate borrowing through the subsidized and unsubsidized Federal Stafford Loan Programs and Federal PLUS Loan Program.

Student Employment

There are many student employment opportunities on campus, both need-based and non-need-based.

Federal Work-Study (FWS) is a need-based self-help award. If you have been awarded FWS, your FWS award is the total that you can earn during the academic year as a work-study student. Funds earned in the Federal Work Study Program are not credited to your student account.

If you have not been awarded FWS and wish to work on campus, there are positions available. Both need-based and non-need-based student employment positions are advertised on the Career Center’s web page: www.studentaffairs.cmu.edu/career.

All undergraduates who are employed by Carnegie Mellon complete timecards and are paid by check on a bi-weekly basis. Students have the option to have their pay direct deposited into a local checking or savings account.

Reserve Officer Training Corps (ROTC) Scholarships

Air Force ROTC

Type I Award: covers full tuition and fees. Type II Award: $15,000 annually. Type VIII Award: 80% of tuition. There is a book allowance of $510, and a monthly stipend ($250 - freshmen; $300 - sophomores; $350 - juniors; $400 - seniors). Stipends are calculated for 9 months for the Air Force because they use the University of Pittsburgh academic calendar.

Students on scholarship are required to attend AFROTC courses (for more information see page 82).

Army ROTC

Army ROTC offers four, three and two-year scholarships of up to $17,000 per year with additional annual allowances of $600 for books and a stipend ($2,000 - freshmen; $2,400 - sophomores; $2,800 - juniors; $3,200 - seniors). Army stipends are calculated for 8 months using Aug. 30 to April 26. High school, undergraduate and incoming two-year graduate students are eligible to apply. For application and information call ROTC at the University of Pittsburgh at (412) 624-6197/6198/6199 (for more information see page 82).

Navy-Marine Corps ROTC

The NROTC offers four-, three- and two-year scholarships based on competitive national selection. The Navy pays for tuition, fees and uniforms. There is a book allowance of $600, and a stipend ($2,250 - freshmen; $2,700 - sophomores; $3,150 - juniors; $3,600 - seniors) with an additional transportation allowance. In addition, NROTC midshipmen receive full active duty pay and benefits when on summer training cruises. Navy stipends are based upon 9 months using the Carnegie Mellon calendar.

Special scholarships are available to minority students and students who are interested in careers as nuclear power officers. These special scholarships are available to students who have completed at least one term of academic college course work. See page 83 for more information.

Billing Information

Payment of Charges

All charges and credits incurred at the university are reflected on your individual account and invoice. This invoice includes tuition and fees; and may include housing, meal plan, sorority or fraternity charges, health insurance, CampusXpress, DineXtra and any miscellaneous charges incurred. Miscellaneous charges could include but are not limited to music lessons, library fines, parking fines, pharmacy fees or emergency loans.

A student account invoice is mailed in July for the fall semester and in November for the spring semester. Payment is due on or before the Monday prior to the first day of classes. Balances not paid in full on or before the Monday prior to the start of classes will be assessed a Late Enrollment fee of $150.

Your account can be paid via personal check, cash, wire transfer, scholarships or loan proceeds. You may also contract a payment plan through Tuition Management Systems (TMS) - see page 34. Enrolled students may pay by e-check via Student Information On-Line (www.cmu.edu/hub).

Enrollment Services
Payment Options

Check and Electronic Check Payments
We will be offering students the option to pay their student account balances via Electronic Check Payment from a checking or savings account. We will activate this payment feature from the student account page within Student Information On-line from The HUB Website.

Carnegie Mellon
P.O. Box 360224
Pittsburgh, PA 15251-6224

When paying by check, write the student’s name on the memo line of your check. If you send a check to this address, DO NOT attach any additional information to your invoice.

Wire Transfer Payments
The following information is required when sending a wire transfer payment:

Mellon Bank, 500 Ross St., Pittsburgh, PA 15262
Routing Number: 043-000-261
Carnegie Mellon Account Number: 197-9903
SWIFT Number: MELNUS3P
Student Name and ID Number

Carnegie Mellon is not responsible for wire transfer payments that are not properly identified. Allow at least 10-14 business days for processing.

Tuition Management Systems Monthly Payment Plan
The Tuition Management Systems Interest-Free Monthly Payment Plan allows you to maximize your savings and income by spreading your education expenses over 10 interest-free monthly payments beginning in July. Your only cost is an annual enrollment fee of $55.

The Carnegie Mellon Tuition Payment Plan includes life insurance coverage, personal account service and counseling, automated account information 24 hours a day and access to your account through their website, www.afford.com.

If you have already set up a monthly payment plan with TMS, one half of your contracted amount will be credited to your fall invoice, the remainder to the other semesters contracted. If you still have a balance once your contracted amount is credited on the invoice and after deducting the amount of your approved loans, you either need to increase your contract with TMS, OR send the amount due to Carnegie Mellon.

Visit www.afford.com for more information on payment options, Carnegie Mellon education loans, free education payment counseling and the many payment options we offer to help you afford a Carnegie Mellon education. You may also contact a TMS Education Payment Counselor at 1-800-722-4867 Monday-Friday, 8:00 a.m. to 10:00 p.m. and Saturday, 9:00 a.m. to 3:00 p.m. (EST).

Monthly payment plan overpayments will be refunded in April.

Enrollment Services Policies and Procedures

Financial Aid Policy

University Academic Scholarship Renewals
Carnegie Mellon University awards academic scholarships as part of the freshman financial aid process. Each of these scholarships is renewable for four academic years of study (five for architecture) based upon the maintenance of a specific cumulative quality point average. The academic scholarship renewal criteria are included in the scholarship notification letter which is mailed to the student prior to the May 1 matriculation deadline.

Each scholarship recipient’s cumulative quality point average is reviewed at the end of each academic year. If the student achieves the scholarship renewal criteria, then the scholarship is automatically renewed for the next academic year.

If the student does not meet the cumulative quality point average requirement for renewal, then s/he is given the opportunity to appeal. A merit scholarship appeal form and instructions are automatically sent to the student at the end of each academic year.

The student’s completed appeal form is reviewed by members of the Enrollment Services staff. Input from the Associate Dean of the student’s college is also considered. The student is notified, in writing, of the decision. The decision may be to renew the scholarship for the entire academic year, renew the scholarship for one academic term, or to reject the appeal. If the appeal is rejected, a written explanation is provided to the student.

Satisfactory Academic Progress
The Department of Education requires recipients of Federal Title IV Financial Assistance to meet academic progress standards each year. Federal Title IV Financial Assistance includes the Federal Pell Grant, Federal Supplemental Educational Opportunity Grant, Federal Perkins Loan, Federal Work-Study, Federal Stafford Loan and Federal PLUS Loan Programs. Each university determines its own policy regarding sufficient progress standards. Federal academic progress standards must include two elements: cumulative QPA and cumulative units. At Carnegie Mellon, we define this as follows: first-year freshman students must pass 80 percent of all cumulative units attempted at Carnegie Mellon and have a 1.75 cumulative QPA after the first year, all other students (excluding graduate students in the Tepper School of Business and Heinz) must pass 80 percent of all cumulative units attempted at Carnegie Mellon and have a 2.00 cumulative QPA.

Outside Scholarship and/or a State or Federal Grant
Outside scholarships do not affect Carnegie Mellon academic scholarships unless the total amount of grants and scholarships exceeds the total amount of tuition, fees, standard room and standard dining.

In the case of federal and state grants that were not included in our initial award, a dollar-for-dollar reduction of the need based institutional grant/scholarship funds will occur. The first $6,000 you receive in outside grants/scholarships will not reduce your Carnegie Mellon gift aid. In some cases, self-help aid (loans and work study) will be adjusted. If you receive more than $6,000 annually in outside grants/scholarships, your need based Carnegie Mellon gift/scholarships will be reduced by one-half the value that exceeds $6,000.

Students Pursuing a Second Bachelor’s Degree
If you are enrolling in a second bachelor’s degree program, you are not eligible for grants/scholarships. However, you may be eligible to receive funds from student loan and student employment programs. Eligibility for student loan funds is contingent upon the student’s prior loan indebtedness.

Undergraduate Tuition Exchange Programs
Carnegie Mellon University assesses the standard tuition charge for the undergraduate tuition exchange programs.

Since Carnegie Mellon assesses the tuition charge, the student can be considered for all forms of institutional, state, and federal aid for which the student may have eligibility with the exception of any student employment program.

Undergraduate Study Abroad Programs
Carnegie Mellon University does not assess the tuition charge for any of the Study Abroad Programs.

Since Carnegie Mellon does not assess the tuition charge, the student is not considered for any institutional grants and scholarships. However, Carnegie Mellon will consider any student participating in an approved Study Abroad Program for all state and federal student aid programs for which the student may have eligibility with the exception of any student employment program.
The U.S. Department of Education and Carnegie Mellon University define an approved Study Abroad Program as one which is part of a contractual agreement between Carnegie Mellon and the host institution. Additionally, courses taken in the Study Abroad Program must be accepted for transfer to Carnegie Mellon by the Dean of the student’s college.

**Undergraduate Sponsored Study Abroad Programs**

Carnegie Mellon assesses full tuition charges and all applicable fees to students participating in an undergraduate sponsored study abroad program.

**Undergraduate International Students**

**Documentation Eligibility (U.S. Citizenship or Eligible Noncitizen)**

You must be a U.S. Citizen or permanent resident alien to receive federal student aid. If you are a U.S. Citizen, **but were not born in the United States**, valid documentation includes a copy of your passport or naturalization certificate.

If you are a U.S. permanent resident alien or refugee, acceptable forms of verification include a photocopy of **both** sides of your I-551 or I-551C card.

Undergraduate international students are ineligible to receive any federal or state student financial aid. Additionally, Carnegie Mellon does not award any institutional financial aid funds to undergraduate international students.

**Student Leave Policy**

www.cmu.edu/policies/documents/StLeave.html

**Policy Statement**

Students must sometimes interrupt their studies for a variety of reasons (financial, academic or personal). Students choosing to take a leave of absence should first contact their department advisor to discuss their plans while on leave and to work out any conditions that may be necessary for a smooth return to Carnegie Mellon.

A Leave of Absence Form must be filled out by all students requesting a leave. Notifying instructors and no longer attending classes does not complete the process. Forms are available in the academic department, Deans’ offices and The HUB. Not completing the leave form results in tuition being charged and failing grades being recorded for the entire semester.

A student may leave Carnegie Mellon by either withdrawing from the university (this means leaving the university with no intention to return) or by taking a leave of absence (this means leaving the university temporarily, with the firm and stated intention to return).

Students are required to fill out all information on the form, including all comment sections relating to reasons for the leave of absence. After completion of the form, students must take it to their home department and Dean’s office for appropriate signatures. The process of taking a leave will not be complete until all necessary signatures are on the leave form. Under certain circumstances, students may also need the Dean of Student Affairs to sign the leave form.

Nonresident alien students must see the Office of International Education for information on possible visa implications prior to going on leave.

Students on leave are not permitted to live in university housing or attend classes or maintain employment as students at Carnegie Mellon while their leave is in effect.

Doctoral candidates under ABD status (All But Dissertation) who wish to take a leave of absence should refer to the Graduate Student Handbook and the ABD and In Absentia policy.

Leave during the academic semester will take effect as of the date the student began the leave procedure. After the Leave of Absence Form is received by Enrollment Services, it will be reviewed for appropriate tuition refunds (see Enrollment Services: Tuition Adjustment Policy) and grade implications.

Student recording of courses and grades for a leave in a semester follows the deadlines for semester or mini courses, as follows:

- On or before the university deadline to drop classes with W (withdrawal) grades: all courses or grades are removed.
- After the university deadline to drop classes but before the last day of classes: W (withdrawal) grades will be assigned to all classes. (W grades apply to all undergraduate students, and to graduate students only in the Mellon College of Science.)
- After the last day of classes: permanent grades assigned by the instructor will be recorded.

**Contact:** Questions concerning this policy or its intent should be directed to: The HUB, x88186.

**Student Return Policy**

www.cmu.edu/policies/documents/StLeave.html

**Policy Statement**

Students on leave wishing to return to Carnegie Mellon to resume their degree studies may do so under several conditions. In order to be considered for return from leave, a student must first obtain a Return from a Leave of Absence form from The HUB or their academic department. This application requires information from the student regarding the intended semester of return, current address information and information about their leave. This application must be submitted to their home department at least one month prior to the beginning of the semester.

Undergraduates may return within their same academic department within two years. After two years, students returning in the same academic department are subject to space constraints and academic performance review. Graduate students must negotiate their return with their home department and must follow their department policy.

The Return from Leave of Absence form requires approval of the student’s academic department and Dean. If a student’s department chooses to deny the student’s Return from Leave of Absence form, the student may appeal to their Dean. Any constraints governing the student’s eligibility to return will be specified directly on the application by the academic department and/or Dean’s office or the Office of Student Affairs.

Students who have taken courses elsewhere must submit an official transcript and course descriptions with their Return from Leave of Absence form. Transfer credit approval is determined by the academic department based on course level, performance and appropriateness to the student’s curriculum requirements. Credit transfer is subject to college-specific policy. Failure to submit the necessary documents at the time of return will result in denial of transfer credit.

The process of returning is not completed until all necessary signatures on the Return form are obtained by the student and until all outstanding bills are paid. Enrollment Services will then notify the appropriate university offices of the student’s return.

**Contact:** Questions concerning this policy or its intent should be directed to: The HUB, x88186.

**Tuition Adjustment Policy**

www.cmu.edu/policies/documents/TuitionRefund.html

**Application**

This policy applies to withdrawals and leaves of absence by all students (graduate, undergraduate, non-degree) for all semesters (Fall, Spring, Summer 1, Summer 2, Summer All).

**Official Date of Withdrawal/Leave of Absence**

For students who notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is the earliest of:

- the date the student began the withdrawal or leave of absence process;
- the date the student notified his or her home department;
- the date the student notified the associate dean of his or her college;
- the date the student notified the dean of students.
For students who do not notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is:

- the midpoint of the semester;
- the last date the student attended an academically-related activity such as an exam, tutorial or study group, or the last day a student turned in a class assignment.

Tuition Adjustment

Students who withdraw or take a leave of absence before completing 60% of the semester will be charged tuition based on the number of days completed within the semester. This includes calendar days, class and non-class days, from the first day of classes to the last day of final exams. Breaks which last five days or longer, including the preceding and subsequent weekends, are not counted. Thanksgiving and Spring Break are not counted. There is no tuition adjustment after 60% of the semester is completed. No tuition is charged to a student who is administratively withdrawn. See The HUB website for the complete tuition assessment schedule for the current semester.

Housing, Meal Plan & Fee Adjustments

Housing charges are adjusted daily, beginning on check-in day and ending on the last day of final exams for the semester. Holiday breaks are included. The Winter Break period is not included.

Meal plan charges are adjusted weekly. DineXtra and CampusXpress are assessed based upon actual use.

There is no adjustment of the Port Authority Fee, the Technology Fee or Student Activity Fee.

Financial Aid Adjustment

Federal and institutional financial aid is adjusted on the same basis as tuition. A student earns 100% of his or her federal or institutional financial aid when 60% of the semester is completed.

State grants and non-federal outside scholarships are adjusted based upon the withdrawal policy of the agency awarding the funds.

Contact: Questions concerning this policy or its intent should be directed to: The HUB, x88186.

Student Accounts Receivable Policy and Procedures

Policy Statement

A student is responsible for the payment of charges incurred at the university by the stated payment deadline. The purpose of this policy statement is to detail the specific process and action steps to be used to resolve any outstanding student account balance.

Procedural Overview

Enrollment Services will take progressive action to resolve any student account balance greater than $500. These actions include: communication, first with the student and second with the parent/s, regarding the account status, academic and administrative consequences of nonpayment, and the provision of information and realistic payment options to resolve the delinquent balance; communication with appropriate university service administrators and the associate dean of the student’s college concerning the same issues communicated to the student and parent/s.

In situations where the university attempts to resolve the outstanding balance but the student has not made or met satisfactory arrangements for payment, the university will take one or both of the following two actions: (1) financial suspension and/or (2) wage garnishment.

In the case of a financial suspension, the student will be restricted from registering for and enrolling in university courses and programs, and s/he will be prohibited from using university academic and administrative services. These services include, but are not limited to, computing facilities, library services, housing, dining, career center services, degree verification and the release of (official) academic transcripts.

If a student is employed by Carnegie Mellon, the university may garnish the student’s wages to recover the amount due to the university. The cashier will notify the student prior to any action, and the amount to be garnished will be tailored to individual circumstances.

Procedures

Currently Enrolled Student/New Balance Due

Enrollment Services will notify, in writing, any enrolled student who has an account balance greater than $500 following the current semester deadline for enrollment, will be subject to the following procedures. Enrollment Services will send notification of continued nonpayment after the 15th day of classes (third week) to the student and parent/s, the university service administrators and the associate dean of the student’s college. This action will be documented in the student’s administrative records.

Enrollment Services will work with the student and parent/s to resolve the financial issue. Payment arrangements will follow standard practices related to collections, to include a promissory note with a specified repayment schedule within the current semester. Requests for exceptions to standard collection practices, such as extending the payment schedule beyond the current semester, must be made in writing to the vice president for enrollment. All requests will be reviewed by the Student Accounts Receivable Committee, composed of the vice president for enrollment, vice president for business, the dean of student affairs and the directors of Enrollment Services. Input from the associate dean of the student’s college will be requested and considered. When a payment agreement is reached, Enrollment Services will mail a letter to the student and parent/s detailing the conditions of the agreement and the risk of financial suspension if the agreement is not fulfilled. This correspondence will be copied to representatives of the Student Accounts Receivable Committee and to the associate dean of the student’s college.

Currently Enrolled Students/Carry-over Balance Due

A student who received account balance action letters from Enrollment Services during the previous semester who has an account balance greater than $500 following the current semester deadline for enrollment, will be subject to the following procedures. Enrollment Services will send notification of continued nonpayment after the 15th day of classes (third week) to the student and parent/s, the university service administrators and the associate dean of the student’s college. This action will be documented in the student’s administrative records.

Enrollment Services will work with the student and parent/s to resolve the financial issue. Payment arrangements will follow standard practices related to collections, to include a promissory note with a specified repayment schedule within the current semester. Requests for exceptions to standard collection practices, such as extending the payment schedule beyond the current semester, must be made in writing to the vice president for enrollment. All requests will be reviewed by the Student Accounts Receivable Committee, composed of the vice president for enrollment, vice president for business, the dean of student affairs and the directors of Enrollment Services. Input from the associate dean of the student’s college will be requested and considered. When a payment agreement is reached, Enrollment Services will mail a letter to the student and parent/s detailing the conditions of the agreement and the risk of financial suspension if the agreement is not fulfilled. This correspondence will be copied to representatives of the Student Accounts Receivable Committee and to the associate dean of the student’s college.

If a financial agreement is not reached, the student will be financially suspended. The student will be prohibited from using university academic and administrative services. These services include, but are not limited to, computing facilities, library services, housing, dining, career center services, degree verification and the release of (official) academic transcripts.
and the release of (official) academic transcripts for the upcoming semester.

If the student has an overdue balance at the completion of the current term (a carry-over balance greater than or equal to $500 for 2 consecutive terms), Enrollment Services will send a letter to the student and parent/s to advise them that the student has been "financially suspended" and that s/he will not be permitted to return to the university until the account balance is paid in full. This correspondence will be copied to representatives of the Student Accounts Receivable Committee, university service administrators and to the associate dean of the student's college.

If at any point in the process the student's account balance is paid in full, Enrollment Services will update the student's enrollment status and release the hold on his/her academic and financial records. The student will then be able to register for courses and use university academic and administrative services. Enrollment Services will also notify the appropriate university academic and administrative staff members.

**Delinquent Account/Financially Suspended**

A student who has been financially suspended and who retains an account balance will be subject to the following procedures.

Enrollment Services will send a series of financial status letters to the student indicating the consequences of nonpayment or continued account delinquency. Enrollment Services will mail the first letter when the student is classified as having a delinquent balance, with follow-up letters at distinct intervals from the point in time Enrollment Services determines that the student's account is in a delinquent status. Enrollment Services will also use telephone conferences with the student and parent/s.

Enrollment Services will note any response to the financial status letter or telephone communication with the student and parent/s in the student's financial records, along with any arrangements for payment. Enrollment Services will update the student's account balance to reflect any payment and will assign an appropriate follow-up review date to ensure that the student continues to take action to resolve the financial delinquency.

If at any point in time Enrollment Services determines that internal collection efforts have been unsuccessful, Enrollment Services will refer the student's account to an outside collection agency. Enrollment Services will notify the student and parent/s before any referral to a collection agency.

If the student's account balance is paid in full at any point in the process, Enrollment Services will update the student's account status and release the hold on his/her academic and financial records. The student will be able to register for courses and use university academic and administrative services. Enrollment Services will notify the appropriate university academic and administrative staff members.

**Contact:** Questions concerning this policy or its intent should be directed to: The HUB, x88186.
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University Policies
http://policy.andrew.cmu.edu/univ_policy/

Policy on Cheating and Plagiarism

Students at Carnegie Mellon are engaged in preparation for professional activity of the highest standards. Each profession constrains its members with both ethical responsibilities and disciplinary limits. To assure the validity of the learning experience a university establishes clear standards for student work.

In any presentation, creative, artistic, or research, it is the ethical responsibility of each student to identify the conceptual sources of the work submitted. Failure to do so is dishonest and is the basis for a charge of cheating or plagiarism, which is subject to disciplinary action.

Cheating includes but is not necessarily limited to:
1. Plagiarism, explained below.
2. Submission of work that is not the student’s own for papers, assignments or exams.
3. Submission or use of falsified data.
4. Theft of or unauthorized access to an exam.
5. Use of an alternate, stand-in or proxy during an examination.
6. Use of unauthorized material including textbooks, notes or computer programs in the preparation of an assignment or during an examination.
7. Supplying or communicating in any unauthorized information to another student for the preparation of an assignment or during an examination.
8. Collaboration in the preparation of an assignment. Unless specifically permitted or required by the instructor, collaboration will usually be viewed by the university as cheating. Each student, therefore, is responsible for understanding the policies of the department offering any course as they refer to the amount of help and collaboration permitted in preparation of assignments.
9. Submission of the same work for credit in two courses without obtaining the permission of the instructors beforehand.

Plagiarism includes, but is not limited to, failure to indicate the source with quotation marks or footnotes where appropriate if any of the following are reproduced in the work submitted by a student:
1. A phrase, written or musical.
2. A graphic element.
3. A proof.
4. Specific language.
5. An idea derived from the work, published or unpublished, of another person.

Computing and Information Resources Code of Ethics

The ethical principles which apply to everyday community life also apply to computing. Every member of Carnegie Mellon has two basic rights: privacy and a fair share of resources. It is unethical for any other person to violate these rights.

Privacy
- On shared computer systems every user is assigned an ID. Nobody else should use an ID without explicit permission from the owner.
- All files belong to somebody. They should be assumed to be private and confidential unless the owner has explicitly made them available to others.
- Messages sent to other users should always identify the sender.
- Network traffic should be considered private.
- Obscenities should not be sent by computer.
- Records relating to the use of computing and information resources are confidential.

Resources
- Nobody should deliberately attempt to degrade or disrupt system performance or to interfere with the work of others.
- Loopholes in computer systems or knowledge of a special password should not be used to alter computer systems, obtain extra resources, or take resources from another person.
- Computing equipment owned by departments or individuals should be used only with the owner’s permission.
- University resources are provided for university purposes. Any use of computing for commercial purposes or personal financial gain must be authorized in advance. Many of the agreements that the university has specifically forbid this activity.
- Computing and information resources are community resources. Theft, mutilation, and abuse of these resources violate the nature and spirit of community and intellectual inquiry.

System Administration
- On rare occasions, computing staff may access others’ files, but only when strictly necessary for the maintenance of a system.
- If a loophole is found in the security of any computer system, it should be reported to the system administrator and not used for personal gain or to disrupt the work of others.
- The distribution of programs and databases is controlled by the laws of copyright, licensing agreements, and trade secret laws. These must be observed.

This code of ethics lays down general guidelines for the use of computing and information resources. Failure to observe the code may lead to disciplinary action. Offenses that involve academic dishonesty will be considered particularly serious.

Policies on Examinations

Preamble

The Faculty Senate adopted the following policies on the administration of examinations for the undergraduate courses (defined as courses that are numbered 6xx or below). These policies represent an understanding between faculty and student concerning an important but often stressful period, especially at the conclusion of each academic semester and at mid-semester. There should be no expectation that the following points will cover every conceivable situation. The student should anticipate the demands of the exam schedule, plan accordingly and early, and be prepared. The faculty should recognize that the student is encumbered with many tightly orchestrated and intensive obligations during this period over which he or she has no control: expectations should be reasonably consistent with the number of course units and, of course, should be made known to the student well in advance of the final examination period, preferably as part of the course syllabus.

In order to help students plan their time and study optimally for examinations, this document lays out in some detail the policies regarding final and in-term examinations. Instructors are requested to provide notification of the major in-term examinations in the course syllabus. The final examination date is posted early in the semester. It is the responsibility of the student to give his or her instructor sufficient notice and to work with the instructor to reschedule examinations if this is needed.

Definitions
- Final examination period. The university’s official final examination period begins on the Monday immediately following the last day of classes and continues through the last day of scheduled final examinations, with the exception of reading day(s).
• **Scheduled final examinations.** Scheduled final examinations are those scheduled by Enrollment Services.

• **Self-scheduled examinations.** An instructor may choose not to fix a schedule for the final examination, but instead allow each student to choose the examination time; such exams are called self-scheduled examinations.

• **Final examinations.** Final examinations can either be comprehensive, covering all course materials, or noncomprehensive, covering only a part of the course.

• **In-term examinations.** Major examinations during the semester are referred to here as in-term examinations.

## I. In-Term Examinations

1. All in-term examinations should be given during the regularly scheduled class time. However, if the exam requires additional time to complete, then examinations may be administered outside of regularly scheduled class time.

2. No examinations given outside of class time (excluding make ups and self-scheduled examinations) shall be administered on a Friday after 4:30 pm, or at any time Saturday or Sunday.

3. The instructor administering an exam (or another required class event) that falls outside class time must make any and all reasonable accommodations to provide an alternative time to students who have conflicts with the proposed time period, including those conflicts due to activities, meetings, other classes, etc. (provided that the instructor is notified of such conflict in a timely manner).

4. No student shall be required to take more than two full-period in-class or out-of-class examinations on the same day. It is the responsibility of the student to notify the instructor in a timely manner of his/her circumstance so that appropriate accommodations can be made.

## II. Final Examinations

1. All scheduled final examinations are held at the end of the semester during the university’s official final examination period. Comprehensive final examinations are not required for each course, but are given at the option of the department or instructor. The reading day and weekend preceding the examination days shall never be used for examination purposes of any kind, unless a student opts to take a self-scheduled examination during this time. Non-comprehensive final examinations or final projects (but not both) are allowed during this final examination period only in courses that do not give a final comprehensive examination.

2. Instructors are expected to return all work assigned no later than the last regular day of classes in courses for which there is a final examination. In cases when this is not possible, an answer key, solution sets or equivalent feedback should be provided unless the final examination will not cover material in work that has not been returned.

3. No other coursework, including laboratory or studio work, will be due during the final examination period unless it is assigned in advance and in lieu of the course’s final examination. Regardless of whether there is a final examination in the course, no classes other than review sessions shall be held during the final examination period. Review sessions should be scheduled for optimal attendance, and a serious effort should be made to accommodate students who cannot attend. In appreciation of the time required to prepare for final examinations, no other examinations, portfolio reviews, critiques or juries shall be scheduled for the last class day of a course with a final examination.

4. Instructors shall never exert or submit to pressures to move an examination so that people can leave earlier nor pressure students to take an examination on a reading day or weekend preceding examinations.

5. No student is required to take more than two scheduled examinations that start within a 24-hour period. A student who has more than two examinations scheduled within a 24-hour period or has two examinations scheduled at the same time should first contact the instructors of the courses for assistance in resolving conflicts. If the problem cannot be resolved by that means, the student should contact the associate dean of his or her home college.

6. Take-home final examinations shall be given for any 24-hour period of the student’s choosing during the final examination period.

7. Students are expected to present themselves at the place assigned at the start of the examination; late arrival will reduce the total time a student has to complete the examination, unless instructor’s course policy indicates otherwise. Instructors reserve the right to require attendance within a specific time period. Students who miss an examination with a reasonable excuse and wish to petition for a make-up final examination should check with the instructor. Instructors are encouraged to include late arrival policy and make-up exam policy in the course syllabus.

8. Any student shall be permitted to review his or her corrected, graded final examination in the presence of an instructor or a teaching assistant. Any controversy arising from this review shall be dealt with in accordance with the university procedure for the appeal of grades and academic actions. A final examination that is not returned to a student will be kept available for a year for review. In the event that the instructor or teaching assistant is not available for the review, the responsibility shall rest with the department head of the instructor offering the course or his or her designee. Since instructors are expected to return all work assigned before the final examinations, they are not responsible for retaining unclaimed coursework.

9. Concerns related to final examination, complaints about violations of the final examination policy or alterations of the final examination schedule should be directed to the department head of the instructor offering the course or to the associate dean of the student’s home college.

**Contact:**
Questions concerning this policy or its content should be directed to the Vice Provost for Education, x8-5865.

## Student Health Insurance Policy

### Reason for Policy
The high cost of health care in the United States presents a potentially serious health and financial risk to students and their accompanying dependents. The absence of adequate insurance coverage can result in temporary or permanent interruption of a student’s education. The university is committed to offering student health insurance that provides access to quality health care and achieves a balance between premium cost and adequate coverage without overburdening students’ financial resources. This balance is best achieved through a mandatory/hard waiver insurance program that mitigates the effect of adverse selection.

### Policy Statement General Requirements
All full-time students are required to carry health insurance and will be assessed a charge for the individual basic mandatory plan offered through the university student health insurance program. The charge will appear on the invoice of the first semester of attendance in the academic cycle. The student is required to take one of the following three actions:

1. **Enroll in the basic plan as charged.**
2. **Upgrade the benefit plan by enrolling in the enhanced student health insurance options during the open enrollment period.**
3. **Apply for a waiver from the mandatory plan.**

### Requirements for Waiver
Application for a waiver from the university student health insurance plan must be made to Student Health Services by the last day of the open enrollment period. Students applying for waiver must provide documentation of continuing coverage verifying that they are enrolled as the dependent, partner/spouse or principal in an employer or government-sponsored insurance plan. Additionally, the plan must meet minimum standards for coverage as set forth below:

- It must offer at least 75% coverage for inpatient and outpatient medical services in the Pittsburgh area.
- It must include mental health benefits.
- The deductible must not exceed $500 per accident or illness.
- It must offer medical benefits of at least $50,000 per accident or illness.
- It must cover pre-existing conditions.
Contact
Questions should be directed to Student Health Services, x8-2157.

Free Speech and Assembly and Controversial Speakers
Free Speech and Assembly Policy
Carnegie Mellon University, a private university chartered under the corporation laws of the Commonwealth of Pennsylvania, encourages freedom of speech, assembly and exchange of ideas. As a university sincerely espousing the philosophy of academic freedom, the university urges and supports its community’s desires and efforts to pursue these rights. All persons may distribute printed material, offer petitions for signature, make speeches and conduct other similar activities outside university buildings.

The only limits on these activities, within the law, are the rights of the members of the university community and the maintenance of the normal functioning of the university. To ensure this, any protest or demonstration must be of an orderly nature so that no acts or credible threats of violence occur and the normal, orderly operation of the university is not impeded; the protest or demonstration shall not infringe upon the rights or privileges of individuals not in sympathy with it. No activities that harm individuals, damage or deface property, block access to university buildings or disrupt classes will be permitted. The enforcement of these restrictions will not depend in any way on any subject matter involved in a protest or demonstration.

If such activity on this campus were to occur that is not responsibly conducted and is therefore disruptive, the university will attempt to deal with the disruption by internal means if at all possible. If such activity becomes destructive of property or threatens life or limb, the university may have to request immediate assistance from law enforcement officials outside the university.

Controversial Speakers
The following statement, abridged from a resolution by the Pittsburgh Council on Higher Education and adopted by the university Board of Trustees, establishes the principle governing the right of the university to invite speakers to address the campus community.

If men and women are to value freedom, they must experience it. If they are to learn to choose wisely, they must know what the choices are; and they must learn in an environment where no idea is unthink-able and where no alternative is withheld from their consideration.

The assumptions of freedom are that men and women will more often than not choose wisely from among the alternatives available to them and that the range of alternatives and their implications can be known fully only if men and women can express their thoughts freely.

When, as they will, speakers from within or from outside the campus challenge the moral, spiritual, economic or political consensus of the community, people are uneasy, disturbed and at times outraged. In times of crisis, this is particularly true. But freedom of thought and freedom of expression cannot be influenced by circumstances. They exist only if they are inviolable. They are not matters of convenience but of necessity. This is a part of the price of freedom.

For their part, colleges and universities must hold vital the students’ right to know. When so-called controversial speakers are invited to the campus by a recognized campus organization, they speak not because they have a right to be heard but because the students have a right to hear. It is the students’ right to hear that the university must defend if it is to serve its high function in society.

Contact
Questions about this policy or its intent should be directed to: Michael Murphy, Dean of Student Affairs, x8-2075.

Student Immunization Policy
Reason for Policy
Vaccine-preventable diseases continue to occur on American campuses and pose a significant threat to the public health of the campus community. Outbreaks not only impose a significant cost to infected individuals in terms of mortality and morbidity but also can be costly to the university by disrupting university activities.

Policy Statement
The goal of the Student Health Services and the university is to provide adequate protection of the campus community against vaccine-preventable diseases by requiring students to be vaccinated against and/or screened for certain highly contagious diseases. This goal can best be achieved through a mandatory prematriculation immunization requirement. The following requirements are consistent with Pennsylvania State Law and with the recommendations of the American College Health Association, the Advisory Committee on Immunization Practices.

Requirements for All Full-Time Students

- All entering full-time students born after 1956 must demonstrate proof of immunity against measles, mumps and rubella by either providing dates of inoculation of two doses of the measles vaccine and at least one dose of mumps and rubella or providing blood titers that demonstrate immunity to these infections or providing documentation from a physician of having had the infection.

Additional Requirements for Students Residing in University Housing

- All students residing in university housing must demonstrate immunity against Hepatitis B by either providing documentation of having initiated or completed the three dose vaccination series.

- The student is expected to complete the series within six months of initiation of the series.

Human Subjects in Research at Carnegie Mellon University

The university is committed to the protection of the rights and welfare of human subjects in research investigations conducted under the jurisdiction of the university. The university believes that review independent of the investigator is necessary to safeguard the rights and welfare of human subjects of research investigations. All research involving human subjects is conducted in accordance with federal regulations, including Title 45 of the Code of Federal Regulations, Part 46 (45 CFR 46). Under federal regulations, human subjects are defined as: living individual(s) about whom an investigator conducting research obtains:

1. data through intervention or interaction with the individual, or

2. identifiable private information.

An Institutional Review Board (IRB) is established under the provost to ensure adequate safeguards. The provost is responsible for the composition of the IRB with respect to: (1) the qualifications of IRB members in terms of educational background and research or other relevant experience, and (2) broad representation of relevant university interests.

This IRB is responsible for reviewing investigational procedures involving human subjects prior to the initiation of the research procedure in reference to (1) the rights and welfare of the individuals involved, (2) the appropriateness of the methods used to obtain informed consent, and (3) the risks and potential benefits of the investigations. The IRB is responsible for determining when additional expertise is required for adequate review and for obtaining that additional expertise. The IRB is further responsible for maintaining records of its review activities and decisions and for ensuring that records of informed consent are developed and kept by investigators where appropriate.

It is the responsibility of investigators who plan to use human subjects in research to obtain written consent from the IRB prior to conducting an investigation involving human subjects. It is the investigator’s further responsibility to take whatever steps are determined necessary for the protection of the subjects, and to meet the reporting requirements established by the IRB.
The policy reflects the following goals:

• The mission of the university remains the generation and dissemination of knowledge.

• Intellectual property will be generated within the university, and there exists an obligation to disseminate it. An interface is needed if better technology transfer is to be achieved, and the university will provide mechanisms for that function.[1]

The policy is based upon the following principles relating faculty, staff and students to the university.

• Intellectual property is created by individuals, or by groups of individuals, who are entitled to choose the course of disclosure; academic freedom of individuals is a higher priority than possible financial rewards.

• There exists a historical tradition allowing authors to retain ownership of intellectual property rights from textbooks and works of art.

• The university is the support of the whole campus community, and is thereby entitled to share in financial rewards.

• There should be incentives for all parties to pursue financial rewards together, consistent with the expressed goals of the policy. The distribution of these rewards should reflect, insofar as possible, the creative contributions of the creator, and the resources contributed by and risks assumed by both the creator and the university in developing intellectual property.

• Since it is frequently difficult to meaningfully assess risks, resources and potential rewards, negotiated agreements are to be encouraged whenever possible.

2. Definitions

Certain terms are used in this document with specific meanings, as defined in this section. These definitions do not necessarily conform to customary usage.

**Intellectual Property** includes any patentable invention, any copyrightable subject matter, or trade secret. It also includes works of art, and inventions or creations that might normally be developed on a proprietary basis.

**University** means Carnegie Mellon.

**Student** means any full-time or part-time graduate or undergraduate student, regardless of whether the student receives financial aid from the university or from outside sources. It is the responsibility of students who are also employees of other outside entities to resolve any conflicts between this policy and provisions of agreements with their employers prior to beginning any undertaking at the university that will involve the development of intellectual property.

**Faculty** means members of the university’s Faculty Organization as defined in the Faculty Handbook, plus instructors and special faculty appointments (even in the first year), and part-time faculty.

**Staff** means any employee of the university other than students and faculty as defined above. If a student is also a part-time university employee, he is considered as staff with regard to intellectual property developed as a result of his employment, and as a student with regard to other intellectual property. A full-time non-faculty employee who is also taking one or more courses is considered to be staff. Visitors to the university who make substantial use of university resources are considered as staff with respect to any intellectual property arising from such use. (The distinction between faculty and staff does not affect intellectual property rights except for representation on the Intellectual Property Adjudication Committee [see Section 5].)

**Creator** means any person or persons who create an item of intellectual property.

**Net proceeds to the university** means all proceeds received by the university on intellectual property that it assigns, sells or licenses, minus any application, litigation, interference, or marketing costs directly attributable to the intellectual property being licensed. Deducted costs shall be reasonable and fair, and shall be properly disclosed; the sources and amounts of compensation shall also be properly disclosed.

**Net proceeds to the creator** means all proceeds received by the creator from intellectual property owned by him that he sells, assigns or licenses, less the costs of application, legal protection, or litigation, interference, travel and other marketing costs directly attributable to the intellectual property being exploited. Such net proceeds do not include compensation legitimately received by the creator for...
consulting services or interest or other return on invested labor or capital. Deducted costs shall be reasonable and fair, and shall be properly disclosed; the sources and amounts of compensation shall also be properly disclosed.

**Substantial use of university facilities** means extensive unreimbursed use of major university laboratory, studio or computational facilities, or human resources. The use of these facilities must be important to the creation of the intellectual property; merely incidental use of a facility does not constitute substantial use, nor does extensive use of a facility commonly available to all faculty or professional staff (such as libraries and offices), nor does extensive use of a specialized facility for routine tasks. Use will be considered “extensive” and facilities will be considered “major” if similar facilities would cost the creator more than $5000 (five thousand dollars) in constant 1984 dollars if purchased or leased in the public market. Creators wishing to directly reimburse the university for the use of its facilities must make arrangements to do so before the level of facilities usage for a particular intellectual property becomes substantial. (This provision is not intended to override any other department or university policy concerning reimbursement for facilities usage.)

In general:

In any given year the equivalent figure for a particular amount of money in constant 1984 dollars will be obtained by multiplying that amount of money by the ratio of the most recent quarterly Disposable Personal Income Deflator divided by the average monthly Disposable Personal Income Deflator for the year 1984.

As used in this policy, the masculine gender includes the feminine gender, singular or plural, wherever appropriate.

### 3. Policy Provisions

This section states the policies concerning ownership of intellectual property created at the university. In order of precedence, ownership of intellectual property shall be as follows:

#### 3-1. Externally Sponsored Work

**Ownership Provisions:** Intellectual property created as a result of work conducted under an agreement between an external sponsor and the university that specifies the ownership of such intellectual property shall be owned as specified in said agreement. If the university declares itself to be a sponsor, but does not declare itself to be the owner of the intellectual property, ownership shall be determined in accordance with 3-6-4 below.

**Procedural Provisions:** It is the responsibility of the Office of Sponsored Research of the university to inform each person whose intellectual property rights are limited by an externally sponsored contract of the intellectual property provisions of that contract in advance of the beginning of work thereon. Such notice is to be in writing and the university may require written acknowledgment of such provisions by any person working on externally sponsored projects. A summary of external sponsorship agreements limiting the intellectual property rights of potential creators will be maintained by the Office of Sponsored Research and will be available to the general university community.

If the university fails to notify a creator, effectively and in advance, of limitations imposed on his intellectual property rights arising from the sponsorship limits the intellectual property rights of potential creators will be maintained by the Office of Sponsored Research and will be available to the general university community.

If the university fails to notify a creator, effectively and in advance, of limitations imposed on his intellectual property rights by internal university sponsorship, the creator is entitled to receive from the university 50% (fifty percent) of the net proceeds to the university resulting from his intellectual property.

#### 3-2. Internally Sponsored Work

**Ownership Provisions:** When the university provides funds or facilities for a particular project to the extent of substantial use, it may also choose to designate itself as sponsor of that work. The university may declare itself the owner of intellectual property resulting from said work. In such cases the university must specify in advance the disposition of any intellectual property rights arising from the project. If the university declares itself to be a sponsor, but does not declare itself the owner of the intellectual property, ownership shall be determined in accordance with 3-6-4 below.

**Procedural Provisions:** It is the responsibility of the Office of Sponsored Research of the university to inform each person whose intellectual property rights are limited by internally sponsored work of the intellectual property ownership rights specified by the university as to that work in advance of the beginning of work thereon. Such notice is to be in writing and the university may require written acknowledgment of such provisions by any person working on internally sponsored projects. A summary of work for which university sponsorship limits the intellectual property rights of potential creators will be maintained by the Office of Sponsored Research and will be available to the general university community.

If the university fails to notify a creator, effectively and in advance, of limitations imposed on his intellectual property rights by internal university sponsorship, the creator is entitled to receive from the university 50% (fifty percent) of the net proceeds to the university resulting from his intellectual property.

#### 3-3. Individual Agreements

**Ownership Provisions:** Intellectual property which is the subject of a specific agreement between the university and the creator(s) thereof shall be owned as provided in said agreement. Such agreements by the university and the faculty are encouraged.

**Procedural Provisions:** Except where limited by external sponsorship agreements, creators and the university may negotiate individual agreements to govern ownership of intellectual property regardless of the applicability of any other provision hereof.

#### 3-4. Intellectual Property Created Within Scope of Employment

**Ownership Provisions:** Intellectual property created by university employees who were employed specifically to produce a particular intellectual property shall be owned by the university if said intellectual property was created within the normal scope of their employment. Faculty are presumed not to be hired to produce a particular intellectual property. On the other hand, computer programs written on the job by staff computer programmers would fall under this provision.

#### 3-5. Public Dedication

**Ownership Provisions:** Except when limited by subparts 3-1, 3-2, 3-3 or 3-4 above, the creator of any intellectual property may choose to place his or her creation in the public domain. In such cases both the creator and the university waive all ownership rights to said property.

**Procedural Provisions:** Creators wishing to place their intellectual property in the public domain are responsible for ascertaining that the right to public dedication of that intellectual property is not limited by any external agreement, university sponsorship arrangement or terms of employment as described in Provisions 3-1, 3-2 or 3-3. The university provost will provide such a determination in writing upon request by the creator. It is also the creator’s responsibility to ensure that disclosure does not include valuable intellectual property owned by others. (This provision does not release the university from its general obligation to notify creators of limitations to intellectual property rights specified in Provisions 3-1 and 3-2.)

To facilitate the actual transfer of knowledge of the intellectual property to the public at large, the creator shall provide the university with a complete description and documentation of the property placed in the public domain, specifically including a copy of the property in the case of printed material, and complete machine-readable source code in the case of software. All such material provided to the university will be placed in the University Library and made available to the public at large. The university will take appropriate action on a regular basis to publicize summary descriptions of intellectual property recently placed in the public domain. The university will also provide any member of the general public copies of such material on a cost-recovery basis.

The provisions of this section do not apply to the normal scholarly or creative publication processes unless the creator intends to waive all proprietary rights to the publication.

#### 3-6. In General

Unless governed by subparts 3-1, 3-2, 3-3, 3-4 or 3-5 above, ownership of intellectual property created at the university shall be determined as follows:

#### 3-6-1. Traditional Rights Retained

**Ownership Provisions:** In keeping with academic traditions at the university, the creator retains all rights to the following types of intellectual property, without limitation: books (including textbooks), educational courseware, articles, non-fiction, novels, poems, musical works, dramatic works including any accompanying music, pantomime and choreographic works, static graphic and sculptural works, motion pictures and other similar audio-visual works, and sound recordings, regardless of the level of use of university facilities. This provision does not include computer software (other than educational courseware) or data bases.
Procedural Provisions: The types of intellectual property listed in the preceding paragraph share the attribute that they display information or visual or auditory appearances which are fully revealed to the purchaser or consumer. Thus, for example, source code listings would also be considered within this category. On the other hand, most computer software and databases do not share this attribute; they are characterized by their capacity to perform tasks. Because of their utilitarian nature, ownership rights with respect thereto are governed by 3-6-3 or 3-6-4. Educational courseware is included in this provision in all cases because of its role in furthering the primary educational mission of the university.

This provision applies regardless of any university sponsorship of the work, so it may be modified only by a specific prior agreement between the creator and the university. The use of university-owned computers and other facilities in the preparation of books and similar works does not alter this provision, though other university policies may limit such use or require reimbursement to the university. Similarly, the use of externally sponsored resources does not alter this provision, unless the creator is effectively notified in advance of such limitations to his rights in accordance with 3-1.

3-6-2. No Substantial Use of University

Facilities Ownership Provisions: The creator owns all intellectual property created with substantial use of university facilities, including intellectual property rights in computer software and data bases.

3-6-3. Substantial Use of University Facilities - No External or Internal Sponsorship

Ownership of intellectual property created with substantial use of university facilities, but not directly arising from externally sponsored work, or from work for which the university has declared itself as sponsor, shall be determined as set forth hereinafter depending on whether the creator or the university develops said property.

3-6-3-1. Development by Creator

Ownership Provisions: The creator originally owns intellectual property created with substantial use of university facilities but no external or internal sponsorship, and retains said ownership by commercial development of said property subject to the following:

(i) the university shall receive 15% (fifteen percent) of the net proceeds to the creator above $25,000 (twenty-five thousand dollars) in constant 1984 dollars from all sources (in the case of patents and copyrights, this provision shall be limited to the life of the patent or copyright), and

(ii) the university shall receive a perpetual, non-exclusive, non-transferrable, royalty free license to use said intellectual property. In the case of software, this license includes access by specified university personnel to the source listings, and the university shall require each person to whom a disclosure is made to execute in advance a binding confidentiality agreement in favor of and enforceable by the creator. If the intellectual property is created solely for a student or students, the creator is exempt from the obligation to pay to the university a fraction of his net proceeds, but not from the provision of this paragraph for a non-exclusive license to the university.

Procedural Provisions: If the creator develops an intellectual property that is covered by this provision, he must make full and fair disclosure to the university of all such sources of compensation relating to that intellectual property.

3-6-3-2. Development by the University

Ownership Provisions: When intellectual property is created with substantial use of university facilities, but not directly arising from sponsored research, the creator will originally retain the rights to the property, provided that he desires to commercially develop the property himself or to make it available to the public. If, however, the creator elects not to commercially develop same or fails to show diligence in pursuing such development, then the ownership rights to that property may be acquired by the university. Intellectual property acquired by the university in this fashion will be treated as in 3-6-3-1 above.

Procedural Provisions: At the time the intellectual property is disclosed to the university's provost as required by Section 4-1, or at any time thereafter, the provost may require that the creator make a decision by 3-120 (one hundred twenty) days of the request or the university automatically waives its rights in favor of the creator.

3-6-4. Substantial Use of University Facilities - External or Internal Sponsorship

Ownership of intellectual property created with substantial use of university facilities and directly arising from work sponsored under an agreement between an external sponsor and the university, or from work for which the university has declared itself a sponsor, but for which neither the external sponsor nor the university have specified the ownership of resulting intellectual property shall be determined as set forth hereinafter depending on whether the creator or the university develops said property.

3-6-4-1. Development by University

Ownership Provisions: The university originally owns intellectual property created with substantial use of university facilities provided by an external agreement or internal university sponsorship and retains said ownership by commercial development of said property, subject to the following: in all cases, the creator shall receive 50% (fifty percent) of the net proceeds to the university.

Procedural Provisions: When an intellectual property is created with substantial use of university resources provided by an external research contract or a specific university sponsorship agreement, and when that contract or agreement either does not specify the disposition of the intellectual property rights arising from that sponsorship, or it permits the university and/or creator to retain or acquire such intellectual property rights, the university will originally retain the rights to such intellectual property.

3-6-4-2. Development by Creator

Ownership Provisions: When intellectual property is created with substantial use of university facilities provided by external or internal sponsorship, the university will originally retain the rights to the property, provided that it desires to commercially develop the property or to make it available to the public. If, however, the university elects not to commercially develop same or fails to show diligence in such development, the ownership rights to that property may be acquired by the creator. Intellectual property acquired by the creator in this fashion will be treated as in 3-6-3-1 above. This assignment of rights to the creator may be prohibited by the terms of an external sponsorship agreement with the university or by an internal university sponsorship declaration, but in such cases the creator must be notified in advance, as in Provisions 3-1 and 3-2.

Procedural Provisions: At the time the intellectual property is disclosed to the university’s provost as required by Section 4-1, or at any time thereafter, the provost may request that the university decide whether it will commercially develop the intellectual property or execute an assignment of the intellectual property rights to the creator. Such a decision by the provost must be made within 120 (one hundred twenty) days of the request or the university automatically waives its rights in favor of the creator, and it must execute an assignment of these rights to the creator.

3-6-5. Consulting Agreements

Ownership Provisions: Work done by individuals as consultants to outside firms is presumed not to involve unreimbursed substantial use of university facilities, and the rights to intellectual property created under consulting agreements are retained by the outside firms or the individual as specified by the terms of the consulting agreement and the terms of Provision 3-6-2 above.

Procedural Provisions: Under university policy consulting work must not make substantial unreimbursed use of university facilities except by explicit prior agreement. Any member of the university community who is engaged in consulting work or in business is responsible for ensuring that provisions in his agreements are not in conflict with this policy of the university or with the university’s commitments. The university’s Innovation Transfer Office will, upon request, provide assistance in this respect. The university’s rights and the individual’s obligations to the university are in no way abrogated or limited by the terms of such agreements. Each creator of intellectual property should make his obligations to the university clear to those with whom he makes such agreements and should ensure that they are provided with a current statement of the university’s intellectual property policy. Appropriate sample contract wording to cover various possible external consulting arrangements shall be available from the university provost.
4. General Procedures 4-1.

The creator of any intellectual property that is or might be owned by the university under this policy is required to make reasonably prompt written disclosure to the university’s provost, and to execute any document deemed necessary to perfect legal rights in the university and enable the university to file patent applications and applications for copyright registration when appropriate. This disclosure to the provost should be made at the time when legal protection for the creation is contemplated, and it must be made before the intellectual property is sold, used for profit, or disclosed to the public. Whenever legal protection for intellectual property is anticipated all persons engaged in such creative activity are encouraged to keep regular notebooks and records.

4-2.

Whenever the university undertakes commercial development it shall do so, if possible, in a fashion that provides for the widest possible dissemination, avoiding suppression of inventions from which the public might otherwise benefit, providing for non-exclusive licensing at reasonable royalties, and giving consideration to more favorable or royalty-free licensing to non-profit charitable institutions, minority businesses or enterprises in developing countries.

4-3.

The university’s share of any proceeds under this policy will be used to reimburse the university for its expenses for commercial development of intellectual property. Any additional return to the university will be used to further the academic purposes of all the disciplines of the entire university.

5. Resolution of Disputes

This policy constitutes an understanding which is binding on the university and on the faculty, staff, and students upon whom it is effective according to the terms of Section 6 below, as a condition for participating in research programs at the university or for the use of university funds or facilities.

Any question of interpretation or claim arising out of or relating to this policy, or dispute as to ownership rights of intellectual property under this policy, will be settled by the following procedure:

1. The issue must first be submitted to the university’s Intellectual Property Adjudication Committee in the form of a letter setting forth the grievance or issue to be resolved. The committee will review the matter and then advise the parties of their decision within 60 days of submission of the letter.

2. If any of the parties to the dispute is not satisfied with the committee’s decision, the party may seek binding arbitration in Pittsburgh, Pennsylvania and in accordance with the Rules of the American Arbitration Association then in effect. Judgment upon the award rendered by the arbitrator(s) may be entered in any court having jurisdiction thereof. The arbitrator(s) will give some weight to the decision of the Intellectual Property Adjudication Committee in reaching a decision. The losing party of the arbitration hearing will pay all costs of the arbitration unless the arbitrator(s) specifies otherwise.

The Intellectual Property Adjudication Committee will consist of a chair who is a member of the tenured faculty, four other members of the faculty, and four other members representing, respectively, the university administration, the technical staff, and the graduate and undergraduate student bodies. Initially, half of the members of the committee (including the chair) will be appointed for two-year terms of office, and the remaining half will be appointed for a one-year term. After one year new members of the committee will be appointed for two-year terms of office. The chair will be appointed by the chair of the Faculty Senate, with the advice and consent of the Faculty Senate Executive Committee, and the remaining eight members of the committee will be appointed by the president of the university or his designee. At all times at least one of the faculty members will have had significant practical experience with intellectual property development and exploitation. The faculty members appointed by the president of the university will be selected from a list of nominees prepared by the Faculty Senate or its designated committee and nominees with experience in intellectual property development will be identified as such by the Faculty Senate. The staff representative will be selected from a list of nominees prepared by Staff Council, and the administration representative will be named directly by the president of the university or his designee. The graduate student representative will be selected from a list of nominees prepared by the Graduate Student Organization. The undergraduate representative will be chosen from a list of nominees prepared by the Student Senate. The committee will use the guidelines set forth in this policy to decide upon a fair resolution of any dispute.

If possible, the committee will also provide on request informal advisory opinions to creators and the university indicating how it is likely to interpret the provisions of this policy as it applies to special cases.

6. Effective Date of Policy

This policy will become effective August 27, 1985. Once effective this policy will be binding on new faculty, administration, and staff when hired, and on graduate and undergraduate students when admitted. Current faculty and staff will also become bound by this policy when they sign new employment contracts as the result of the renewal of limited-term appointments or promotion. Other university personnel, including tenured faculty, and current staff and students may choose to become bound by this policy for future and pending intellectual property by voluntary written consent. Unless the creator and the university agree to a different arrangement, intellectual property that is already partially developed at the time this policy becomes effective will be treated according to the provisions of the patent policy by which the university creator is currently bound. Similarly, members of the university working under contracts signed before the effective date of this policy who do not choose to accept this policy will remain bound by the patent policies that already apply to them. With respect to intellectual property developed during the course of employment at the university this policy shall continue to be binding on any person whose relationship with the university becomes terminated. The university should take all administrative steps necessary to ensure that employees and students sign, upon initial employment, registration or at other appropriate times, forms that indicate their acceptance of this policy.

7. Amendments of the Policy

Amendments of this policy may be proposed by the Faculty Senate, Staff Council or university administration. Proposed amendments must be approved by a two-thirds majority of votes in the Faculty Senate and subsequently approved by a simple majority of votes cast in a referendum administered by the Faculty Senate that is open to all members of the faculty as defined by this policy and to the exempt staff. Provided that this majority constitutes at least twenty-five percent of those eligible to vote. This referendum must be preceded by an opportunity for public discussion open to all interested faculty, administration, staff and students. Amendments that are supported by the faculty and staff must then be approved by the president of the university and adopted by the university trustees. Once adopted, amendments will become binding on new faculty, administration, and staff when hired, on existing faculty and staff when they sign new employment contracts, and on graduate and undergraduate students when admitted. Other university personnel, including tenured faculty, and current staff and students may choose to become bound by this policy for future and pending intellectual property by voluntary written consent. Intellectual property that is already developed or under development at the time that an amendment to the policy is ratified will not be bound by the terms of the amendment without the voluntary written consent of both the creator and the university.

Footnote:

1. This document presumes the existence of a university office to facilitate technology transfer. Such an office would serve as a clearinghouse for contacts with outside partners, would perform patent and copyright tasks, and would develop an effective marketing capability.

Policy on Student Privacy Rights

Policy Statement

Under the Family Educational Rights and Privacy Act (FERPA), you have the right to:

- Inspect and review your education records;
- Request an amendment to your education records if you believe they are inaccurate or misleading;
- Request a hearing if your request for an amendment is not resolved to your satisfaction;
- Consent to disclosure of personally identifiable information from your education records, except to the extent that FERPA authorizes disclosure without your consent;
• File a complaint with the U.S. Department of Education Family Policy Compliance Office if you believe your rights under FERPA have been violated.

1. Inspection

What are education records?
Education records are records maintained by the university that are directly related to students. These include biographic and demographic data, application materials, course schedules, grades and work-study records. The term does not include:

• Information contained in the private files of instructors and administrators, used only as a personal memory aid and not accessible or revealed to any other person except a temporary substitute for the maker of the record;
• Campus Police records;
• Employment records other than work-study records;
• Medical and psychological records used solely for treatment purposes;
• Records that only contain information about individuals after they have left the university;
• Any other records that do not meet the above definition of education records.

How do I inspect my education records?
• Complete an Education Inspection and Review Request Form (available online as a PDF document or from The HUB, 12C Warner Hall) and return it to The HUB.

• The custodian of the education record you wish to inspect will contact you to arrange a mutually convenient time for inspection, not more than 45 days after your request. The custodian or designee will be present during your inspection.

• You will not be permitted to review financial information, including your parents’ financial information; or confidential letters of recommendation, if you have waived your right to inspect such letters.

• You can get copies of your education records from the office where they are kept for 25 cents per page, prepaid.

2. Amendment

How do I amend my educational records?
• Send a written, signed request for amendment to the Vice President for Enrollment, Carnegie Mellon University, 610 Warner Hall, Pittsburgh, PA 15213. Your request should specify the record you want to have amended and the reason for amendment.

• The university will reply to you no later than 45 days after your request. If the university does not agree to amend the record, you have a right to a hearing on the issue.

3. Hearing

How do I request a hearing?
• Send a written, signed request for a hearing to the Vice President for Enrollment, Carnegie Mellon University, 610 Warner Hall, Pittsburgh, PA 15213. The university will schedule a hearing no later than 45 days after your request.

How will the hearing be conducted?
• A university officer appointed by the Vice President for Enrollment, who is not affiliated with your enrolled college will conduct the hearing.

• You can bring others, including an attorney, to the hearing to assist or represent you. If your attorney will be present, you must notify the university ten days in advance of the hearing so that the university can arrange to have an attorney present too, if desired.

• The university will inform you of its decision, in writing, including a summary of the evidence presented and the reasons for its decision, no later than 45 days after the hearing.

• If the university decides not to amend the record, you have a right to add a statement to the record that explains your side of the story.

4. Disclosure

Carnegie Mellon generally will not disclose personally identifiable information from your education records without your consent except for directory information and other exceptions specified by law.

What is directory information?
Directory information is personally identifiable information of a general nature that may be disclosed without your consent, unless you specifically request the university not to do so. It is used for purposes like compiling campus directories.

• if you do not want your directory information to be disclosed, you must notify The HUB, 12C Warner Hall, in writing within the first 15 days of the semester.

Notifying The HUB covers only the disclosure of centralized records. Members of individual organizations such as fraternities, sororities, athletics, etc. must also notify those organizations to restrict the disclosure of directory information.

Carnegie Mellon has defined directory information as the following:

• your full name,
• local/campus address,
• local/campus telephone number,
• email user id and address,

(User ids cannot be completely suppressed from our electronic systems. While it may be possible to suppress the association of an individual’s name with their user id, doing so may adversely impact the delivery of electronic mail or other electronic services.)

• major, department, college,
• class status (freshman, sophomore, junior, senior, undergraduate or graduate)
• dates of attendance (semester begin and end dates),
• enrollment status (full, half, or part time)
• date(s) of graduation,
• degrees awarded,
• sorority or fraternity affiliation.

For students participating in intercollegiate athletics, directory information also includes:

• height, weight,
• sport of participation.

What are the other exceptions?
Under FERPA, Carnegie Mellon may release personally identifiable information from your education records without your prior consent to:

• school officials with legitimate educational interests ("School officials" are Carnegie Mellon employees in administrative, supervisory, academic or support staff positions; Carnegie Mellon trustees; individuals and companies with whom the university has contracted, such as attorneys, auditors, or collection agencies; and individuals assisting school officials in performing their tasks. School officials have a "legitimate educational interest" if they need to review an education record in order to fulfill their professional responsibilities.);

• certain federal officials in connection with federal program requirements;

• organizations involved in awarding financial aid;

• state and local officials who are legally entitled to the information;
testing agencies such as the Educational Testing Service, for the purpose of developing, validating, researching and administering tests;

- accrediting agencies, in connection with their accrediting functions;

- parents of dependent students (as defined in section 152 of the Internal Revenue Service Code);

- comply with a judicial order or subpoena (after making a reasonable effort to notify the student in advance of compliance so that the student can take protective action, except in cases where the university is legally required not to disclose the existence of the subpoena);

- appropriate parties in a health or safety emergency, if necessary to protect the health or safety of the student or other individuals;

- officials of another school in which the student seeks or intends to enroll;

- victims of violent crimes or non-forcible sexual offenses (the results of final student disciplinary proceedings);

- parents or legal guardians of students under 21 years of age (information regarding violations of university drug and alcohol policies);

- courts (records relevant to legal actions initiated by students, parents or the university).

5. Complaints

If you believe the university has not complied with FERPA, you can file a complaint with the:

Family Policy Compliance Office, Department of Education, 400 Maryland Avenue, S.W. Washington, DC 20202-4605

Policy on Restricted Research

Universities have two primary purposes: to create knowledge and to disseminate knowledge. Carnegie Mellon University recognizes the importance of open intellectual communication within a research group, within the university, and within the larger community outside. Ideally, all units of the university would disseminate the results of research as quickly and as widely as possible. Some members or units of the university, however, desire to do research that may be difficult or impossible without restrictions or without access to classified or proprietary materials.

There exists, therefore, a tension between the university's goal of disseminating knowledge freely and the desire of some of its members to conduct restricted research on important problems. The university intends to guarantee the academic freedom of all faculty members to do research in their own manner on topics of their own choosing, provided that such research is consistent with the overall purposes of the university.

This policy seeks to resolve the tension between the desire to participate in restricted research and the desire to maintain the open atmosphere of the university by confining restricted research to semi-autonomous units, which are not associated with any academic departments. It thereby establishes the principle that restricted research is inappropriate at Carnegie Mellon University except in the semi-autonomous units.

This policy does not attempt to anticipate all possible concerns about restricted research. In some cases, decisions will need to be made about particular research projects to which the application of particular policy guidelines are not clear. In choosing to accept or decline such projects, the university will weigh the potential of a project for generating and disseminating new knowledge for the benefit of society, against the project's potential for adversely affecting the climate for research conducted in a free and open environment. While this policy sets no explicit limits on the extent of classified research permitted in the semi-autonomous units, it is not the intent of the policy to encourage any unit of the university to engage in classified research as a primary ongoing activity. Indeed, it is expected that classified projects will never represent more than a small fraction of the total research effort in any unit.

Definitions

Research: all projects and investigations involving the creation of new knowledge of a theoretical or practical nature. The term "research" as used here encompasses both "research" and "development" as they are commonly defined.

Classified research: research, the free dissemination of the results of which is deemed to jeopardize national security. The federal government controls access to the environment in which such research is performed, restricts discussions about the work in progress to individuals with clearance and a "need to know," and limits publication of research, results or access to data needed to verify results, for a specified period of time.

Proprietary research: research that results in intellectual property that is owned by entities other than Carnegie Mellon University. Such entities may wish to market products derived from inventions or ideas that are developed at the university. They might, therefore, desire to fund projects which restrict access to data and to discussions about work in progress to individuals with a "need to know," and to seek, for a specified period of time, a delay in publication of research results or data needed to verify results. Such entities may also provide access to proprietary material, which researchers must agree not to include in publications.

Publication: oral or written dissemination.

Restricted research: includes all classified research, and any proprietary or other research that requires more than a six month delay in publication of the research results.

Semi-autonomous units: units of the university specifically designated by the president, after consultation with the URC and the Faculty Senate, currently the Mellon Institute and the Software Engineering Institute.

Non-autonomous units: all university entities other than semi-autonomous units.

Restricted Research In Non-Autonomous Units

It is the policy of Carnegie Mellon that restricted research is inappropriate and, therefore, not permitted within its non-autonomous units.

It is also the policy of Carnegie Mellon not to permit involvement of students in projects which carry restrictions that may impede their progress toward a degree. Therefore, students should not be involved in contracts that require the delay of a student's publication of research results when such results are intended for use in obtaining academic credit, except that a sponsor may require a delay of thirty days for review of publications for removal of proprietary information that was provided by the sponsor for the conduct of the research.

Proprietary research is allowed within non-autonomous units provided it is subject to limitations (excluding students' publications as noted above) no more stringent than the following:

- A sponsor may request a delay of up to six months in publication so that steps may be taken to secure intellectual property rights to inventions or ideas developed under the contract.

- A sponsor may require a delay of thirty days for review of publications for removal of proprietary information which was provided for the conduct of the research.

Considerations for faculty/researchers:

The university recognizes that problems arise in both restricted research and research that is not itself restricted but that involves access to classified or proprietary information or materials (hereinafter, restricted materials). Researchers may also have access to restricted materials when serving as consultants. Access to restricted materials gives rise to concerns about limitations on researchers' freedom to communicate. In such instances, researchers must exercise considerable judgment to conduct their research in an open environment while protecting the restricted materials to which they have access.

Researchers must also be aware that the university will judge their performance as researchers through their publications or through other scholarly products that arise from their research. Research that is restricted in dissemination, or not available for public review, cannot be considered in promotion or reappointment decisions or in evaluations of academic performance of any kind.
Considerations for faculty/researchers:

There are important concerns about the involvement of students in restricted research. It is necessary for students to publish their work in order to obtain degrees, course credit and professional recognition. Students rely on a large degree on their faculty advisor's judgment for guidance and advice. Research that is restricted in dissemination, or not available for public review, cannot be used for academic credit. Thus, before working on such research, a student must be notified in writing that work on this research may not be used for academic credit.

**Restricted Research in Semi-Autonomous Units**

The semi-autonomous units associated with Carnegie Mellon may conduct restricted research.

Faculty members may conduct restricted research in or in cooperation with semi-autonomous units only on a consulting basis or by means of a formal, internal leave of absence from their non-autonomous units. Work that is restricted in any way may not be used for academic evaluations until it is released for publication, and then only with respect to future academic actions.

Students may occasionally be employed by the semi-autonomous units, provided that such employment does not interfere substantially with progress toward a degree. However, they must be made aware that work that is restricted cannot be used for academic credit. Work that was restricted and is later released for dissemination and review can be applied toward future academic credit. Students should be discouraged from working on restricted research in which dissemination may be delayed indefinitely.

**Guidelines for all Units**

Work by students on restricted research projects shall not be made a condition for admission or financial aid.

The principal investigator is responsible for informing all members of a project (faculty, staff and students) of any restrictions imposed on the dissemination of information related to the research. This must be done prior to the start of the project or prior to an individual joining an existing project.

Restrictions on access to university facilities due to the conduct of restricted research must be kept to a minimum. Access to and movement through the facilities in which restricted research is conducted must be consistent with standard university procedures.

The Provost's Office is responsible for obtaining signed documents from principal investigators on restricted research projects attesting that they are aware of all restrictions imposed on the research and that they have informed all participants of these restrictions.

The Office of Sponsored Research shall review all proposals and contracts prior to approval for conformity with these guidelines. Any that do not meet these guidelines will be referred to the University Research Council (URC) for review and recommendation of appropriate action to the provost.

To maintain a balance with the university's goals of broad dissemination of knowledge, the URC will conduct an annual review of all restricted research being conducted at the university. This review will be made based on a listing of all contracts that involve restricted research. This listing shall include the title and sponsor(s) of the research, name(s) of principal investigator(s), and the amount of funding of each contract.

The university community will be informed annually, through the URC's written report to the Faculty Senate and Student Senate, of the nature and overall impact of restricted research at Carnegie Mellon.

Existing sponsored research projects shall be allowed to continue under the terms of their present contract. However, renewal contracts must conform with this policy.

**Statement of Assurance**

Carnegie Mellon University does not discriminate and Carnegie Mellon University is required not to discriminate in admission, employment, or administration of its programs or activities on the basis of religion, creed, ancestry, belief, age, veteran status, sexual orientation or in violation of federal, state, or local laws or executive orders. However, in the judgment of the Carnegie Mellon Human Relations Commission, the Department of Defense policy of “Don’t ask, don’t tell, don’t pursue’ excludes openly gay, lesbian and bisexual students from receiving ROTC scholarships or serving in the military. Nevertheless, all ROTC classes at Carnegie Mellon University are available to all students.

Inquiries concerning application of these statements should be directed to the provost, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone (412) 268-6684 or the vice president for enrollment, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone (412) 268-2056.

Carnegie Mellon University publishes an annual campus security report describing the university's security, alcohol and drug, and sexual assault policies and containing statistics about the number and type of crimes committed on the campus during the preceding three years. You can obtain a copy by contacting the Carnegie Mellon Police Department at 412-268-2323. The security report is also available online.

**Student Activities Fee**

By action of the Board of Trustees, a required Student Activities Fee in addition to tuition is charged to all undergraduate students and graduate students who enroll for 19 units or more. Student Government is responsible for administering the fee and for using it only for the support of projects under the following guidelines:

1. Activities and facilities which can be described as meeting the reasonably predictable social, cultural, recreational, or welfare needs of college students.
2. Publications which can reasonably be presumed to serve the needs of the student community for communication, expressions of opinion, and the conduct of their business.
3. Such enterprises of an entrepreneurial nature undertaken by the student body as can reasonably be expected to serve as an instrument for meeting the needs described above.

All functions and services provided by the fees described above must be in accordance with Carnegie Mellon’s policy of non-discrimination. In addition, no use of such fees may be intended to violate or circumvent the policies of the university or the laws of the land.

Final responsibility for establishing the amount of any required fee rests with the Board of Trustees, which will consider changes only upon requests of the Student Government and the officers of the university.

Note: Historically, the Student Government has dedicated a specific portion of graduate students’ activities fees to the Graduate Student Assembly to be used at their discretion.

**Policy on Temporary Emergency Closing of the University**

**Policy Statement**

Carnegie Mellon University has an important commitment to students, parents, sponsors, benefactors and the community. Accordingly, the university will make every attempt to operate normally during severe weather or other emergencies. This includes holding classes, conducting research programs, and operating facilities and services.

The university will attempt to operate normally unless such operation represents a clear danger to students, staff or faculty.

There may be occasions when the university community is served best by suspending normal operations. In that event, only the president (or the president’s designated representative) has the authority to close the university and to specify those persons or group of persons who are free to leave or refrain from coming to campus.

Staff members who provide primary services, including certain members of Physical Plant, Dining Services and Security, may be asked to work.
Standard Operations

Unless the president announces that the university is closed, everyone is expected to be at work as usual. When the university is in session, faculty members are expected to meet their scheduled classes and other obligations. If a faculty member is unable to meet a scheduled class, he or she should notify the department office and arrange either for a qualified substitute or for a future make-up session.

If the university is open but a staff member is unable to come to work because of severe weather or other emergency, he or she should notify the supervisor as soon as possible. Staff members will be expected to make up lost time or use Paid Time Off (PTO), consistent with regular operating protocols.

Announcement of Closing

As soon as the president or his/her designee determines that the university must be closed, University Relations will alert local radio and television stations. Also, announcements of closings will be posted on the Carnegie Mellon electronic bboard official.cmu-news.

Contact

Questions concerning this policy or its intent should be directed to the Office of the President, extension x8-2200.

Student Leave Policy

www.cmu.edu/policies/documents/STLeave.html

Students must sometimes interrupt their studies for a variety of reasons (financial, academic or personal). Students choosing to take a leave of absence should first contact their department advisor to discuss their plans while on leave and to work out any conditions that may be necessary for a smooth return to Carnegie Mellon.

A student may leave Carnegie Mellon by either withdrawing from the university (leaving the university with no intention of returning) or by taking a leave of absence (leaving the university temporarily, with the firm and stated intention of returning).

A Leave of Absence Form must be completed by all students requesting a leave. A Withdrawal Form must be filled out by all students who are withdrawing. Notifying instructors and no longer attending classes does not complete the process. Forms are available in the academic departments, deans’ offices and on The HUB WebSite. Not completing the form results in tuition being charged to the midpoint of the semester or the last date the student attended an academically-related activity such as an exam, tutorial or study group, or the last day a student turned in a class assignment.

Students are required to fill out all information on the form, including all comment sections relating to reasons for their leave. After completing the form, students must take it to their home department and dean’s office for appropriate signatures. The process of taking a leave will not be complete until all necessary signatures are on the leave form. Under certain circumstances, students may also need the Dean of Student Affairs to sign the appropriate form. Nonresident alien students must consult the Office of International Education for information on possible visa implications prior to going on leave.

Students on leave are not permitted to live in university housing or attend classes or maintain employment as students at Carnegie Mellon while their leaves in effect.

Doctoral candidates under ABD status (All But Dissertation) who wish to take a leave of absence should refer to the ABD and In Absentia policy.

Leaves during the academic semester will take effect as of the date signed by the student’s dean. After the Leave of Absence or Withdrawal Form is received by Enrollment Services, it will be reviewed for appropriate tuition refunds (see Enrollment Services: Tuition and Fees Adjustment Policy) and grade implications. The recording of student courses and grades for taking a leave in a semester follows the deadlines for semester or mini courses, as follows:

- Permanent grades assigned by the instructor will be recorded, after the last day of classes.

Contact: Questions concerning this policy or its intent should be directed to: The HUB, x8-8186.

Student Return Policy

www.cmu.edu/policies/documents/STLeave.html

Policy Statement

Students on leave wishing to return to Carnegie Mellon to resume their degree studies may do so under several conditions. In order to be considered for return from leave, a student must first obtain a Return from a Leave of Absence form from The HUB or their academic department. This application requires information from the student regarding the intended semester of return, current address information and information about their leave. This application must be submitted to their home department at least one month prior to the beginning of the semester.

Undergraduates may return within their same academic department within two years. After two years, students returning in the same academic department are subject to space constraints and academic performance review. Graduate students must negotiate their return with their home department and must follow their department policy.

The Return from Leave of Absence form requires approval of the student’s academic department and Dean. If a student’s department chooses to deny the student’s Return from Leave of Absence form, the student may appeal to their Dean. Any constraints governing the student’s eligibility to return will be specified directly on the application by the academic department and/or Dean’s office or the Office of Student Affairs.

Students who have taken courses elsewhere must submit an official transcript and course descriptions with their Return from Leave of Absence form. Transfer credit approval is determined by the academic department based on course level, performance and appropriateness to the student’s curriculum requirements. Credit transfer is subject to college-specific policy. Failure to submit the necessary documents at the time of return will result in denial of transfer credit.

The process of returning is not completed until all necessary signatures on the Return form are obtained by the student and until all outstanding bills are paid. Enrollment Services will then notify the appropriate university offices of the student’s return.

Contact: Questions concerning this policy or its intent should be directed to: The HUB, x8-8186.

Tuition Adjustment Policy

www.cmu.edu/policies/documents/TuitionRefund.html

Application

This policy applies to withdrawals and leaves of absence by all students (graduate, undergraduate, non-degree) for all semesters (Fall, Spring, Summer 1, Summer 2, Summer All). Official Date of Withdrawal/Leave of Absence

For students who notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is the earliest of:

- the date the student began the withdrawal or leave of absence process;
- the date the student notified his or her home department;
- the date the student notified the associate dean of his or her college; or
- the date the student notified the dean of students.

For students who do not notify the university of their intent to withdraw or take a leave of absence, the official date of withdrawal or leave of absence is:

- W (withdrawal) grades will be assigned to all classes (for undergraduate students, and to graduate students only in TSB or the Mellon College of Science.), after the university deadline to drop classes but before the last day of classes:
• the midpoint of the semester;
• the last date the student attended an academically-related activity such as an exam, tutorial or study group, or the last day a student turned in a class assignment.

**Tuition Adjustment**

Students who withdraw or take a leave of absence before completing 60% of the semester will be charged tuition based on the number of days completed within the semester. This includes calendar days, class and non-class days, from the first day of classes to the last day of final exams. Breaks which last five days or longer, including the preceding and subsequent weekends, are not counted. Thanksgiving and Spring Break are not counted. There is no tuition adjustment after 60% of the semester is completed. No tuition is charged to a student who is administratively withdrawn. See The HUB website for the complete tuition assessment schedule for the current semester.

**Housing, Meal Plan & Fee Adjustments**

Housing charges are adjusted daily, beginning on check-in day and ending on the last day of final exams for the semester. Holiday breaks are included. The Winter Break period is not included.

Meal plan charges are adjusted weekly. DineXtra and CampusXpress are assessed based upon actual use.

There is no adjustment of the Port Authority Fee, the Technology Fee or Student Activity fee.

**Financial Aid Adjustment**

Federal and institutional financial aid is adjusted on the same basis as tuition. A student earns 100% of his or her federal or institutional financial aid when 60% of the semester is completed.

State grants and non-federal outside scholarships are adjusted based upon the withdrawal policy of the agency awarding the funds.

**Contact:** Questions concerning this policy or its intent should be directed to: The HUB, x88186.

**Student Accounts Receivable Collection Policy and Procedures**

**Policy Statement**

A student is responsible for the payment of charges incurred at the university by the stated payment deadline. The purpose of this policy statement is to detail the specific process and action steps to be used to resolve any outstanding student account balance.

**Procedural Overview**

Enrollment Services will take progressive action to resolve any student account balance greater than $500. These actions include: communication, first with the student and second with the parent/s, regarding the account status, academic and administrative consequences of nonpayment, and the provision of information and realistic payment options to resolve the delinquent balance; communication with appropriate university service administrators and the associate dean of the student's college concerning the same issues communicated to the student and parent/s.

In situations where the university attempts to resolve the outstanding balance but the student has not made or met satisfactory arrangements for payment, the university will take one or both of the following two actions: (1) financial suspension and/or (2) wage garnishment.

In the case of a financial suspension, the student will be restricted from registering for and enrolling in university courses and programs, and s/he will be prohibited from using university academic and administrative services. These services include, but are not limited to, computing facilities, library services, housing, dining, career center services, degree verification and the release of (official) academic transcripts.

If a student is employed by Carnegie Mellon, the university may garnish the student's wages to recover the amount due to the university. The cashier will notify the student prior to any action, and the amount to be garnished will be tailored to individual circumstances.

**Procedures**

**Currently Enrolled Student/New Balance Due**

Enrollment Services will notify, in writing, any enrolled student who has an account balance greater than $500 for 20 days beyond the stated payment due date. The letter will state that s/he risks administrative action by the university, including possible financial suspension, if the student does not resolve the outstanding balance.

**Graduating student with any balance due**

During the spring semester, Enrollment Services will notify, in writing, any graduating student with an account balance. The letter will clearly address the outstanding balance and consequences of nonpayment. It will be mailed with the student's follow-up spring semester statement/letter or student account. Any graduating student who does not clear his/her account balance prior to commencement will not receive a diploma. In addition, the student will be prohibited from using university academic and administrative services. These services include, but are not limited to, computing facilities, library services, housing, dining, career center services, degree verification and the release of (official) academic transcripts.

**Currently Enrolled Students/Carry-over Balance Due**

A student who received account balance action letters from Enrollment Services during the previous semester, and who has an account balance greater than $500 following the current semester deadline for enrollment, will be subject to the following procedures.

Enrollment Services will send notification of continued nonpayment after the 15th day of classes (third week) to the student and parent/s, the university service administrators and the associate dean of the student’s college. This action will be documented in the student’s administrative records.

Enrollment Services will work with the student and parent/s to resolve the financial issue. Payment arrangements will follow standard practices related to collections, to include a promissory note with a specified repayment schedule within the current semester. Requests for exceptions to standard collection practices, such as extending the payment schedule beyond the current semester, must be made in writing to the vice president for enrollment. All requests will be reviewed by the Student Accounts Receivable Committee, composed of the vice president for enrollment, vice president for business, the dean of student affairs and the directors of Enrollment Services. Input from the associate dean of the student's college will be requested and considered. When a payment agreement is reached, Enrollment Services will mail a letter to the student and parent/s detailing the conditions of the agreement and the risk of financial suspension if the agreement is not fulfilled. This correspondence will be copied to representatives of the Student Accounts Receivable Committee and to the associate dean of the student's college.

If a financial agreement is not reached, the student will be financially suspended. The student will be prohibited from using university academic and administrative services. These services include, but are not limited to, computing facilities, library services, housing, dining, career center services, degree verification and the release of (official) academic transcripts for the upcoming semester.

If the student is an employee of the university, the university may garnish the student’s wages to recover the amount due to the university. Enrollment Services will notify the student prior to any action, and the amount garnished will be tailored to individual circumstances.

Prior to the registration period for the upcoming semester, Enrollment Services will send correspondence to any student who has a carry-over balance and who has not developed or maintained a satisfactory repayment plan. This correspondence will advise the student and parent/s that the student will be ineligible to register for the upcoming semester until s/he pays the balance in full. This correspondence will be copied to representatives of the Student Accounts Receivable Committee, university service administrators and the associate dean of the student’s college. Additionally, the student will be prohibited from using university academic and administrative services. These services include, but are not limited to, computing facilities, library services, housing, dining, career center services, degree verification and the release of (official) academic transcripts for the upcoming semester.

If the student has an overdue balance at the completion of the current term (a carry-over balance greater than or equal to $500 for 2 consecutive terms), Enrollment Services will send a letter to the
student and parent/s to advise them that the student has been “financially suspended” and that s/he will not be permitted to return to the university until the account balance is paid in full. This correspondence will be copied to representatives of the Student Accounts Receivable Committee, university service administrators and to the associate dean of the student’s college.

If at any point in the process the student’s account balance is paid in full, Enrollment Services will update the student’s enrollment status and release the hold on his/her academic and financial records. The student will then be able to register for courses and use university academic and administrative services. Enrollment Services will also notify the appropriate university academic and administrative staff members.

Delinquent Account/Financially Suspended

A student who has been financially suspended and who retains an account balance will be subject to the following procedures.

Enrollment Services will send a series of financial status letters to the student indicating the consequences of nonpayment or continued account delinquency. Enrollment Services will mail the first letter when the student is classified as having a delinquent balance, with follow-up letters at distinct intervals from the point in time Enrollment Services determines that the student’s account is in a delinquent status. Enrollment Services will also use telephone conferences with the student and parent/s.

Enrollment Services will note any response to the financial status letter or telephone communication with the student and parent/s in the student’s financial records, along with any arrangements for payment. Enrollment Services will update the student’s account balance to reflect any payment and will assign an appropriate follow-up date to ensure that the student continues to take action to resolve the financial delinquency.

If at any point in time Enrollment Services determines that internal collection efforts have been unsuccessful, Enrollment Services will refer the student’s account to an outside collection agency. Enrollment Services will notify the student and parent/s before any referral to a collection agency.

If the student’s account balance is paid in full at any point in the process, Enrollment Services will update the student’s account status and release the hold on his/her academic and financial records. The student will be able to register for courses and use university academic and administrative services. Enrollment Services will notify the appropriate university academic and administrative staff members.

Contact

Questions concerning this policy or its intent should be directed to: The HUB, x88186.

Financial Aid Policy Statement (See page 34)

University Academic Scholarship Renewals

Carnegie Mellon University awards academic scholarships as part of the freshman financial aid process. Each of these scholarships is renewable for four academic years of study (five for architecture) based upon the maintenance of a specific cumulative quality point average. The academic scholarship renewal criteria are included in the scholarship notification letter which is mailed to the student prior to the May 1 matriculation deadline.

Each scholarship recipient’s cumulative quality point average is reviewed at the end of each academic year. If the student achieves the scholarship renewal criteria, then the scholarship is automatically renewed for the next academic year.

If the student does not meet the cumulative quality point average requirement for renewal, then s/he is given the opportunity to appeal. A merit scholarship appeal form and instructions are automatically sent to the student at the end of each academic year.

The student’s completed appeal form is reviewed by members of the Enrollment Services staff. Input from the Associate Dean of the student’s college is also considered. The student is notified, in writing, of the decision. The decision may be to renew the scholarship for the entire academic year, renew the scholarship for one academic term, or to reject the appeal. If the appeal is rejected, a written explanation is provided to the student.

Undergraduate Tuition Exchange Programs

Carnegie Mellon University assesses the standard tuition charge for the undergraduate tuition exchange programs.

Since Carnegie Mellon assesses the tuition charge, the student can be considered for all forms of institutional, state, and federal aid for which the student may have eligibility with the exception of any student employment program.

Undergraduate Study Abroad Programs

Carnegie Mellon University does not assess the tuition charge for any of the Study Abroad Programs.

Since Carnegie Mellon does not assess the tuition charge, the student is not considered for any institutional grants and scholarships. However, Carnegie Mellon will consider any student participating in an approved Study Abroad Program for all state and federal student aid programs for which the student may have eligibility with the exception of any student employment program.

The U.S. Department of Education and Carnegie Mellon University define an approved Study Abroad Program as one which is part of a contractual agreement between Carnegie Mellon and the host institution. Additionally, courses taken in the Study Abroad Program must be accepted for transfer to Carnegie Mellon by the Dean of the student’s college.

Undergraduate Sponsored Study Abroad Programs

Carnegie Mellon assesses full tuition charges and all applicable fees to students participating in an undergraduate sponsored study abroad program.

Undergraduate International Students

Documentation Eligibility (U.S. Citizenship or Eligible Noncitizen)

You must be a U.S. Citizen or permanent resident alien to receive federal student aid. If you are a U.S. Citizen, but were not born in the United States, valid documentation includes a copy of your passport or naturalization certificate.

If you are a U.S. permanent resident alien or refugee, acceptable forms of verification include a photocopy of both sides of your I-551 or I-551C card.

Undergraduate international students are ineligible to receive any federal or state student financial aid. Additionally, Carnegie Mellon does not award any institutional financial aid funds to undergraduate international students.

Statement of Assurance

Carnegie Mellon University does not discriminate and Carnegie Mellon University is required not to discriminate in admission, employment, or administration of its programs or activities on the basis of race, color, national origin, sex or handicap in violation of Title VI of the Civil Rights Act of 1964, Title IX of the Educational Amendments of 1972 and Section 504 of the Rehabilitation Act of 1973 or other federal, state, or local laws or executive orders.

In addition, Carnegie Mellon University does not discriminate in admission, employment, or administration of its programs on the basis of religion, creed, ancestry, belief, age, veteran status, sexual orientation or gender identity. Carnegie Mellon does not discriminate in violation of federal, state, or local laws or executive orders.

However, in the judgment of the Carnegie Mellon Human Relations Commission, the Presidential Executive Order directing the Department of Defense to follow a policy of “Don’t ask, don’t tell, don’t pursue” excludes openly gay, lesbian and bisexual students from receiving ROTC scholarships or serving in the military. Nevertheless, all ROTC classes at Carnegie Mellon University are available to all students.

Inquiries concerning application of these statements should be directed to the provost, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-6684 or the vice president for enrollment, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-2056.

Carnegie Mellon University publishes an annual campus security report describing the university’s security, alcohol and drug, and sexual assault policies and containing statistics about the number and type of crimes committed on the campus during the preceding three years. You can obtain a copy by contacting the Carnegie Mellon Police Department at 412-268-2323. The security report is also available online.

Undergraduate Academic Regulations

Availability of Required Courses

In order to ensure that students do not have to compete for access to their required courses, registration priority is given to students who are registering for courses in their primary major. Although the University encourages the exploration of other disciplines, access to courses outside a student’s primary major (including those courses that fulfill requirements for an additional major, minor, etc.) is on a space-available basis and is not guaranteed.

Conduct of Classes

Students are expected to attend all scheduled classes unless the instructor explicitly informs the class that other ways of doing the work are acceptable. The action to be taken in regard to tardiness, absence (excused or unexcused) has been left to the discretion of the individual instructor; the instructor should consult with the department head and the student’s Dean if major action such as dropping the student from the course is being considered.

All classes will be held at their scheduled hour on days immediately before and after all holidays and recesses. Both faculty and students are expected to be present.

Students who, because of religious beliefs, cannot attend class may arrange as individuals to be absent, provided the work missed is made up in a manner satisfactory to the instructor(s) of the class(es) missed.

No student shall leave a scheduled exercise because of the absence of the instructor until a reasonable time has passed. By tradition, and as a matter of courtesy, a student should wait 10 minutes before leaving.

Degree Requirements

Students are responsible for checking to ensure that the degree requirements (as listed in the appropriate catalog at the time of their matriculation) have been met. They may also refer to the university’s on-line academic audit website www.cmu.edu/hub. If the degree requirements have been modified by College Council action, the student is responsible for checking to ensure that the modified requirements have been met.

In order to graduate, students must complete all residence requirements and all course requirements in their approved curriculums and be recommended for degrees by the faculty of the appropriate college. Such recommendation shall be based upon the good standing of the student in academic and disciplinary matters.

No student may receive a diploma until all financial obligations to the university have been met.

Statement on Course Attendance and Enrollment

A student is responsible for the payment of charges incurred at the university by the stated payment deadline. The purpose of this policy statement is to detail the specific process and action steps to be used to resolve any outstanding student account balance.

Students will be held financially and academically accountable for course(s) which they attend or for which they are enrolled. Enrollment in a course which is not actively taken, or contrarily, the taking of a course for which enrollment has not been completed, will result in the assignment of a grade and responsibility for applicable tuition charges.

Students who fail to resolve their enrollment and balances will be prohibited from using university academic and administrative services. The services include, but are not limited to, computing facilities, library services, housing, dining, career center services, degree verification and the release of (official) academic transcripts for the upcoming semester.

Rank in Class

Carnegie Mellon does not rank students by class. Undergraduates at Carnegie Mellon pursue degrees in one or more of our ten schools or colleges. They may choose to pursue coursework, majors and minors within and between schools/colleges. In an institution where students’ educational experiences are so varied, class rank is not a meaningful way to measure achievement.

Carnegie Mellon and Enrollment Services will no longer report nor record students’ rank in class, rank in college and rank in department. For those graduate school and employer requests that request a students’ rank, they will be completed with the statement “Carnegie Mellon does not report rank in class.”

Grading Policies

Policy Statement

This policy offers details concerning university grading principles for students taking courses, whether those students are undergraduates, non-degree students or graduate students. This policy covers the specifics of Assigning and Changing Grades (including Final and Mid-Semester grades, Incompletes and Conditional Failures), Grading Options (Audit and Pass/Fail), Drop/Withdrawals, Course Repeats, and defines the undergraduate and graduate Grading Standards.

Questions about grading for a specific course should be addressed to the instructor of the course in question. Graduate students with questions about Pass/Fail and Drop/Withdrawal should contact their individual programs.

Appeals for an exception to any grading policy may be made by the dean’s office of the student’s home college.

1. Definitions

Certain terms are used in this document with specific meanings, as defined in this section.

Student means any full-time or part-time degree-seeking undergraduate or graduate student, or full-time or part-time non-degree student.

Non-degree student means a student who is not in a university degree program.

Faculty means members of the university’s Faculty Organization as defined in the Faculty Handbook, plus instructors and special faculty appointments (even in the first year), and part-time faculty.

Instructor means a faculty member, teaching assistant, and /or lecturer who is the instructor of record, as recorded in the Student Information System (SIS).

Assigning Grades

Final grades are awarded to each student, in each course scheduled, at the end of the semester, mini-semester or summer session. All students taking a course at Carnegie Mellon must be assigned grades. Enrollment Services will query instructors who do not assign a grade to a student. Copies of the query regarding the lack of grade will be sent to the student, to the dean and to the department head. If the instructor does not assign a letter grade or an incomplete grade within one month of Enrollment Services query, the department head will be responsible for insuring that a grade is assigned.

Changing a Grade

A student who believes that an assigned grade is incorrect, may request that a final grade be changed. Final grades will be changed only in exceptional circumstances and only with the approval of the instructor and, for undergraduates, with the approval of the dean's office of the college/school offering the course; for graduate students, department approval is required. The intention of this policy is to insure that, under normal circumstances, all students in a class are treated equally and no student is unduly advantaged.

Mid-Semester Grades

Mid-semester grades provide valuable feedback to students as they assess their performance in courses. Furthermore, mid-semester grades and the QPA's they generate are used by Deans and advisors in identifying and dealing in a timely way with students in academic trouble. Therefore it is imperative that mid-semester grades accurately reflect student performance and are turned in on time. Mid-semester grades are not permanent and are kept only until final grades are recorded. Because mid-semester grades are not permanent, changes of mid-semester grades as a rule will not be accepted.

Incomplete Grades

Carnegie Mellon students are expected to complete a course during the academic semester in which the course was taken. However, if the instructor agrees, a grade of I (incomplete) may be given when a student, for reasons beyond his or her control, has been unable to complete the work of a course, but the work completed to date is of passing quality and the grade of incomplete provides no undue advantage to that student over other students. In awarding an I grade, an instructor must specify the requirements for completing the work and designate a default letter grade where no further work is submitted. Students must complete the required course work no later than the end of the following academic semester, or sooner if required by prior agreement. The instructor must record the permanent grade by the last day of the examination period of that following semester, or Enrollment Services will administratively assign the default grade.

Conditional Failures

X grades are conditional failures. They are factored in the student grade point average as a failure in the semester they are awarded and can be replaced by nothing higher than a D. When awarding an X grade, the instructor specifies to the student the requirements necessary to achieve a grade of D. Requirements may be the completion of a prescribed course with a performance of C or better or may be specified work related to the course in which the student received the X. Students must complete the required course work no later than the end of the following academic semester, or sooner if required by prior agreement.

The instructor must record the permanent grade of D by the last day of the examination period of that following semester, or Enrollment Services will administratively assign the default grade of R.

Pass/Fail Grades

Undergraduate students may elect to take a free-elective course pass/fail unless precluded by the course, the course's department or the student's home department/college. Policies for graduate students vary and students should be advised to check with their individual colleges/departments/programs for details.

A student must submit a Pass/Fail Form to Enrollment Services indicating the course they are electing as pass/fail before the end of the university's drop period. This decision is irreversible thereafter. No information regarding the student's decision will be passed on to the instructor. Instructors will submit letter grades, which will automatically be converted to pass/fail.

A through D work will receive credit for units passed and be recorded as P on the student's academic record; below D work will receive no credit and will be recorded as N on the student’s academic record. No quality points will be assigned to P or N units; P or N units will not be factored into the student’s QPA.

In exceptional circumstances, departments may ask to designate a course pass/fail or request that the course be evaluated only with letter grades. The College Council must approve designating a course as pass/fail only or as graded only. If such a decision will have an adverse effect on the requirements of any other college, Academic Council must review the decision. The decision to designate a course as graded or pass/fail must be made before the add period for the course and is irreversible thereafter.

Audit Grades

Auditing is presence in the classroom without receiving academic credit, a pass/fail or a letter grade. The extent of a student's participation must be arranged and approved by the course instructor. A student wishing to audit a course is required to register for the course, complete the Course Audit Approval Form, obtain permission of the course instructor and their advisor, and return the form to The HUB prior to the last day to add a course.

Any student enrolled full-time (36 units) may audit a course without additional charges. Part-time or non-degree students who choose to audit a course will be assessed tuition at the regular per unit tuition rate.

Drop/Withdrawal Grades

Students at Carnegie Mellon may drop a course by accessing on-line registration on or before the drop deadline as published in the official university calendar. This applies to all courses with the exception of mini-semester courses. Policies for graduate students vary and students should be advised to check with their individual colleges/departments/programs for details. The deadline to drop a mini-semester course is the last day of the fourth week of the mini-semester course. When a course is dropped by these deadlines, the course is removed and does not appear on the academic record.

After the deadline to drop, students may withdraw from a course by accessing on-line registration on or before the last class day, prior to the beginning of final examinations. After the deadline to drop, a W (withdrawal) grade is assigned and appears on the student’s academic record. W grades do not apply to graduate students except in TSB and MGS.

Undergraduates who are registered as full-time students as of the 10th day of classes are expected to remain full-time for the duration of the semester. Full-time is defined as registered for a minimum of 36 units. Permission to drop below the 36-unit minimum can only be granted in extraordinary circumstances by the student’s home Associate Dean. Undergraduates who are registered as part-time are also subject to the above deadlines to drop or withdraw from a course.

Course Repeats

When a course is repeated, all grades will be recorded on the official academic transcript and will be calculated in the student’s QPA. This is the case regardless if the first grade for the course is a passing or failing grade, including Pass/Fail.

Undergraduate students who wish to repeat a course already passed must obtain approval from the student's Dean or Department Head. When a student takes a course s/he has already passed, only one set of units will count towards graduation requirements.
3. University Grading Standards

The undergraduate student Grading Standard is as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Quality Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.00</td>
</tr>
<tr>
<td>B</td>
<td>3.00</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
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<tr>
<td>D</td>
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<tr>
<td>R</td>
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<td>P</td>
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<td>O</td>
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<td>N</td>
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<tr>
<td>I</td>
<td>0.00</td>
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<tr>
<td>AD</td>
<td>0.00</td>
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</tbody>
</table>

Any +/- grades received by undergraduate students when taking graduate-level courses will automatically convert to the corresponding letter grade as listed in the scale above.

The graduate student Grading Standard is as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Quality Points</th>
</tr>
</thead>
<tbody>
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<td>A+</td>
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</tr>
<tr>
<td>A</td>
<td>4.00</td>
</tr>
<tr>
<td>A-</td>
<td>3.67</td>
</tr>
<tr>
<td>B+</td>
<td>3.33</td>
</tr>
<tr>
<td>B</td>
<td>3.00</td>
</tr>
<tr>
<td>B-</td>
<td>2.67</td>
</tr>
<tr>
<td>C+</td>
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</tr>
<tr>
<td>C</td>
<td>2.00</td>
</tr>
<tr>
<td>C-</td>
<td>1.67</td>
</tr>
<tr>
<td>D+</td>
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<td>D</td>
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<td>I</td>
<td>0.00</td>
</tr>
<tr>
<td>AD</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Students who entered Carnegie Mellon (as graduate students) prior to Fall 1995 follow their previous graduate grading standard. Graduate students who take a leave of absence and return to Carnegie Mellon will do so under the 4.33-point grading scale. These students will have their past semester QPAs recalculated at the time of their return.

No A+ may be given to H&SS or CIT students. No D or D+ may be given to a TSB student. Pass/Fail policies for graduate students vary and students should be advised to check with their individual colleges/departments/programs for details. Only TSB and MCS record W grades.

Department and college policy determine minimum passing grades in graduate courses. Any course that a graduate student completes will be graded using this scale. This includes undergraduate courses taken by graduate students.

Graduation with University Honors

In recognition of exemplary academic achievement as undergraduates, some candidates for undergraduate degrees will be named to the University Honors List. Each of the undergraduate colleges will select students for honors on the basis of a cumulative grade point average and/or recommendations of the faculty.

Overloads

The University is committed to insuring that each degree candidate has access to a normal course load before it permits other students to register for a greater than normal number of units. A normal course load has been established by each academic department. Students should check with their academic advisor, department head, or dean’s office for the definition of a normal course load. Students may register for an overload up to 12 units with the approval of their academic advisor if they have demonstrated their ability to successfully complete a normal course load. Successful completion of a normal course load is defined as having earned at least a 3.00 (3.50 for students in ECE) cumulative QPA through the preceding semester or at least a 3.00 (3.50 for students in ECE) semester QPA in the current semester (in which case all final grades must be recorded before the student can register for the overloaded class). Overloads greater than 12 units or other exceptions must have the approval of the student’s Associate Dean. Freshmen and transfer students are limited to a normal course load in their first semester of attendance.

Procedure for the Appeal of Grades & Academic Actions

Students who believe that a grade which has been awarded to them is incorrect or that an academic action, recommended by their department and approved by the College Council, is unreasonable or inconsistent with the practice of the college should use the following procedures for prompt and equitable resolution of the grievance.

In the case of grades the student must:

1. Present the case verbally to the faculty or staff member responsible for the course in which the student believes an inappropriate grade has been awarded.
2. Present the grievance in written form with appropriate documentation to the department head of the department responsible for the course if the student believes that Step 1 does not adequately resolve the grievance. The department head will provide within 30 days a written decision and the basis for it in the matter of the grievance.
3. Present copies of all documents originally sent to the department head in Step 2 and a formal letter of appeal to the College Council of the college responsible for the course if Step 1 does not resolve the grievance. The department head will provide within 30 days a written decision and the basis for it in the matter of the grievance.

In cases in which the student believes an academic action recommended by the head of the department and approved by the College Council is inconsistent with the policies of the college or incorrect, the student should use the following procedure:

Contact

Questions concerning this policy or its intent should be directed to Enrollment Services, 8-8186.
1. In writing, the student must petition the College Council to make a formal review of the appropriateness of the action, such review to take place at the next scheduled meeting of the College Council.

2. The Dean of the college will provide, in writing within 30 days after the next scheduled meeting of the College Council, the response of the council to the petition and the basis for it.

If, after carrying out the steps described above as appropriate, the student believes that the matter is not adequately resolved or if no decision has been rendered on the last step outlined for the particular grievance, the student must present copies of all documents and a formal letter of appeal to the Provost or another university officer designated by the President for resolution of the grievance. That officer, acting for the university, will respond in writing with prompt and equitable resolution of the complaint, normally within 30 days, and will document the basis for the decision.

Residency Requirement

A candidate for the bachelor's degree must complete at the university a minimum of four semesters of full-time study, or the equivalent of part-time study, comprising at least 180 units of coursework. Note that these are minimum residency requirements applicable to all university undergraduates. Some of the university's colleges and departments have developed more restrictive requirements in this area. Students should consult that section of the catalog in which their college or department's academic regulations are presented for the residency requirements applicable to them. Deviation from these policies requires action by the Dean of the student's home college.

Implications of Residency Requirements for transfer students seeking second undergraduate degree: Students who received degrees from other universities could have up to 2 years of credits earned elsewhere applied to their Carnegie Mellon degree requirements and would need to meet Carnegie Mellon's Residency Requirement and complete at the university a minimum of four semesters of full-time study, or the equivalent of part-time study, comprising at least 180 units of coursework. Deviation from these policies will require action by the Dean of the student's home college.

Retention of Student Work

The university reserves the right in all colleges to retain indefinitely any student work the faculty may select. All work not retained by the university must be claimed at the time specified on the bulletin boards (or other forms of communication) of the department concerned; otherwise, the work will be destroyed.

Standard Course Equivalencies for Advanced Placement/International Baccalaureate Units Policy

The university has standard units assigned to Advanced Placement (AP) and International Baccalaureate (IB) credits for all majors. Standard course equivalencies for each exam will be determined by "expert departments" in each college for each acceptable AP/IB score.

Under this procedure, students' AP or IB credit for a particular course will only go toward their degree requirements if allowed by the home department or college policies. Should a student decide to transfer to another major and/or academic unit within the university, AP/IB credits applicability to new degree requirements will depend upon the requirements of the new home department (or college). Students may only be granted credit for the Higher Level IB exams. This policy assumes no significant AP and/or IB exam changes. In the event of significant exam changes, students will be notified of any resulting policy changes no later than July 30 prior to their enrollment to take effect the fall of that year.

Standard Degree Terminology

Carnegie Mellon University offers a wide variety of programs; the opportunities vary greatly between and among the colleges. For the purposes of clarification, this section defines:

- standard degree terminology;
- changes to the existing degree declaration process;
- the existing procedure for creating new degrees, majors and minors.

Major Terms

Degree

Examples: B.S. (Bachelor of Science); M.F.A. (Master of Fine Arts); Ph.D. (Doctor of Philosophy)

Joint Degree

Degree program offered between two or more colleges/departments or offered in conjunction with an outside University.

Examples: M.S. in Colloids, Polymers, and Surfaces (Chemistry and Chemical Engineering); B.H.A from College of Fine Arts and Humanities and Social Sciences.

Major

Field(s) studied in greatest depth by fulfilling a department-determined set of course requirements. The primary major is the field in which the degree is granted.

Example: Creative Writing; Physics; Marketing

Students may pursue an additional major(s) in a single degree program.

Option

(Now referred to variously as track, option, etc.)

A specific area of study associated with the major or additional major(s), which transforms the title of the major or double major.

Examples: Civil Engineering (Biomedical Engineering Option) Physics (Computer Science Option)

Minor

Minors are not listed on the diploma but appear, instead, on the student's transcript. The type of degree sought is determined by the major (that of the home department), not the minor(s). Examples: Film Studies; History of Ideas

Concentration

(Now referred to variously as track, option, etc.)

A specific area of study generally associated with a major or double major, which appears only on the transcript.

Home College

The college into which the student was originally admitted or into which the student formally transferred.

Home Department

The department into which the student was originally admitted or the department offering the major which the student has declared.

Concurrent College/Department

College/department other than the home college/department, granting the second of multiple degrees, or offering the additional major(s) of double or triple major, or minor.

Single Degree/Major

One diploma, stating the degree and the major field of study. Currently, the Statute of Limitations on earning an undergraduate degree is eight years.

Examples: B.A. in Psychology; M.S. in Industrial Administration

Requirements: Fulfillment of all requirements of the home college.

Declaration: At least by registration time (early November), first semester junior year.

Certification: Home college, home department
Multiple Degrees

More than one degree granted by the university (whether simultaneous or sequential). One diploma for each degree. When awarded simultaneously, two degrees are referred to as dual degrees, three degrees as triple degrees. Multiple graduate degrees may be given in conjunction with (an) outside University(ies).

Examples of how such degrees appear on the respective diplomas:
- Bachelor of Fine Arts in the field of Art; Bachelor of Science in the field of History
- Bachelor of Science in the field of Physics; Bachelor of Science in the field of Computer Science

Requirements: Multiple bachelor’s degrees
Declaration: Undergraduates: at least by registration time (early November), semester junior year
To receive multiple bachelor’s degrees the student must:
- satisfy all requirements for each degree.
- complete a number of units determined as follows: the aggregate number of units must exceed by at least 90 the required number of units for at least one of the degrees. (For example: if one of two degrees requires 365 units and the other requires 380 units, a total of at least 455 units is required to obtain both degrees.)
- comply, for each degree, with the statute of limitations regarding the time at which units are earned.
- while working towards more than one degree simultaneously, designate one of the departments (and if necessary colleges) as the home college/department.

Multiple Degrees Involving Graduate Degrees

Policies involving multiple graduate degrees or a graduate/undergraduate degree program or sequence are dictated by each college involved.

Examples: M.S. in Public Management and Policy and the degree of Juris Doctor (Heinz School/University of Pittsburgh School of Law).
Declaration: Undergraduates: at least by registration time (early November), first semester junior year.
Declaration: Graduates: upon admittance OR by the end of the semester preceding the expected graduation date.
Certification: Home college, home department and concurrent college (if any), concurrent department (if any).

Additional Major

One degree, stating the major in the home department first and the additional major second. The type of degree given (B.A., B.S.) is determined by the major of the home department.

For example, a student whose home department is Physics:
- This degree is valid: B.S. in Physics with an additional major in History
- This degree is not valid: B.S. in History with an additional major in Physics

The intent of a double major is an in-depth understanding of two major fields. Students may pursue a second major in a field where the primary degree is different from the degree associated with the additional major: e.g., B.S. in Economics with an additional major in History.

Requirements: If the double majors involve two different colleges or the same college, the student must fulfill:
- all requirements (including core) for the first major degree as defined by the home college;
- all major requirements (including core prerequisites) for the additional major;
- any specific requirements for double majors imposed by the department(s)/college(s) involved.

Declaration: At least by registration time (early November), first semester junior year.
Certification: Home college, home department; concurrent college (if any), concurrent department (if any).

Additional Majors

One degree, stating the major of the home departments first, the second and the third major afterwards. The type of degree sought (B.A., B.S.) is determined by the major in the home department.

For example, a History student, this degree is valid: B.A. in History with additional majors in Professional Writing and in Hispanic Studies.

This degree is not valid: B.A. in Professional Writing with additional majors in History and in Spanish.

Requirements: If the triple major involves two or three different colleges OR the same college, the student must fulfill all requirements listed for each additional major.

Declaration: At least by registration time (early November), first semester junior year.
Certification: department
Concurrent college (if any), concurrent department (if any)
Second concurrent college (if any), second concurrent department (if any)

Minor

One degree, stating the major first and the minor second (or third, if there is also (an) additional major(s) involved). The type of degree sought (B.A., B.S.) is determined by the major (that of the home department). Minors are not listed on the diploma, but appear on the transcript.

Examples: B.F.A. in Music Performance (Voice) with a minor in Theatre Arts; B.S. in Applied History with an additional major in Information Systems and a minor in Mathematics.

Requirements: The student would generally take 45 units pertaining to the minor, in addition to fulfilling all requirements for the major degree (as defined by the home college). The “minor” courses are negotiated between the student and the department certifying the minor.

Declaration: At least by registration time (early November), first semester junior year.
Certification: department
Options (Tracks, Specializations, Area Cores, etc.)

These concentrations will not be considered part of the student’s degree title unless included are part of the major or (an) additional major(s) field title.

Major - Declaration Process

For undergraduates, depending on the student’s college, the major is usually declared at the end of the freshman or sophomore year. Departments enter the appropriate majors into the Student Information System upon declaration.

For graduates, the major is usually indicative of the department and is supplied by the department via SIS.

Additional Majors/Minors Declaration Process

For undergraduates, all variations on a student’s sought degree and major field must be declared by the end of the first semester of the student’s junior year. Having already declared a major, students should be well prepared by this time to choose additional majors and/or minors.

It is assumed that by these proposed deadlines, the student will have taken a majority of degree requirements and electives. The student can then, in conjunction with an advisor, review his/her course history and decide which options may or may not apply towards the desired
degree and field(s).
A student who wishes to pursue additional majors and/or minors should consult with his/her advisor and receive a detailed curriculum for attaining the additional desired degree, major or minor. The student should then notify the college/department offering the additional program. Upon receipt of this notification, the college/department will update the Student Information System which will reflect this information to the Commencement System for graduation. This procedure ensures that when a student is expected to graduate, all degree/major information is immediately accessible, and certification of the degree is simplified.

**Transitional Students:**
Transitional student status has been instituted by the university to assist students who have changed their minds about their original field of study or who have been judged unlikely to make satisfactory progress in their chosen field. Becoming a Transitional Student gives a student an opportunity to maintain a relationship with the home college while re-orienting academic plans and goals. It also gives a student time to explore his/her options and/or enhance admisibility to another college in the university, or to another institution. Ordinarily, a student will be permitted to register as a Transitional student for no more than one semester. Although, in exceptional circumstances, a student may be allowed to extend the status beyond one semester. A student must obtain the permission of his/her home college Associate Dean to initiate this option.

Transitional student status may be available to students upon the advice of their advisor, or upon their own request. Interested students must make an appointment with the Associate Dean of their home college to discuss this option.

**Note:** Students at Carnegie Mellon in good academic standing may transfer from one program to another as long as they meet curricular or artistic requirements and as long as there is space in the program into which they wish to transfer.

**Process for Creation of New Degrees, Majors, Minors**
Departments proposing new degrees, majors, additional majors, and/or minors must complete a New Degree/Major/Minor Request Form. This should include any and all notations to the university diploma and/or transcript (new degrees, majors, minors, options). Departments proposing to offer a new degree, major, additional major and/or minor must follow university policies for approval as follows:

- Document the Program by completing the New Degree/Major/Minor Request Form. Departments proposing new degrees and majors must complete this form and attach course descriptions, curriculum proposal, list of present faculty who will support the Program, and verify the availability of other units’ courses. This documentation must indicate the starting semester for the Program, and in the case of new majors, also indicate if it is available only as a major/additional major/minor, or in combination.
- Receive Department approval.
- Receive Dean and College Council approval.
- Submit all Program documentation complete with College Council approval to the Vice Provost for Education. New majors or degrees will not be processed without the approval of the Provost’s Office.
- The Provost’s Office will approve or deny, and inform the sponsoring Department and Enrollment Services.
- The Department may then publicize and offer the program for student enrollment.

**Status, Class Standing**
Students should refer to the sections of the catalog pertaining to their college and/or department to determine the number of units required each academic year by their specific curriculum. Students must achieve passing grades in order to earn units; students do not earn units for incomplete or failed courses.

A freshman student becomes a sophomore after earning passing grades in three-fourths of the units required by his/her freshman curriculum.

A sophomore becomes a junior after earning the number of units required by his/her curriculum for the freshman year plus three-fourths of the number of units for the sophomore year.

A junior student becomes a senior after earning the number of units required by his/her curriculum for the freshman and sophomore years plus three-fourths of the number of units for the junior year.

Classification of students is made only at the time of their first registration in any academic year and remains unchanged throughout the rest of that academic year.

**Statute of Limitations**
All units required for an undergraduate degree, whether earned in residence, transferred from another institution or granted via advanced placement, must have been earned within eight years of the date on which the degree is granted. This statutory period can be extended by the Dean of the student’s college under the following conditions:

- the courses taken prior to the statutory period still represent a reasonable part of the student’s total academic program;
- the prior courses provide adequate preparation for courses which must still be taken to fulfill the degree requirements;
- there is a legitimate reason(s) for the student not completing the academic program within the statutory period.

A request for a waiver of the statute of limitations must be submitted to the Dean of the student’s college. The request for a waiver should address all of the above conditions for an extension. For cases in which a waiver is granted, the waiver covers specific courses and is intended for a specific period during which the program must be completed.

**Student Suspension/Required Withdrawal Policy**

**Policy Statement**
University Suspension is a forced, temporary leave from the university. There are three types of suspension for students that apply to both graduate and undergraduate students:

- Academic Suspension is the result of poor academic performance or violation of academic regulations and is imposed by the student’s college or academic department (see university and college academic policies).
- Disciplinary Suspension is the result of serious personal misconduct and is imposed by the Office of Student Affairs (see The Word/Student Handbook).
- Administrative Suspension is the result of failure to meet university financial obligations or failure to comply with federal, state or local health regulations and is imposed by Enrollment Services. (See Student Accounts Receivable Collection Policy and Procedures for financial obligations. Contact Student Health Services for information about health regulations.)

**Suspended students may not:**

- register for courses
- attend classes
- live in student or fraternity/sorority housing
- use campus facilities, including athletic facilities, library and computer clusters
- participate in student activities
- be members of student organizations
- have student jobs

(Note: students on academic suspension may have a summer campus job if they accepted the job before they were suspended.)

**Employment**
Although suspended students may not hold student jobs, students on academic suspension may, under certain circumstances, have a non-student job with the university; students on disciplinary or administrative suspension may not.

To have a non-student job, students on academic suspension must receive approval from their associate dean (undergraduate students) or department head (graduate students) to ensure that the job will not violate their suspension terms. Students in violation of this will lose their degree student status, meaning they would have to reapply for admission to Carnegie Mellon through either Undergraduate Admission or the appropriate graduate department.
Transfer Credit

Suspended students may take courses elsewhere; however, they may receive transfer credit only if their college's and department's policies allow this.

Appeals

To appeal any action of this policy, the student may write to the following people:
- Academic Suspension - associate dean (undergraduate students) or department head (graduate students);
- Disciplinary Suspension - dean of student affairs;
- Administrative Suspension - vice president for enrollment, vice president for business and planning, and the dean of student affairs, in consultation with the student's associate dean.

Returning from Suspension

In order to return from a suspension, a student must have the following approval:
- Academic Suspension - associate dean (undergraduate students) or department head (graduate students);
- Disciplinary Suspension - dean of student affairs;
- Administrative Suspension - vice president for enrollment or his designate.

Contact

Questions concerning this policy or its intent should be directed to The HUB, x88186.

Transfer Credit Evaluation and Assignment Policy

The Policy on Grades for Transfer Courses, originally dated January 13, 1993, and approved by the Committee on Educational Programs and Student and Faculty Affairs states:

“Carnegie Mellon University offers students the opportunity to take courses for credit through a cross-registration program and through the receipt of transfer credit from other accredited institutions. The Carnegie Mellon University transcript will include information on such courses as follows:

Carnegie Mellon courses and courses taken through the university’s cross-registration program will have grades recorded on the transcript and be factored into the QPA. All other courses will be recorded on this transcript indicating where the course was taken, but without grade. Such courses will not be taken into account for academic actions, honors or QPA calculations. (Note: Coursework taken when a student is on suspension is not acceptable for transfer credit.)

Definitions

A Carnegie Mellon course is one conducted under Carnegie Mellon University regulations regarding course content and grading and taught by faculty under the supervision of a Carnegie Mellon academic unit. Courses taught by Carnegie Mellon faculty on the Carnegie Mellon campus qualify. Courses that are part of the regular offerings of other universities do not qualify, unless faculty at the other universities receive appointments at Carnegie Mellon and handle Carnegie Mellon students under Carnegie Mellon academic regulations.

Courses offered for cross-registration are those taken under the PCHE (Pittsburgh Council on Higher Education) agreement during the regular academic year.

Only official and final college or university transcripts will be accepted for the awarding of transfer credit. Grade reports, letters and the like are not acceptable. It is the responsibility of the Offices of Enrollment Services and Admission to verify official transcripts. Official transcripts for the awarding of transfer credit will reside in the student’s permanent university academic folder in the Office of Enrollment Services.

It is the responsibility of each academic department to review and establish transfer course credit for their degree-seeking students.

Transfer Credit Evaluation Procedure External Transfer Students

External applicants applying for transfer to Carnegie Mellon will arrange for submission of:

- official transcripts to the Office of Undergraduate Admission as part of the admission process,
- official, final transcripts to the Office of Undergraduate Admission once they are admitted and prior to their beginning coursework at Carnegie Mellon.

As part of the admission process, Admission will verify the official final transcripts, and then send them to the appropriate academic unit responsible for college/department acceptance decisions. Each unit will be responsible for student’s review of transfer credit and the establishment of transfer course credit for each individual student.

Current Students

Current Carnegie Mellon students taking courses at other accredited institutions (colleges and universities), during either summer semesters or as part of exchange programs or other departmentally approved programs, or while on leave from Carnegie Mellon, must arrange for the submission of official final transcripts to the Office of Enrollment Services.

Upon receipt, Enrollment Services will verify these official transcripts and send a copy of the transcript to the appropriate academic unit responsible for that student’s college/department transfer credit decisions. The official transcript will reside in the student’s university academic folder in Enrollment Services. Each unit will be responsible for its students’ transfer credit review and the establishment of transfer course credit for each individual student. Should a unit receive the official transcript, it must be sent immediately to Enrollment Services.

Undergraduate Course Meetings

Usually, no undergraduate classes, exams, academic, or artistic activities (including extra help sessions, rehearsals, ROTC drill, make-up exams, etc.) are scheduled on weekdays between 4:30 p.m. and 6:30 p.m. On occasion, some courses may be scheduled during these hours by Enrollment Services when they also are offered at other times: students may elect to take such courses during the 4:30 to 6:30 p.m. period.

Units and Quality Points

Carnegie Mellon has adopted the method of stating in “units” the quantity of work required of students. In each subject of study, the college catalog tells how much time per week is expected of the average student for each kind of work (e.g., recitations, laboratory, studio, study). For the average student, one unit represents one work-hour of time per week throughout the semester. The number of units in each subject is fixed by the faculty of the college offering the subject. Three units are the equivalent of one traditional semester credit hour.

A subject requiring 9 hours of the average student’s time per week for a semester is known as a 9-unit subject. For example, Chemistry might require 3 hours in the laboratory, 3 hours of lecture/recitation and 3 hours of preparation, a total of 9 work hours. Mathematics might require 3 hours of recitation plus 3 hours of preparation for each recitation, a total of 12 work hours.

Final grades are given “Quality Point Values” as follows:

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<th>Grade</th>
<th>Quality Points</th>
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<tr>
<td>A</td>
<td>4</td>
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<tr>
<td>B</td>
<td>3</td>
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<tr>
<td>C</td>
<td>2</td>
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<td>D</td>
<td>1</td>
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Units earned for a course multiplied by the Quality Point Value of the grade given for that course equals the Quality Points for that course. For example, a 9-unit course assigned a “C” grade is awarded 18 quality points (9 units x 2 quality points = 18 quality points). Total Quality Points divided by Total Units Factorable equals the Quality Point Average.
For example, a student's record in one semester might be:

<table>
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<tr>
<th>Course</th>
<th>Units</th>
<th>Grade</th>
<th>Quality Points</th>
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<tbody>
<tr>
<td>Mathematics</td>
<td>11</td>
<td>&quot;A&quot;</td>
<td>44</td>
</tr>
<tr>
<td>Physics</td>
<td>10</td>
<td>&quot;R&quot;</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry</td>
<td>9</td>
<td>&quot;B&quot;</td>
<td>27</td>
</tr>
<tr>
<td>History</td>
<td>9</td>
<td>&quot;C&quot;</td>
<td>18</td>
</tr>
<tr>
<td>English</td>
<td>9</td>
<td>&quot;D&quot;</td>
<td>9</td>
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</tbody>
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Total Units = 48
Total Quality Points = 98
Quality Point Average (98 divided by 48) = 2.04

"I" (incomplete), "P" (pass), and "W" (withdrawal) grades are not awarded quality points and are not considered as "factorable" units when calculating the QPA.

The same procedure is applied to all grades earned at the university to establish the Cumulative Quality Point Average.

**Withdrawal of a Degree**

The university reserves the right to withdraw a degree even though it has been granted should there be discovery that the work upon which it was based or the academic records in support of it had been falsified. In such a case the degree will be withdrawn promptly upon discovery of the falsification.

**Level of English Fluency Needed for Non-Native English Speakers**

To be successful at Carnegie Mellon University, students who are nonnative speakers of English need to begin their undergraduate work with a strong foundation in academic English and a high level of proficiency with speaking, reading and writing in English. The importance of English language abilities cannot be overstated since there are no basic ESL language courses at Carnegie Mellon. All students will have sufficient English language proficiency to be able to participate fully in the academic work and to interact in daily life outside of the classroom.

Students' English fluency will enable them to handle the demands of academic work, including the ability to comprehend, process, and master complex material presented in English, both in written and spoken form. Students will possess the fluency to communicate their ideas and questions to faculty, classmates, and others, in a classroom environment that is often highly participatory. For example, many classes require group discussion, team projects, oral presentations, and/or independent research. In addition to fluent English skills, studying in a new culture requires openness and flexibility to adapt to a new, and often very different, academic system.

To assess the language of nonnative speaking applicants, a minimum score of 600 (250 Computer Based) on the Test of English as a Foreign Language (TOEFL) has been established as the standard for admission. This minimum score indicates that an applicant has the fundamental building blocks of language needed for academic tasks and for continued language development. Since the TOEFL does not assess speaking, students additionally should seek feedback on their speaking skills and work to improve conversational skills before beginning academic work.

**Exchange Students**

Each term, Carnegie Mellon welcomes exchange students from partner institutions around the world. Exchange students enrich the learning experience at Carnegie Mellon and are expected to be full participants in the curricular and metacurricular life. Therefore, their admission should adhere to the English language guidelines described above. Exchange students submit standardized English language testing scores (such as the TOEFL) as part of the Exchange application process, and present the same high level of English language abilities as degree-seeking students. With exchange students, high-level English abilities are particularly critical since academic, personal and extracurricular experiences must be maximized in a short period of time sometimes only four months in duration.
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<td>Carnegie Mellon Action Project</td>
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<td>Computing Services</td>
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<td>Fellowship Resource Advising Center</td>
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<td>University Police</td>
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University Services

Assistance for Individuals with Disabilities
Equal Opportunity Services
Whitfield Hall, 143 N. Craig Street, Pittsburgh PA 15213
http://hr.web.cmu.edu/eos.html

Everett Tademy, Director (412) 268-2012
et19@andrew.cmu.edu

Larry Powell, EOS Manager (412) 268-2013
lpowell@andrew.cmu.edu

Courtney Bryant, EOS Administrative Coordinator (412) 268-2012
cbryant@andrew.cmu.edu

Qualified individuals with disabilities are entitled to reasonable accommodations under the Americans with Disabilities Act (ADA regulations). Accommodations are determined on a case-by-case basis. Equal Opportunity Services provide links between individuals with disabilities and the campus community. Information released will provide documentation of a disability for faculty, staff, students and prospective students of Carnegie Mellon University. All information will be considered confidential and only released to appropriate personnel on a need to know basis. To access services, individuals must initiate a request in writing for specific services/accommodations (books on tape, enlargements, interpreters, etc.). Accommodations prescribed only apply to Carnegie Mellon University and may not be valid elsewhere. The individual takes full responsibility for ongoing assistance. In order to receive services/accommodations verification of a disability according to Carnegie Mellon guidelines is required.

To establish that an individual is covered under the ADA, the documentation must indicate that the disability substantially limits some major life activity, including learning. The documentation requirements are provided in the interest of assuring that a disability demonstrates an impact on a major life activity, is appropriate to verify eligibility, assures the implementation of appropriate accommodations, and supports the request for accommodations, academic adjustments, and/or auxiliary aids.

For more information on disability resources and documentation guidelines please contact Larry Powell, EOS Manager (412) 268-2013– lpowell@andrew.cmu.edu or visit our website at, http://hr.web.cmu.edu/eos.html

Carnegie Mellon Action Project
The Carnegie Mellon Action Project (CMAP) was founded at Carnegie Mellon in 1968. It was established originally to aid the university in recruiting African American students, to provide them with academic and supportive services to assure their progress toward graduation. In the fall of 1991, Hispanic and Native American students became a part of CMAP’s target population. CMAP provides a wide range of academic and non-academic activities including a fall pre-orientation program for incoming first year students, academic tracking and monitoring and a comprehensive tutoring program. Attention is paid to students’ personal development through a variety of special programs, and assistance is available to help them explore career interests and mount effective job searches. But perhaps the most important aspect of CMAP is that it is a place where students can “chill out” and where the uniqueness of each student is the number one priority. CMAP is not just for “students who need help.”

Recruitment and Admission
All students are admitted through the Office of Admission. CMAP assists in the recruiting process by meeting with prospective students and parents, conducting information sessions and co-sponsoring campus visitation events.

Summer Academy for Math and Science (SAMS)
One of seven pre-college programs at Carnegie Mellon, SAMS is designed for African-American, Hispanic, and Native American, and other juniors and seniors who are considering careers in engineering, science and other math-based disciplines. Traditional classroom instruction, along with creative “hands-on” projects will allow students to apply concepts and principles. This six-week residential summer experience focuses on creating interest in technical disciplines and building academic and personal skills required for admission to competitive colleges and universities.

Academic Advising
CMAP advisors, working in cooperation with academic departmental advisors, assist students with course selection and sequencing to meet their major requirements. CMAP monitors students’ performance throughout the school year. The primary objective is to assure that students are making consistent progress towards graduation.

Tutorial Services
CMAP offers a comprehensive tutoring program. The tutoring sessions, both individual and group, are available to CMAP students at no cost. An extensive roster of professional and peer tutors is maintained to ensure that help is available to any student who needs or desires it in a timely manner. In addition to tutoring, CMAP also sponsors workshops such as study skills, time management and test taking strategies.

Personal Counseling
CMAP advisors are available to address the personal, emotional and social needs of African American, Hispanic and Native American students. One-on-one sessions cover a multitude of topics. CMAP’s goal is to help them clarify issues, explore possible solutions and make sound decisions.

Career Development
Students are encouraged to investigate career options in depth through one-on-one work with their advisor. Workshops on interviewing skills, resume preparation, image development and other job search strategies are held throughout the year. Carnegie Mellon minority alumni frequently visit to share their experiences with current students. We also conduct seminars hosted by companies that are interested in creating a diverse workforce. Recognizing that work experience helps students to clarify career direction, CMAP provides current information on opportunities for summer and permanent employment in their chosen fields. For those students who want to pursue graduate school guidance and workshops are offered as well.

Community Service
Activities may involve one-time and on-going service opportunities in a variety of settings. Through community service involvement, students will improve the quality of life for others, enrich and enhance what they learn in the classroom, gain leadership skills, explore career interests, get “connected” and make new friends.

Summary
CMAP exists to provide a supportive environment where student talent is guided and reinforced. The program interfaces with all major administrative, academic and student service departments to assure that the retention effort is an integral part of the campus community. The focus remains on viewing and treating all students, and especially minority students as individuals with goals, talents and abilities . . . as individuals who can be successful at Carnegie Mellon.

Carnegie Mellon Action Project Staff
Mrs. Ty Walton, Director, tw0y@andrew.cmu.edu
Phone: (412) 268-2150 Fax: (412) 268-1527

Office Hours: M – F 8:30 am – 5 p.m.
Computing Services
Vice Provost for Computing Services: Joel Smith
Cyert Hall
www.cmu.edu/computing/

Computing Services develops, maintains and supports the computing and communications resources for the students, faculty and staff of Carnegie Mellon. Their services include networking the central campus computers, Andrew file servers, and personal computers as well as a high-speed wireless infrastructure. The division is also responsible for system software development, computer clusters, computer repair, computer store and telephone services that include voicemail and long distance as well as cable TV services. Visit www.cmu.edu/computing/ for additional information.

The college/s-wide network (dubbed "Andrew" for benefactors Andrew Carnegie and Andrew Mellon) provides high-speed data connections that reach into every residence hall and campus office. In 2001, Carnegie Mellon became the first university to offer a wireless network that encompasses all campus buildings and key outdoor areas. Today, the campus network is comprised of more than 22,000 personal computers, workstations and servers and more than 12,000 wireless connections.

The Help Center: Cyert Hall A-50
www.cmu.edu/computing/support/

The Help Center staff is available to answer your questions or resolve problems related to computing at Carnegie Mellon. Consultants are available weekdays from 9:00 a.m. to 5:00 p.m. You can contact the Help Center by phone, in person, or by sending e-mail to advisor@andrew.cmu.edu.

The Help Center also handles computer accounts and user IDs that are used in the university's central computing systems. Account information is available from the University Directory web page at www.cmu.edu/directory/.

Information Sources
www.cmu.edu/computing/software/

To easily access a variety of information and services on the web, the Computing Services division developed the Carnegie Mellon web portal. You can subscribe to a variety of news and service portlets to create your own gateway to the information and services you want. Visit the portal on the web at my.cmu.edu.

The division publishes documentation to help you configure your machine for the campus network, read e-mail and bulletin boards, get the software you need, and more. Printed copies of some of these documents are available at the Help Center in Cyert Hall A-50. All documentation is available on line at www.cmu.edu/computing/documentation/.

Additionally, in an effort to help new students become oriented to our computing environment, Computing Services initiated the FreshStart program. Visit the FreshStart web site at www.cmu.edu/computing/freshstart/ for help with finding your user ID, password, hardware requirements for computing on campus, and other related information.

Clusters
www.cmu.edu/computing/clusters/

Cluster Services provides 400 UNIX, Macintosh, and IBM-compatible computers in eight public computer labs known as "clusters." Most clusters are open 24 hours per day when classes are in session and have a consultant on duty to answer basic computing questions.

The College of Fine Arts in conjunction with clusters runs the Multimedia Studio. The Multimedia Studio provides students with the multimedia digital equipment for digital video, animation, and computer modeling, digital imaging, digital sound recording, music composition, and large format color printing. This facility is available to the campus community with preference for CFA courses and coursework.

Telecommunications
www.telecom.cc.cmu.edu/

Telecommunications provides telephone services, including lines, equipment, maintenance, voicemail and long distance, to students, faculty, and staff. Telecommunications also manages the university's Cable TV services.

Computer Store: Cyert Hall A-64
www.cmu.edu/computing/store/

The Computer Store offers a variety of hardware and software with a focus on the needs and requirements of the university computing environment. Hardware, from vendors such as Apple, IBM, Dell, Hewlett Packard, Gateway, and educational software are available for faculty, staff, and students with a valid Carnegie Mellon ID card. Peripherals and supplies such as removable media, paper, ink cartridges, and printers are also available. If an item is not in stock, the Computer Store can order it for you. The store accepts check, cash, department charge, CampusXpress, MasterCard and Visa.

Computer Maintenance Group: Cyert Hall A-75
www.cmu.edu/computing/cmg/

The Computer Maintenance Group (CMG) offers repair services for a wide range of products including those sold through the Computer Store. These services are available to any member of the campus community. If the parts are readily available, repairs are usually completed within two to three working days. When parts must be special-ordered, CMG makes the arrangements and quotes prices and turn-around time. Other services include pick-up and delivery to academic buildings on campus, shipping equipment to the manufacturer, back up of hard drives, upgrades, equipment evaluation, and extended warranty contracts. CMG accepts check, cash, department charge, MasterCard or Visa.

Applications Software
www.cmu.edu/computing/software/

The Applications Software group acts as a central point of information for campus software licenses, both those negotiated by Computing Services and those obtained by other campus groups, colleges, and departments. Applications Software maintains a web site at www.cmu.edu/computing/software/ where you will find extensive information about their services and schedules. Available software can be downloaded from the My Andrew web service at www.cmu.edu/myandrew/.

Network Group
www.net.cmu.edu/

The Network Group is comprised of: Network Engineering, Network Development and Data Communications. These groups provide the networking hardware and software to interconnect the central campus computers, the Andrew file servers, and personal computers in various configurations. Key components of their service include:

- A campus-wide Internet running TCP/IP.
- An External Internet that includes both commodity and research connectivity.
- A dialup modem pool comprised of V.90 modems that can be accessed by telephone.
- Campus-wide wireless access.

For more information about Computing Services, visit our web site at www.cmu.edu/computing/.
**Dining Services**

Carnegie Mellon Dining Services offers students a medley of campus dining choices. Several components are combined to provide the highest quality of food, service and convenience to our students.

**Casual Dining Program**

Local restaurants and caterers offer specialty and ethnic meals at different locations on campus. This is the perfect way for busy and active students to get a complete and satisfying meal.

- **Posner Hall** deli sandwiches, hot entrees and salads
- **Mainstreet Market Express** (Newell Simon Atrium): pastries, hot entrees, sandwiches, soups and pizza
- **La Prima Espresso** (Wean Hall fifth floor lobby, Baker Hall annex): espresso, cappuccino, Italian pastries and focaccia bread
- **Asiana** (Newell Simon Atrium): Chinese entrees and soups.
- **Taste of India** (4902 Forbes Avenue and Resnick Hall): Northern Indian cuisine

**University Center (UC) Dining Gallery**

The UC Dining Gallery was introduced to the Carnegie Mellon campus in 1996. This concept features a wide variety of offerings from local restaurants and in-house providers.

- **Original Hot Dog Shop** (UC first floor): french fries, hot dogs, hamburgers and Philly Cheese Steaks
- **Andy’s Eatery**
- **Barista Cafe** (UC second floor): Enjoy a cup of our special blend coffee, cappuccino, or espresso. Also be sure to sample one of our freshly baked pastries.
- **East Street Deli** (UC second floor): Choose from your favorite deli meats, cheese and Breadworks bread. Our menu also includes daily features.
- **SI Senor** (UC second floor): homemade Mexican cuisine, wraps, tacos and burritos.
- **Grab & Go** (UC second floor): upscale salad selection, vegetarian/vegan offerings, and kosher meals, sandwiches, bottled beverages and snacks.
- **Penne’s International** (UC second floor): For those of you who want traditional food, you will want to stop at Penne’s market. We feature chicken potpie, carved turkey with fresh mashed potatoes and many other selections including daily vegetarian items.
- **Pepperazzi** (UC second floor): The ultimate in fresh dough pizza and pasta. At Pepperazzi we prepare fresh pizzas, calzones, hot subs and fresh pasta.
- **CK’s Pretzel Works** (UC second floor): fresh baked, hand twisted, gourmet soft pretzels, pretzel pocket sandwiches, ice cream, yogurt and cheesecake.
- **Skibo Coffeehouse** (UC second floor): Kiva Han coffee, espresso, cappuccino, gourmet sandwiches, smoothies, soup bowls and a variety of appetizers.
- **Schatz Dining Room** (UC second floor): full-service buffet restaurant, hot entrees and salad bar.

**Vending Services**

Vending Services occupy a number of locations on campus. From this 24-hour service, students may choose entrees, “Healthy Choice” lunch meats, soup, coffee, assorted beverages and snacks.

**Meal Plans**

A variety of meal plan options are offered to the students. Participation in the Carnegie Mellon Dining Plan offers convenience, value and variety. All meal plans are encoded on the Carnegie Mellon Card. For more information, please call x4-4180.

**Division of Student Affairs**

**Michael C. Murphy, Dean of Student Affairs**

Warner Hall 301

The Division of Student Affairs coordinates student services and orchestrates the metacurricular life of the campus. The operation is founded on a broad-based system focusing on the intellectual, occupational, emotional, spiritual, physical and cultural growth and nurturing of students.

With primary emphasis on the development of the entire student, the division includes the following departments:

- **Career Center**
  - Counseling and Psychological Services
  - Health Services
  - Housing Services
  - Office of International Education
  - Office of the Assistant Dean
  - Office of the Dean
  - Office of Orientation and First Year Programs
  - Office of Student Activities
  - Student Life Office

Departments within the division strive not only to meet specific student needs, but to provide general student direction and guidance, including referral to resources available both within and outside the university. The division places particular emphasis on developing community and integrating various constituencies to expedite student growth, including faculty, staff, alumni, parents, trustees, and members of the broader local, national and international communities. The division holds as its ambition that each student reaches his or her highest potential in the areas of intellectual and artistic development, personal and professional skill development, leadership development, and contribution to the larger community. The staff throughout the division are here to help undergraduate and graduate students. We care about you, your studies, your social growth, your well-being and your future. We want to help you enjoy a great Carnegie Mellon experience.

**Career Center**

Paul Fowler, Director and Associate Dean of Student Affairs

University Center Lower Level, 8-2064

The thoughtful selection of a satisfying career path and the subsequent preparation needed to attain this goal are two prime concerns for most of today’s students during their university experience. Therefore, it becomes a key responsibility for institutions of higher learning to be responsive to this and to offer career development and job-search programs which are of the highest quality, comprehensive in their scope, and uniquely designed to meet the needs of their students. Carnegie Mellon has long demonstrated the importance of this segment of a young person’s development by maintaining an office charged with that responsibility since the earliest years of the university.

The range of services currently offered by the Career Center includes workshops and seminars designed to equip students with important career exploration and career decision making skills, individual advising and the availability of state of the art interactive computer based career interest inventory and other professionally administered techniques to aid in this process. A career consultant works with the students and faculty in each college to provide targeted programming and individual advising that meet the specific needs of students within each college.

A very important resource available in the Career Center is the career library collection which features an extensive assortment of electronic and paper materials on career planning and career choice, occupa- tional monographs, job vacancy listings, business and professional directories, graduate study directories and employer information and recruiting brochures featuring most of the leading firms in the nation. Students regularly use this information as they consider their choice of an occupation, career or profession or as they are actively engaged in the search for summer internships, part time campus employment or that first job after graduation.
Because the name of Carnegie Mellon has come to be regarded as synonymous with the highest qualities of scholarship, research and artistic endeavor, employers of all types see the university as the source of some of the most able and talented graduates in the nation. During the past year, approximately 600 firms sent representatives to the campus to meet with interested internship and full time job candidates. This represents over 1100 interview schedules and approximately 10,000 individual interviews over the course of the academic year. Average starting salaries offered to Carnegie Mellon graduates in most fields consistently rank above national norms.

Recruiting Policy

All organizations are given equal access to recruit on campus by the Career Center. Organizations are advised of Carnegie Mellon’s Statement of Assurance and are required to submit a copy of their non-discrimination policy. They are also required to complete a Career Center information form that includes questions about the organization’s hiring policies pertaining to citizenship requirements, drug testing and sexual orientation.

Counseling and Psychological Services

Cynthia Valley, Director
Morewood Gardens E-Tower, x-2922

Counseling provides students with an opportunity to talk about personal, career or academic concerns. Students go to the Counseling Center for a variety of reasons: problems with friends, family or school; confusion about future goals; feelings of stress, low self-esteem, anxiety, depression or loneliness; substance abuse and eating disorders. Counselors at the center are good people to talk to when you have any kind of concern. The center offers individual and group psychotherapy, crisis intervention, and psychiatric consultation. Counseling sessions are free and confidential. Students who have personal concerns or concerns about others are encouraged to contact the center for assistance. The Counseling and Psychological Services center office is open weekdays, and there is a professional on call for emergencies during evenings and on weekends.

Health Services

Anita Barkin, Director
Morewood Gardens E101, x-2157

Health Services provides general medical care, gynecological care and contraception, allergy injections, first aid and on-site pharmaceuticals. Appointments to see the physician, nurse practitioners and registered nurses can be scheduled by calling the office Monday through Saturday during normal operating hours. Walk-in emergency appointments are also provided.

Examinations for illness and injury are free of charge, however, fees for laboratory tests, diagnostic procedures and referral to the emergency room or specialists are the responsibility of the student. There may be a fee for medication. Entering students are asked to submit the health history form found in the admission packet. Immunization information must be completed on the back of the form. Several immunizations are required for full matriculation to the university. If a student has a medical emergency when the office is closed, he/she can call campus security at x-2323 for transport to an emergency room or specialists are the responsibility of the student. Nurses can be scheduled by calling the office Monday through Saturday during normal operating hours. Walk-in emergency appointments are also provided.

Health Insurance

The university requires students to carry adequate medical insurance. All students are charged for basic coverage under the university plan. Students are required to take one of three actions: 1) pay for the basic plan as charged on the student account or 2) enroll in one of the enhanced benefit options or 3) complete the waiver form indicating that the student is already covered under another plan. In order to qualify for a waiver from the student insurance program, the student must be listed as the principle, spouse or dependent in a government or employer-sponsored plan that meets certain criteria for coverage. The charge for the basic plan will be removed if, and only if, the plan qualifies. Individually purchased plans are not accepted. Questions can be addressed to shinsure@andrew.cmu.edu

Office of the Dean of Student Affairs

Michael Murphy, Dean of Student Affairs
Jennifer Church, Associate Dean of Student Affairs
Warner Hall 301, x-2075

The dean is responsible for leading the division of student affairs in providing students with quality services, programs and experiences that support and complement the academic mission of the university. The Office of the Dean of Student Affairs provides central guidance and direction of student services at Carnegie Mellon by coordinating divisional and student life assessment efforts and facilitating interdepartmental interaction. Staff in the office of the dean serve as housefellows to five residential areas and coordinate specific initiatives that promote leadership development; multicultural, gender, and GLBT awareness; and promote community involvement. While students are encouraged to seek out any member of the division for help, you may also meet with the dean or associate dean directly by contacting 268-2075 and scheduling an appointment at your convenience.

Office of the Assistant Dean

Wendy S. Hermann, Assistant Dean of Student Affairs
Morewood Gardens A-Tower, 8-9510

The Office of the Assistant Dean works in partnership with multiple offices in and out of the Division of Student Affairs to serve and support the metacurricular experience of Carnegie Mellon students. The focus of the office centers on being a residential liaison through the participation in the Housefellow Program as well as a non-residential liaison in terms of student organization advising. Other key areas include, service learning and community partnerships, initiatives in artistic and intellectual development and programs designed for personal and professional development. Programs housed in the Office of the Assistant Dean include:

- The University Lecture Series
- Soup and Substance Lecture Series
- Arts Pass Program
- Alternative Spring Break
- Dimensions Workshops

Contacts in the Office of the Assistant Dean include:

- Housefellows for Morewood A&B, C&D, E-Tower and Mudge
- Advising for SDC
- Advising for Underground Programming
- Advising for the First Year Service Initiative (FYSI)

Office of International Education

Lisa Krieg, Director of International Education
Warner Hall, 3rd Floor, x-5231

The Office of International Education (OIE) serves three main groups: foreign students, foreign scholars, and all students who would like to study abroad. OIE also plays a prime role in Carnegie Mellon’s effort to internationalize the campus.

Service to Foreign Scholars

OIE advises departments on immigration matters and preparation of visa documents for visiting professors and researchers who come to Carnegie Mellon from abroad. The foreign scholar advisor meets with all visitors upon arrival to verify their immigration documents, provide orientation data and answer any questions they may have relating to immigration matters and adjustment to life in the Pittsburgh area, and more specifically, Carnegie Mellon. OIE advises and assists departments in assuring that all visitors maintain a valid immigration status while they are at Carnegie Mellon.

Service to Foreign Students

OIE coordinates two orientation programs each August which are designed to help all international students who come to Carnegie Mellon. There is a week-long program for international graduate students and a shorter program for international undergraduates. During the orientation, OIE introduces students to university life, public transportation, campus security, health care, health insurance,
social security, cultural adjustment, etc. Assistance with finding housing is also provided to graduate students. Special support is offered to spouses and partners of foreign students by the International Spouses and Partners Organization. During orientation and all through the year, the foreign student advisors serve as liaisons to the university for foreign students and advise them on personal, immigration, academic and social issues. Seminars on career opportunities, income tax preparation and other matters are held at appropriate times. The foreign student advisors also serve as advisors to the International Student Union and other international student groups on campus.

### Study Abroad

www.cm.edu/studyabroad

Carnegie Mellon students from every major can study in virtually any part of the world for a semester, year or summer. A well planned study abroad program will allow a student to receive credit for study abroad and graduate on time. Most students study abroad during their junior year; however, a growing number of students are studying abroad during their sophomore year.

The Study Abroad Advisor provides general information sessions as well as individual advising to assist students in the study abroad process. The Office of International Education (OIE) has a library of over 3,000 available programs as well as useful web links to help students to find the most appropriate study abroad program. In addition, OIE offers orientations to help with personal, academic and acculturation issues, before and after a study abroad experience.

Carnegie Mellon offers students a variety of payment schemes for study abroad to allow students to study abroad regardless of financial need. There are two categories of programs, exchange programs and sponsored study abroad programs that allow students to pay through Carnegie Mellon and maintain all scholarships, grants and financial aid.

Carnegie Mellon offers a variety of options for study abroad, including:

### University Exchange Programs

Carnegie Mellon University has a number of university-wide undergraduate exchange programs. Students who participate in exchange programs pay Carnegie Mellon tuition and receive their regular financial aid package. Students are responsible for room, board, travel and miscellaneous expenses. Currently, University Exchange programs are offered in Switzerland, Mexico, Japan, Singapore, Chile, Israel, China and Australia.

### Departmental Exchanges

Art, Design, Chemical Engineering, Materials Science and Engineering, and Business offer departmental exchange programs. Students should contact the department for additional information. Departmental exchanges are set up in the same way as university exchanges; students pay Carnegie Mellon tuition and receive their normal financial aid package. Students are responsible for room, board, travel and miscellaneous expenses.

### Sponsored Study Abroad

The university has designated a few study abroad programs administered by other organizations or universities as sponsored programs. On these programs, students will pay a university fee equivalent to current tuition, room and board charges, and retain their eligibility for all financial aid. Carnegie Mellon will pay the program costs to the study abroad sponsor. Where applicable, funds are distributed to the student for room, board, travel, and personal expenses. Applications and information are available in OIE.

Currently we have sponsored programs in Australia, Botswana, Canada, China, England, France, Germany, Ghana, Ireland, Italy, Japan, the Netherlands, South Africa and Spain.

### External Programs

Students may also participate in a program sponsored by another university or study abroad organization. If the student’s home department approves the program and its course offerings, the student may participate. Students will pay the other organization or institution directly. Students who receive institutional aid from Carnegie Mellon will not be eligible for this aid while they are abroad. However, students with state and federal aid will still qualify. Semester and full year programs are available. Information may be obtained in OIE. Examples of programs that Carnegie Mellon students have attended are: AIFS, Arcadia University, Boston University, Butler University, Council, Cornell University, Institute for the International Education of Students (IES), Syracuse University DIS, Semester at Sea; as well as direct enrollment to international universities.

### Office of Orientation and First Year Programs

Anne R. Witchner, Assistant Dean of Student Affairs
Morewood Gardens 188, B-4887

The Office of Orientation and First Year Programs is responsible for providing vision and leadership for a comprehensive approach to new student orientation and transition programs. The office provides programs, opportunities and services to help students and family members successfully transition to the Carnegie Mellon community.

The office is responsible for program development, marketing and implementation of orientation and transition programs. Areas of concentration include: new student orientation, parent’s programming such as Family Weekend, freshman programming series, and special event planning.

### Office of Student Activities

John Hannon, Director of Student Activities
University Center 103, x8-8704

The Division of Student Affairs centers its support of campus activities through the Office of Student Activities in the University Center. Students are encouraged to pursue extracurricular interests which will give them an opportunity to meet other students, become familiar with the university, have fun, learn a skill or make the campus and the community a better place.

Student Activities is committed to assisting student-run organizations on campus and provides advising, support, and leadership training for the student organizations that exist at Carnegie Mellon. The Office of Student Activities also works to ensure that students have an opportunity to broaden their social, spiritual, physical, intellectual, and cultural understanding by means of an extensive series of programs designed to complement curricular learning opportunities.

The student activities fee, administered by the Student Government, provides funding for a wide range of extracurricular activities. The Activities Board is responsible for bringing a variety of programs to campus, including concerts, lectures, films, as well as planning coffeehouses and dances. Students using the resources provided by the student activities fee have sponsored many activities including ultimate frisbee, a robotics club, an art gallery, a newspaper and an FM radio station. Students have also formed special interest groups dealing with leisure recreation activities as varied as skiing, amateur exploring, karate and ham radio. Still other student-designed activities provide for the needs and interests of the student body.

The university has always encouraged the formation of new student organizations, clubs or activities to meet newly identified needs. Student Government has been eager to support both financially and with its organizational resources a wide variety of experiences important to the self-development of students.

### Student Life Office

Renee Camerlengo, Director of Student Life
Office: Morewood Gardens, A-Tower, x8-2142

The Student Life Office strives to foster the development of residential communities that offer meaningful and diverse experiences in support of students achieving their full academic, personal and professional potential at Carnegie Mellon and beyond. In collaboration with other divisional staff, Student Life is responsible for the resident advisors and community advisors that lead the house communities and can connect students with the team responsible for their specific living area.

Carnegie Mellon is proud to have 13 national fraternities, four national sororities, one private sorority and four colonies as part of our community which is advised by Student Life. Carnegie Mellon Greek organizations are dedicated to academic achievement, service to the community, leadership development, and the cultivation of friendships. Membership in each chapter reflects the diversity on our campus as Greeks have a variety of majors and interests, and come from all geographic locations.
The Student Life Office also coordinates the community standard process. Working with individuals and groups to uphold the highest standards of personal, ethical and moral conduct possible, staff in this office counsel and advise students as they go through the mediation process. The university is committed to a strong community supported by the adherence to a set of standards of mutual respect for all individuals. The judicial process is educational in nature, allowing representative members of the community (students, faculty and staff) to be able to influence and make recommendations in regard to judicial outcomes. The university reserves the right to dismiss students for serious infractions of regulations, improper behavior or unsatisfactory academic standing. Dismissal for disciplinary reasons does not take place without providing the student access to the university judicial process. All judicial procedures are outlined in The WORD/Student Handbook.

Housing Services
Tim Michael, Director
Morewood Gardens, E-Tower, x8-2139
www.housing.cmu.edu

Housing Services provides a variety of accommodations for Carnegie Mellon students. Living arrangements include traditional single-gender residence halls, coeducational residence halls, suites, apartments, houses and fraternity and sorority living areas. Campus housing is assigned to all first year students 17 years of age or older. Students who will not be 17 before the start of their first semester are asked to contact Housing Services upon receipt of their campus housing application. Transfer student housing is subject to availability and therefore, transfer students are also asked to contact Housing Services.

Campus housing is available on campus and in our Oakland apartments. All on-campus residential areas are located in close proximity to academic buildings. The Oakland apartments are located very near the campus and are an approximate 5-10 minute walk to campus. The university’s shuttle bus services these areas on a regularly scheduled basis.

Furnishings and Amenities
Housing Services provides each resident with a bed, a desk and chair, a bookshelf, a dresser and a closet or wardrobe. Each room is also equipped with window coverings and cable TV, and all of our buildings have ethernet or broadband service for fast data connectivity. Items such as pillows, linens, area rugs, etc., are the student’s responsibility.

Room Rates
Room rates include utilities, maintenance, campus and local phone service, a cable TV jack and Ethernet/broadband connection in each room, apartment, or house. Students pay separately for room and service, a cable TV jack and Ethernet/broadband connection in each

Room Preferences
We give our best effort in fulfilling each student’s individual housing preferences, but it is often difficult to accommodate everyone’s top choice due to the high demand for housing at Carnegie Mellon. Financial Aid budgets are based on standard double room rates. It is

Apartments
- Efficiency, one-bedroom and two-bedroom apartments are available
- Grouped and priced by occupancy, location, and number of bedrooms
- In-room cooking facilities

Houses
- Grouped and priced by occupancy and location
- Includes bedrooms, a kitchen, a dining room, a living room, private bath and laundry facilities

NOTE: Please be aware that the typical first-year student budget used in determining financial aid is based upon residence in a standard double room. These budgets are not adjusted for more expensive living accommodations.

Other Living Arrangements
All first-year students live in campus housing. First-year students who wish to be exempt from this requirement and would like to commute from home should contact Housing Services.

Students receiving this permission, moving into a fraternity or sorority house or leaving campus housing (except to participate in an academic program away from the Pittsburgh area) should be aware that their opportunities to move into Carnegie Mellon campus housing in the future may be very limited. Students wishing to return to campus housing join a wait list for spaces remaining after all returning residents, incoming first-year students and transfer students have been housed.

Community Housing
The Office of Housing Services in Morewood Gardens provides an off-campus housing advisory service. This community housing service maintains up-to-date information on available apartments, houses and rooms in private homes for rent, as well as on students who are looking for roommates. Additional services are also offered that assist customers in finding a new home and provide guidance through all the processes that accompany it.

Since accommodations in the campus residence system are not available to graduate students, Community Housing Services is a good resource for graduate students seeking accommodations in the local area. For more information on our services, please visit our website at http://www.housing.cmu.edu/.

Housing Reservations
Returning Student Room Selection (Room Draw)
Each spring returning resident students will have an opportunity to reassess spaces in campus housing on a seniority basis through the Room Draw process that takes place in March. Returning students most often select apartments and residence hall rooms that offer more flexibility and privacy, features typically created by a kitchen and/or semi-private bathroom facilities.

First-Year Student Room Assignments
Most first-year students are assigned to traditional residence hall rooms where each floor shares a community bathroom. Because these traditional residence hall rooms (standard rooms) support the development of strong community, they provide excellent opportunities for first-year students to develop many friendships on their floor and throughout the building. While every effort is made for first-year students to share a room with other first-year students, a small number of first-year students will sometimes share a room with a returning student. If two first-year students request each other as roommates, their request will usually be honored unless their dates of deposit are too far apart.

Room assignments for first-year students will be made in the order in which their original university deposits were processed by the Office of Admission. The Office of Admission provides Housing Services with the information concerning the date on which each incoming student deposit was processed.
important for those who are not assigned to this type accommodation to be aware of this fact. Housing Services does not adjust any of the housing rates for students, even though they may be assigned to an accommodation at a rate higher than that requested.

**Roommate Matching Procedures**
A number of factors are taken into account when we make roommate assignments: a preference for a special residential program, specific hall or room type, smoking status, and college and major. Also factored into the equation is personal information about how you intend to utilize your room (social or study purposes), how clean you intend to maintain your room and whether you consider yourself to be a “night” person or a “morning” person. Housing Services does not, and will not, discriminate in any way in regards to roommate matching. It is important for students to be honest when filling out the housing application as it will eliminate the potential for roommate conflicts.

**Housing License Agreement**
Students are required to complete, sign and return the Housing License Agreement with their housing application. The Housing License Agreement states the terms and conditions of occupancy by which the student and the university intend to be legally bound. Housing Services advises students, parents and guardians to read the agreement thoroughly before being signed and returned. The Housing License Agreement is for two full terms, beginning with the fall semester.

**Important Information About Temporary Housing**
Because housing is in high demand at Carnegie Mellon, occupancy pressures may dictate that a limited number of first-year students spend anywhere from a few days to a few weeks in temporary housing. We utilize a local hotel staffed with our resident assistants and offer the same programs and support offered to other first-year students. Other amenities offered from the hotel are air conditioning, daily maid service, regular shuttle service to and from campus, and a free continental breakfast. Once it is time to relocate to a permanent assignment, Housing Services will orchestrate and assist in the move.

**Housing Terms and Conditions**
The Housing License Agreement is a binding document and states the terms and conditions of occupancy by which the student and the University intend to be legally bound, including the dates of residence. The University advises the student and parents or guardians to read the Agreement carefully before signing and returning it to the Office of Housing Services. THE HOUSING LICENSE AGREEMENT IS FOR TWO FULL TERMS, BEGINNING WITH THE FALL SEMESTER.

**Refund Policy:** As a rule, a student who signs a Housing License Agreement for the academic year may not receive any refund for withdrawing from campus housing before the end of the entire two-term period or other dates specified in the agreement, except for reasons of marriage, verified departure from the university or the application of special provisions and refund amounts based on sorority or fraternity membership (based upon negotiated leases). During the academic year, if a housing room payment should become refundable, the refund shall be recorded as a credit to the student’s account with the University. Refund amounts are calculated on a pro-rated basis for the days remaining in the contractual term after the student completes the entire withdrawal procedure, which includes completion of the Withdrawal from Campus Housing Form and returning the room key to the Office of Housing Services. Additional information on Housing Services can be found in "The Word", "From the Ground Floor Up, the Housing Services Guidebook" or through the internet for Housing Services at www.housing.cmu.edu.

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**Academic Support Services**

**Academic Development Center**
Linda Hooper, Director
Old Student Center 212, x8-6878

Academic Development provides a variety of support services geared towards helping students develop the skills, strategies, and behaviors needed to perform as confident, independent, and active learners. These services range from study skills instruction in areas such as textbook reading and lecture note taking to tutoring and review sessions in selected courses. These services are free of charge and available to all Carnegie Mellon students – those who are having difficulties and those who just want to improve their skills.

Major programs and services offered through Academic Development include:

- **Peer Tutoring** – Subject-specific tutoring geared primarily (but not exclusively) to introductory courses is available on both a walk-in and individual basis at select times.
- **Study Skills Instruction** – Students can register for group workshops or make one-on-one appointments to receive instruction on topics such as time management, test preparation, etc.
- **Supplemental Instruction (SI)** – The SI Program offers weekly review sessions that supplement regular course content for traditionally difficult subjects.
- **First Year Success Series** – This on-line series provides practical advice from Carnegie Mellon students and faculty about many of the new challenges that first-year students face during their first few weeks of college.
- **Fast Facts** - These pamphlets cover a variety of topics related to academic success ranging from fighting test anxiety to preparing for exams.

**Intercultural Communication Center**
Peggy Heidish, Director
Office: Warner Hall 418, x8-268-4979
www.cmu.edu/icc

**Bridging Language Gaps**
The Intercultural Communication Center equips non-native speakers of English with the skills they need to succeed in their academic programs. Our program is designed for students who are too advanced for traditional ESL programs. In addition to the English language, students study the culture and customs of the American classroom. The center offers:

- A Writing Clinic with individual appointments for both bilingual and non-native speakers who want to improve the writing skills required for their academic work.
- Individual tutoring in specific areas such as speaking, listening, fluency, listening comprehension, grammar, and TA skills.
- Workshops and classes focusing on a variety of language and cultural skills, such as Advanced Grammar Monitoring, Presentation, Pronunciation Targets, Job Interviewing for NonNative Speakers and Language and Culture for Teaching.
- Placement Interviews to evaluate proficiency in spoken English (note: required before students can register for ICC work).
- The ITA Test, a screening test for any non-native speaker of English (undergraduate as well as graduate) who plans to work as a TA.

**Level of English fluency needed for non-Native English speakers - Please see page 60.**
Fellowships
Fellowship Resource Advising Center
Janet Stocks, Assistant Vice Provost for Education, Director
Judy Zang, Scholarship Coordinator

Students at Carnegie Mellon are encouraged to apply and/or be nominated for a number of prestigious national and international fellowships. Each of these provides an opportunity to become part of a new community of scholars and opens doors throughout your career. The Morris K. Udall Foundation Undergraduate Scholarship. The Morris K. Udall Foundation Native American Congressional Internship, the Harry S. Truman Scholarship, the Barry H. Goldwater Scholarship, the Rhodes Scholarship, the Marshall Scholarship and the Fulbright Scholarship are just a few examples of these prestigious awards.

The Fellowship Resource Advising Center also provides information about other scholarships of all kinds, and works closely with students and faculty to help put together a truly competitive application.

Visit the FRAC website www.cmu.edu/frac to receive information and updates about scholarships and fellowships that are relevant to you. The website also contains links to other resources which provide information on external educational opportunities.

The Fellowship Resource Advising Center provides information about these awards and works closely with students and faculty to help develop a truly competitive application.

The FRAC also maintains a small searchable database of more than 500 national and international fellowship and scholarship opportunities as well as pointers to other databases which provide support for undergraduate and graduate work.

Teaching Certification
Carnegie Mellon students interested in secondary school teaching can participate in a 5-year program that will allow them to earn their undergraduate degree at Carnegie Mellon and spend one year in an intensive Master of Arts in Teaching (MAT) program at Chatham College to earn the MAT and Pennsylvania Teacher Certification. To make this program possible, interested undergraduate students should plan to cross register at Chatham for 72 units of required courses, using elective spaces in their schedule.

Criteria for admission or the MAT program includes: An overall GPA of 3.0, and completion of three pre-professional Praxis exams in Reading, Writing and Mathematics. All candidates for initial certification in Pennsylvania must have earned at least a baccalaureate degree, completed an approved program of teacher education, and passed The Praxis content tests for their certification area. For more information about Praxis exams, www.ets.org/praxis.

To plan early, contact Judith Hallinen, Director, Center for School Outreach, 8-1498.

Honor Societies
Phi Beta Kappa Society
Carnegie Mellon shelters a chapter of the Phi Beta Kappa Society, sponsored by the three colleges and one program (College of Humanities and Social Sciences, Mellon College of Science, School of Computer Science, and Bachelor of Humanities and Arts program) that comprise the University’s “arts and sciences” equivalent. The chapter’s name is “Upsilon of Pennsylvania,” and was formally installed in April of 1995.

Founded in 1776 at the College of William and Mary in Williamsburg, Va., Phi Beta Kappa is the nation’s oldest honorary society, with chapters at 249 of the foremost institutions of higher education across the country. Almost all members are elected by the chapters from among candidates for degrees in liberal arts and sciences, usually from the top 10% of the graduating class.

The society’s name is formed by the first letters of the phrase Philosophy Biou Kybernetes, Philosophy (wisdom) is the Guide of Life. In line with the conviction that the test of education lies not in what people know but in what they are, the objectives of humane learning encouraged by Phi Beta Kappa include not merely knowledge but also intellectual honesty and tolerance, a broad range of intellectual interests and understanding.

The Carnegie Mellon chapter is active in sponsoring visiting speakers, on-campus roundtables that focus on current issues, community service activities, scholarship opportunities, student research involvement, and the like.

Many notable figures in American History have earned the coveted Phi Beta Kappa key including leaders of the American Revolution, delegates to the Constitutional Convention of 1788, and members of the Continental Congress and the U.S. Congress. Six United States presidents earned the honor as undergraduates and another 10 presidents were elected as alumni or honorary members.

Membership in Phi Beta Kappa key has become a universally recognized mark of academic achievement in the liberal arts and sciences. The key’s venerable pointing finger proclaims for all to see the wearer’s commitment to Phi Beta Kappa’s ancient principles (represented in the three stars) — friendship, morality and learning.

The Honor Society of Phi Kappa Phi
The Honor Society of Phi Kappa Phi has been an important presence on campus since 1933. Phi Kappa Phi, a national honor society that began in 1897 at the University of Maine, takes its name from the initial letters of its adopted motto, Philosophia Krateito Photon, “Let the love of wisdom rule humanity.” Phi Kappa Phi recognizes and honors persons of good character who have excelled in scholarship, in any field. Members are nominated by their department or their school or college and then invited to join the society. To be eligible, seniors must be in the top ten percent of their class and juniors must be in the top five percent. Graduate students, alumni, faculty and staff are also eligible for nomination. The chapter inducts new members twice a year and provides information to its members on all sorts of opportunities, including study abroad, internships, and national scholarships, recognition and awards.

Undergraduate Research Initiative
Janet Stocks, Director, Lisa Everett, Program Manager
www.cmu.edu/adm/uri

Conducting research as an undergraduate is a terrific way to get to know faculty members, explore an area of interest in depth, turn classroom theory into practical hands-on experience, with a faculty advisor are eligible to participate in the Undergraduate Research Initiative. The term “research” is defined broadly to mean “Research, scholarly, or artistic activities that lead to the production of new knowledge; to increased problem solving capabilities, including design and analysis; to original critical or historical theory and interpretation; or to the production of art or artistic performance.” Students from all fields and at all levels are encouraged to participate in the research process.

Further information, program materials and applications are available on our web page.

Small Undergraduate Research Grants
Undergraduates in good academic standing are eligible to apply for a Small Undergraduate Research Grant [SURG]. Awards are made twice each year based on submitted project proposals. A panel of faculty and administrators from each of the colleges serves on the selection committee and will generally consider requests up to $500. Grants may be used to purchase supplies and materials, rent time on laboratory equipment, pay subjects in an experiment, or even travel to another city to collect data. Deadlines are mid-March for the summer and fall grant periods and late October for the spring grant period.

Summer Undergraduate Research Fellowships
The Summer Undergraduate Research Fellowship program provides full summer support to students conducting research with a faculty advisor on campus. Fellowships come with a stipend of $3000 for ten weeks of full-time research. Fellowships are awarded competitively based on submitted project proposals. The application deadline coincides with the regular SURG grant deadline in mid-March.
Presentation Awards
Students whose work has been accepted for presentation at an academic conference are eligible to apply for a Presentation Award. Awards are made each semester on a first-come basis to help defray the costs of conference registration, transportation, and accommodations. Students may apply for up to 75% (to a maximum of $350) of the total cost of attending the conference.

Undergraduate Research Symposium
The Undergraduate Research Symposium provides an opportunity for students to share the findings of their research projects through poster, oral and artistic presentations. This “Meeting of the Minds” is held annually in early May on the spring reading day during finals.

Advising and Information Services
The Director of the Undergraduate Research Initiative is available to help students locate faculty advisors, discuss project ideas, locate possible funding sources, and generally facilitate the research process. The Initiative also maintains the electronic b-board “official.research.undergrad” and a web site (www.cmu.edu/adm/uri) containing announcements of research opportunities, summer programs, fellowships, seminars, and conferences.

Undergraduate Research Seminar Series
This series provides students with timely information and discussion opportunities on topics such as “Preparing for a Presentation,” “Intellectual Property Rights,” and “Ethics in Research.”

University Center
Carnegie Mellon's University Center is the first building of its kind on our campus. A central gathering place for all members of the university community, the University Center is the hub of Carnegie Mellon's social, athletic, recreational and religious life.

• Play basketball on a full NCAA basketball court (or play volleyball!)
• Play racquetball or squash on one of five courts
• Swim in the eight-lane lap pool or dive into the diving well
• Work out on new weight machines, rowers, stair climbers and cross-country ski machines
• Take an aerobics class—there are plenty to choose from.
If you overdo it, the locker rooms have jacuzzis to soothe those muscles.

Eating at the University Center
We’ve brought in several outside vendors to offer a variety of dining options:

- Andy's Eatery
- Barista Cafe
- CK Pretzels – including hand scooped Hershey Ice Cream and delicious desserts
- East Street Deli
- Grab & Go (healthy food on the run)
- The Original Hot Dog Shop
- Penne’s International Market
- Pepparazzi
- Schatz Dining Room
- Si Senor
- Skibo Coffeehouse

Shopping at the University Center
Carnegie Mellon’s retail stores are in the University Center. These include the Art Supply Store, the Textbook Shoppe, the University Shoppe, a multi-level retail facility for art/engineering supplies and tools, books, clothing and memorabilia and Entropy, a convenience store.

The building houses student organization offices, activity space and a game room. The first floor of the building includes staff offices, a gallery/exhibit area, a multi-denominational chapel and an alumni lounge, which is open to all members of the university community.

University Libraries
Dean: Gloria St. Clair
Office: Hunt Library / 412-268-2447 / gstclair@andrew.cmu.edu
www.library.cmu.edu

Facilities and Services
The University Libraries’ collections support teaching and research at Carnegie Mellon. The collections for various disciplines are housed in three libraries: the Engineering and Science Library (engineering, mathematics, physics, computer science and robotics), Hunt Library (humanities, fine arts, social sciences and business) and the Mellon Institute Library (chemistry and biology). An off-site storage facility holds low-circulating materials, which are available at your request via the library catalog. Interactive access to library resources is supported by the University Libraries’ home page at www.library.cmu.edu/.

Services in each of the libraries enable you to locate, obtain and use information. Reference service helps you to select resources and find the information you need. If you need materials that we do not own, interlibrary loan service will help you to obtain them. Circulation service helps you to borrow and renew materials, and to use course reserves (items that faculty have set aside in the library for their classes to use).

The University Libraries also house several unique collections, including the Architecture Archives (architecture in the western Pennsylvania region), the H. John Heinz III Archives, the Allen Newell Collection, the Herbert Simon Collection, and the University Archives (history of the university). The Fine and Rare Books collection includes exceptional materials in literature, the arts, the history of science and other subjects. The Posner Center, located between the College of Fine Arts and Tepper School of Business, houses the Posner Family Collection of rare books and artifacts.

Library Catalog and Other Online Access
The library catalog (Cameo) provides access to all of the Carnegie Mellon library collections. Use Cameo to find out where materials are located in libraries on campus, and whether they are checked out, on reserve, or available to be borrowed. Cameo’s self service features are also handy. For example, click “User Self Service” and “Library Account Information” to see a list of the items that you have checked out and whether you owe any fines. Click “User Self Service” and “Renew Items” to extend your loans and avoid overdue fines.

You can access many resources and services from the University Libraries’ home page. For instance:

- “Databases” index and describe specific information located in various sources. Some databases include full-text.
- “Full-text Collections” put articles, proceedings, archives and media on your desktop 24/7.
- “Ask A Librarian” (chat, email or phone) is an interactive reference service staffed by Carnegie Mellon librarians.
- “Research Help” pages direct you to key resources in your subject area, including the Carnegie Mellon librarian who is a subject specialist for your field.
- “What's New” items inform you about new library resources, events, and workshops.

From our home page, you can also use the online catalogs for the University of Pittsburgh Library System, The Carnegie Library of Pittsburgh, and other local libraries. We are partners with Pitt and The Carnegie; you can request courier service to deliver items to campus, or you can get library cards and borrow directly from these nearby libraries.

Instruction and Help
Get acquainted with the collections and services that support your school and subject area. Take advantage of library orientations and other library instruction classes that will help you become adept at using information resources. Being able to select good sources, access information efficiently, and evaluate results are skills that you will use throughout your academic and professional career.

Reference desks at the Engineering and Science Library, Hunt Library, Mellon Institute Library, and in Arts and Special Collections (at Hunt Library) are staffed weekdays, evenings, and on weekends. Besides helping you when you are in the library, reference staff also can show
The University Police Department consists of 24 sworn Police Officers, 33 Security Guards, two Traffic Monitors and five Communications Dispatchers. University Police provides campus buildings and grounds patrol, emergency medical transport, personal escorts, and other services to increase the safety and well being of persons and property in the university community. Officers patrol the campus continuously 24 hours a day, seven days a week on foot, on bicycle and in vehicles and remain in constant radio contact so that they can respond rapidly in the event of an emergency. Direct line emergency telephones to the University Police communications center are located both inside and outside of buildings at 53 locations around the campus.

All crimes that occur on campus should be reported immediately to University Police to ensure that appropriate action is taken. Crime occurring on campus can be reported in person, or by calling the University Police emergency number, (412) 268-2323 or x8-2323, any time of the day or night. All other non-emergency inquiries should be made by calling the non-emergency number (412) 268-6232 or x86232.

University Police operates an Operation Campus Watch program to increase the awareness of the entire community at Carnegie Mellon. The concept of Operation Campus Watch includes two simple aims:

1. The sharing of crime information by University Police.
2. The involvement of the entire community in reporting suspicious activity or actual crime.

Additional information on Operation Campus Watch is available at the University Police Office located in Room 100 of the Old Student Center or by calling the non-emergency number, (412) 268-6232. All emergencies on campus, including fire and medical, should be reported immediately to University Police.

Students are responsible for their personal property as well as the property of groups to which they belong. Insurance against loss, theft, or damage to such property occurring in the residence hall or elsewhere on campus must be arranged for by students or their parents through an insurance agent.

University Police makes available on the world wide web a wide range of information about the university’s security practices. Descriptions of crime prevention programs, alcohol and drug, sexual assault policies, and statistics about the number and type of crimes committed on campus during the preceding three years can be found at www.cmu.edu/police.
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Undergraduate Options

Additional Majors/Dual Degrees

Students interested in pursuing more than one area of study are encouraged to consider an additional major or dual degree. Students who complete an additional major will earn a single degree in two areas. Generally, it is possible to fulfill the requirements of both majors in four years by taking the course requirements of the second major in the elective spaces allowed by the first major. Students in Carnegie Institute of Technology may elect to double major in Engineering and Public Policy or Biomedical and Health Engineering, which are offered only as an additional major. Human Computer Interaction is also offered only as an additional major.

Dual Degree programs allow students to earn two degrees. Students who are interested in an additional major or dual degree are encouraged to review the specific possibilities with the relevant academic advisor.

Five-Year Bachelor's/Master's Programs

Qualified undergraduates may apply to one of several programs to earn their bachelor's and master's degrees in five years. For further details about these programs, please refer to the appropriate college or departmental section(s).

Carnegie Institute of Technology

The five-year Integrated Master's/Bachelor's programs offered by the Departments of Electrical and Computer Engineering and Civil and Environmental Engineering offers students superior technical preparation for careers in industry. The Departments of Chemical Engineering and Mechanical Engineering also offer fifth year/Accelerated Masters programs. The Department of Materials Science and Engineering offers a cooperative Industrial Internship Option in which students alternate coursework with practical experience in industry. Admission is highly competitive and leads to a Master of Science degree.

College of Humanities and Social Sciences

The Department of Philosophy offers a bachelor's/master's degree option: the Bachelor's/Master's degree in Logic and Computation. The M.A. in Teaching English to Speakers of Other Languages (TOESL) is a fifth year master's option for Modern Language students who are concentrating in English as a Second Language. Also, the department of English offers an accelerated program for undergraduates to obtain a Master of Arts in Professional Writing.

H. John Heinz III School of Public Policy and Management

The Heinz School's Accelerated Masters program allows qualified undergraduates to earn a prestigious Master of Science degree in Public Policy and Management. For students in the College of Fine Arts or the Bachelor of Humanities and Arts degree program who are interested in careers in arts management, the program leads to a Master of Arts Management degree.

Mellon College of Science

The Honors Programs in the Departments of Chemistry and Mathematics are demanding, accelerated programs that give highly qualified students the opportunity to earn their bachelor's and master's degrees in just four years. Admission is by invitation only.

Tepper School of Business 3-2 Program

Students who are interested in business management may wish to consider the Tepper School of Business 3-2 program. Qualified undergraduate students may earn their master's degree in Industrial Administration in addition to their bachelor's degree. For students interested in earning a Master of Science in Quantitative Economics degree, TSB offers an accelerated B.S./M.S. program in Economics.

Health Professions Program

Director: Amy L. Burkert, Ph.D.
Office: Doherty Hall 1319

The Health Professions Program (HPP) at Carnegie Mellon University is an advising and resource center for all university students and alumni who are interested in one or more aspects of the health professions. This program complements a student's curricular advising and is meant to help students explore their interests, prepare for graduate programs in the health professions, and facilitate their application process. Students can enroll in the program at any time during their academic career, but the importance of early planning is communicated to interested first-year students. Once enrolled, students meet regularly with the director to discuss course requirements, medical exposure opportunities, and other aspects of preparing to be a competitive candidate.

Students in the HPP span all colleges of the university and have many diverse career interests including medicine, dentistry, optometry, biomedical research, medical physics, rehabilitation engineering, medical informatics, and health policy. Although the majority pursue a primary major in the Mellon College of Science, other highly represented disciplines include engineering and the social sciences.

Regardless of a student's major, the basic course requirements outlined below must be completed prior to medical school matriculation, and most should be taken before the student takes the Medical College Admissions Test (MCAT) that is normally taken in spring of the junior year:

1. One year of general biology with lab.
This is typically fulfilled by the following Carnegie Mellon courses:
- 03-121 Modern Biology
- 03-130 Biology of Organisms
- 03-124 Modern Biology Lab
- or
- 03-343 Experimental Genetics and Molecular Biology

2. One year of general chemistry with lab.
This is typically fulfilled by the following Carnegie Mellon courses:
- 09-105 Introduction to Modern Chemistry
- 09-106 Modern Chemistry II
- 09-221 Lab I: Introduction to Chemical Analysis

3. One year of organic chemistry with lab.
This is typically fulfilled by the following Carnegie Mellon courses:
- 09-217 Organic Chemistry I
- 09-218 Organic Chemistry II
- 09-222 Lab II: Organic Synthesis and Analysis

4. One year of physics with lab.
This is typically fulfilled by the following Carnegie Mellon courses:
- 33-106/107 Physics I (for science or engineering students)
- 33-106/107 Physics II (for science or engineering students)
- 33-100 Basic Experimental Physics

5. One year of English.
This is typically fulfilled by the following Carnegie Mellon courses:
- 76-101 Interpretation and Argument
- 76-xxx English course of the student's choice, typically 200-level or higher
In addition to these general course requirements, recommended coursework includes calculus, biochemistry, statistics, behavioral sciences, ethics, and languages. Interdisciplinary studies are also strongly encouraged, and many students design an undergraduate curriculum that incorporates majors and/or minors in both the natural and social sciences. One interesting interdisciplinary minor offered is the Minor in Health Care Policy and Management, which broadens awareness of the health care field from social, economic, historical, and policy perspectives. See page 287 for the details of this minor.

Undergraduate research is a hallmark of the educational experience at Carnegie Mellon in many disciplines. Whether in the psychology lab studying the impact of breast cancer diagnosis on family social dynamics, in the NMR lab imaging metabolic function in the heart or brain, or in the surgery suite testing robotic devices, our students have made significant achievements in research, well beyond the more traditional guided experiments.

Our university policy is to train students to be first class scientists, engineers, artists, writers, managers, or whatever their passion may be. We do not train students to be "pre-meds," but if they choose to use their talents in a health profession, we offer many services to help them obtain their life goals. Regular advising, application workshops, health issue seminars and symposia, community outreach activities, and preceptorship/ internship experiences are all part of our programming. The student pre-health organization on campus, the Doctors of Carnegie (DOCs), together with the Health Professions Program, provide students with many opportunities to learn, explore and prepare for their chosen area of interest.

The Health Professions Program has been successful in helping students to define, prepare for, and own their professional goals. Our students are regularly accepted at top-level medical and graduate programs, and our alumni continue to serve as outstanding ambassadors of Carnegie Mellon and the training and experience they received here.

**Minors**

The following minors offer a secondary focus to the student’s major area of study. Unless otherwise indicated, minors are generally open to all university students.

**Intercollege:**

- Arts in Society (sponsored by the Center for Arts in Society)
- Health Care Policy and Management (sponsored by the College of Humanities and Social Sciences, the H. John Heinz III School of Public Policy and Management, and Mellon College of Science)

**Carnegie Institute of Technology:**

Biomedical Engineering  
Engineering Studies  
Robotics Technology and Policy

**Designated Minors (open only to CIT students):**

Automation and Control  
Biomedical Engineering  
Colloids, Polymers and Surfaces Technology  
Data Storage Systems Technology  
Electronic Materials  
Engineering Design  
Environmental Engineering  
Manufacturing Engineering  
Materials Science and Engineering  
Mechanical Behavior of Materials  
Robotics

**The College of Fine Arts:**

Accompanying (open only to students majoring in Music)  
Architecture  
Architectural History (available also to B.Arch. candidates)  
Architectural Representation and Visualization  
Architectural Technology  
Art  
Building Science (open only to B. Arch. candidates)  
Communication Design  
Conducting (open only to students majoring in Music)  
Drama  
History of the Arts  
Industrial Design  
Jazz Performance  
Jazz Performance (for students majoring in Music)  
Music  
Music Education (for students majoring in Music)  

**Music Performance**  
**Music Technology**  
**Music Theory**  
Photography, Film and Digital Imaging

**The College of Humanities and Social Sciences:**

Chinese  
Decision Science  
English  
Environmental Policy  
Ethics  
European Studies  
Film and Media Studies  
French and Francophone Studies  
Gender Studies  
German  
Hispanic Studies  
History  
International Relations  
Japanese  
Linguistics  
Logic and Computation  
Minority Studies  
Multimedia Production  
Philosophy  
Policy and Management  
Political Science  
Psychology  
Religious Studies  
Russian Studies  
Science, Technology and Society  
Second Language Acquisition  
Sociology  
Statistics  
Student Defined

**Tepper School of Business:**

Business Administration Management (for Students in CFA)

**Mellon College of Science:**

Biological Sciences  
Chemistry  
Discrete Mathematics and Logic  
Environmental Science  
Mathematical Science  
Physics  
Scientific Computing  
Secondary Education and Teacher Certification

**School of Computer Science:**

Computer Science

**Pre-Law Advising Program**

Director: Joseph Devine, Associate Dean  
Office: H&SS Academic Advisory Center, Baker Hall A57

"Law School" is an objective that students frequently mention when asked about post-baccalaureate plans. It seems in its brevity to be a simple enough answer, but in reality it masks a host of complex and momentous personal decisions and strategic tasks.

First and foremost, seeking entry into law school implies an informed decision about the rigors of law school and the realities of professional life as an attorney, as well as a strong and mature commitment to achieving these objectives at significant cost and investment (financial, personal, and intellectual). Second, it implies an understanding of the prolonged sequence of steps involved in the process of selecting law schools to which to apply, actually applying, ultimately selecting a school to attend, financing a law school education, and succeeding in law school. Finally, it implies an understanding of this as one of many alternatives that should be conscientiously and intelligently considered before a choice is made that will so significantly influence the course of one’s personal and professional life.

To address these needs, the University offers a Pre-Law Advising Program for students and alumni/ae who are contemplating or actively seeking to enter law school and careers in the law. The program consists of a range of support services, coordinated centrally, designed to assist these groups in engaging the complex questions associated with decisions about law school and careers in the law, and in successfully negotiating the sequence of tasks associated with selecting, applying and gaining admission to the best law schools possible.
The emphases of this program are:

1. early identification of "pre-law" candidates;
2. stimulation at early stages and throughout this process to consider the essential questions of personal suitability for law school and professional life as an attorney, and also to engage meaningful substantive issues rooted in the law that illustrate the intellectual complexities of our legal system and the corresponding intellectual acumen needed to enter and thrive in this profession;
3. timely direction in designing and executing a well-planned law school research, selection and application strategy;
4. gathering and using accurate data on university alumni entering law school and the legal profession.

The program proper consists of several components, organized and made available as an ongoing service to all students in, and graduates of, the University. These components include periodic workshops and seminars, a Pre-Law Handbook, a pre-Law library, and linkage through the Program Director with law school admissions offices, the Law School Admissions Services, and associations (both regional and national) of pre-law advisers. The program also works with the student Pre-law Society and Undergraduate Student Mock Trial Association.

Two "early admission" options are available to Carnegie Mellon undergraduates interested in either of Pittsburgh's two law schools: the Duquesne University School of Law, and the University of Pittsburgh School of Law. Requirements and procedures vary for each option. Interested students should meet with the University pre-law adviser before the end of their junior year.

Study Abroad

Carnegie Mellon students from every major can study in virtually any part of the world for a semester, year or summer. A well planned study abroad program will allow a student to receive credit for study abroad and graduate on time. Most students study abroad during their junior year; however, a growing number of students are studying abroad during their sophomore year.

The Study Abroad Advisor provides general information sessions as well as individual advising to assist students in the study abroad process. The Office of International Education (OIE) has a library of over 3,000 available programs as well as useful web links to help students to find the most appropriate study abroad program. In addition, OIE offers orientations to help with personal, academic and acculturation issues, before and after a study abroad experience.

Carnegie Mellon offers a variety of payment schemes for study abroad to allow students to study abroad regardless of financial need. There are two categories of programs, exchange programs and sponsored study abroad programs that allow students to pay through Carnegie Mellon and maintain all scholarships, grants and financial aid.

More detailed information can be found at www.cm.edu/studyabroad Carnegie Mellon Offers a variety of options for study abroad, including:

University Exchange Programs

Carnegie Mellon University has a number of university-wide undergraduate exchange programs. Students who participate in exchange programs pay Carnegie Mellon tuition and receive their regular financial aid package. Students are responsible for room, board, travel and miscellaneous expenses. Currently University Exchange programs are offered in Switzerland, Mexico, Japan, Singapore, Chile, Israel, China and Australia.

Departmental Exchanges

Art, Design, Chemical Engineering, Materials Science and Engineering, and Business offer departmental exchange programs. Students should contact the department for additional information. Departmental exchanges are set up in the same way as university exchanges; students pay Carnegie Mellon tuition and receive their normal financial aid package. Students are responsible for room, board, travel and miscellaneous expenses.

Sponsored Study Abroad

The university has designated a few study abroad programs administered by other organizations or universities as sponsored programs. On these programs, students will pay a university fee equivalent to current tuition, room and board charges, and retain their eligibility for all financial aid. Carnegie Mellon will pay the program costs to the study abroad sponsor. Where applicable, funds are distributed to the student for room, board, travel, and personal expenses. Applications and information are available in OIE.

Currently we have sponsored programs in Australia, Botswana, Canada, China, England, France, Germany, Ghana, Ireland, Italy, Japan, the Netherlands, South Africa, and Spain.

Non-Carnegie Mellon Programs

Students may also participate in a program sponsored by another university or study abroad organization. If the student's home department approves the program and its course offerings, the student may participate. Students will pay the other organization or institution directly. Students who receive institutional aid from Carnegie Mellon will not be eligible for this aid while they are abroad. However, students with state and federal aid will still qualify. Semester and full year programs are available. Information may be obtained in OIE. Examples of programs that Carnegie Mellon students have attended are: AIFS, Arcadia University, Boston University, Butler University, Council, Cornell University, Institute for the International Education of Students (IES), Syracuse University DIS, Semester at Sea; as well as direct enrollment to international universities.

University Student-Defined Major

Carnegie Mellon offers the opportunity for undergraduate students to pursue a University Student-Defined Major. (There are also opportunities to pursue a Student-Defined Major in some of the colleges [see relevant college section].) Interested students are encouraged to speak to the Associate Dean (sic) of their current home college or the college most relevant to the proposed course of study. The requirements for successful completion of a University Student-Defined Major include a student proposal approved by an advisor, relevant college(s), and the Provost, and successful completion of the approved course of study. In brief:

- A student interested in pursuing a university student-defined major must develop a proposal which outlines an intellectually coherent area of study (with degree title) and a plan of study (courses to be taken, pedagogical rationale, proposed schedule). The proposal should include an explanation of why it is not appropriate or possible to pursue such a program of study through the curriculum of any one of the colleges. It should outline a program of study for both general education (for example, the core requirements of one of the most relevant colleges or equivalent general education plan) and major requirements. The proposal should designate one of the participating colleges as defacto "home college" for tracking and verification purposes.

- The student's proposal must be approved by a faculty advisor within a college who takes pedagogical responsibility for the program, by the defacto "home college" for administration and advice, and by any other colleges involved in granting the degree. The signed proposal will be submitted to the Provost's office for a final review and approval.

- Once approved by the faculty advisor, colleges, and the Provost's office, the student's major will be administered by the advisor and his/her progress tracked by the Dean's office of the "home college." The "home college" will be responsible for monitoring the student's progress and reminding any collateral colleges of the approval of the student-defined major so that these colleges may insure the student's ability to enroll in the necessary courses. Upon successful completion of the course of study, the "home college" will be responsible for contacting all the relevant colleges and verifying the completion of the degree. Unless there are sufficient numbers of university student-defined majors in any graduation year, upon consultation with the "home college," students may choose to receive the diploma in the most relevant department's ceremony.
University Summer Sessions

The campus is in full operation during the summer, populated by students and faculty from a variety of programs. The university continues to have outstanding, innovative educational programs extending beyond regular involvement with its degree candidates. Three sessions of summer school are held for college students who wish to make up or advance their degree program studies. Every service and support organization is available to summer students: Computing Services, the Student Health Center, the Counseling Center, the University Libraries, the Office of Admission, the Career Center, Student Activities, etc.

Session One: mid-May to early July
Session All: mid-May to mid-August
Session Two: early July to mid-August

The three summer sessions of credit course work are designed to meet the needs of currently enrolled college students (not exclusively Carnegie Mellon students) as they complement or supplement various college programs. The university offers a wide range of courses in the Carnegie Institute of Technology (CIT), College of Fine Arts (CFA), College of Humanities and Social Sciences (H&SS), the Mellon College of Science (MCS), the School of Computer Science (SCS), and the Undergraduate Business Program in the Tepper School of Business (TSB).

Undergraduates have the opportunity to earn advanced credit, remove deficiencies, and regularize their schedules pursued during the academic year; graduates may work toward master’s and doctor’s degrees, and professional people are encouraged to increase their knowledge and skills. There are two summer sessions, both seven weeks in duration. Special programs and graduate work may cover other periods of time.

Carnegie Mellon reserves the right to withdraw any course not justified by the number of applicants and to make changes in scheduling when necessary and advisable.

Requests for further information should be addressed to:

The HUB
Enrollment Services
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
(412) 268-8186
FAX: (412) 268-8084
Carnegie Mellon emphasizes excellence in its intercollegiate athletic programs as well as in its classrooms. The University strongly believes that academic and athletic excellence can successfully coexist. It also believes that intercollegiate athletics are important in student life, and can become a key part of the educational experience. Professional and social endeavors after graduation also benefit from university experiences as a student-athlete.

Carnegie Mellon sports teams have competed intercollegiately since the early 1900s. In the past 15 years the program has experienced extensive success. The Tartans have won 75 conference championships and competed in over 80 national championships since 1976. This success has been achieved while meeting all of the academic requirements of demanding programs and without athletic scholarships.

In 1986 Carnegie Mellon became a charter-member of the University Athletic Association (UAA), a nine-team league of similar institutions with regard to academic and athletic programs. The UAA, a national association which geographically reaches as far north as Massachusetts, as far south as Atlanta and as far west as St. Louis and Chicago, sponsors intercollegiate competition in 24 sports including 12 for men and 12 for women. UAA members include Brandeis University, Case Western Reserve University, Carnegie Mellon University, Emory University, New York University, the University of Chicago, the University of Rochester and Washington University in St. Louis.

Carnegie Mellon, like the other seven UAA members, is a member of the National Collegiate Athletic Association (NCAA). Its intercollegiate teams compete on the Division III level, which prohibits athletic scholarships and operates under the true meaning of amateurism. Student-athletes who play at the varsity level are students first and athletes second. All students, both athletes and non-athletes, are treated equally with regard to admission and financial aid policies. Carnegie Mellon fully supports a policy of equity in resources and opportunities for women and men.

The university fields competitive teams in 18 sports. The Tartans compete in football, men’s and women’s soccer, men’s and women’s cross-country, men’s and women’s tennis, women’s volleyball, men’s and women’s basketball, men’s and women’s swimming, men’s and women’s indoor and outdoor track and field, and golf.

Carnegie Mellon’s intercollegiate program has consistently produced winners. The Tartans’ football team has won 14 conference championships, has a string of 27 consecutive winning seasons, and has appeared in the NCAA Division III Championship playoffs four times. In 1979, Carnegie Mellon was awarded the Lambert Trophy as the best small college team in the northeast. The men’s cross-country team holds the NCAA Division III record with 109 consecutive dual meet victories. Women’s cross-country won the 1998 conference and placed 4th nationally.

A freshman computer science major on the men’s tennis team won the NCAA National singles title in 2000 and Carnegie Mellon’s top doubles team also was selected to play in the nationals. The women’s tennis team has recently produced national ranked players in the NCAA competition. Both men’s and women’s swimming and track teams annually qualify a number of athletes for the national championships. Swimming recently has produced a national champion.

To provide excellence in the athletic program the department employs full-time coaches in varsity sports. Intercollegiate competition begins with the first football and soccer games in early September and ends with the UAA track and field and tennis championships in late April. Students with athletic skills in any of the above mentioned sports are welcome to become members of the team. Participation is open to all students. Inquiries may be directed to the appropriate coach at the:

Department of Athletics, Skibo Gymnasium, Carnegie Mellon University, Pittsburgh, PA 15213 (412) 268-2211

Intramurals

Michael Mastroianni, Director
Office: 101 Gymnasium

For those who seek another level of competition or just like to participate and have fun, the Intramural Program provides recreation and relaxation for all students, faculty and staff, regardless of the degree of their natural athletic skills. The university prides itself on an intramural program which annually involves some 6,000 students. Men and women, both graduate and undergraduate, compete in one or more of over 40 indoor and outdoor sports, ranging from flag football and basketball to table tennis, water polo, and ultimate frisbee.

The Intramural Department is under staff direction, but four student-run organizations (the Intramural Board, the Managers’ Club, the Women’s Representatives and the Officials’ Club) govern the events. Through participation in this program, students are able to keep physically fit, put to good use various learned skills, and develop leadership, team play and sportsmanship. Intramural activities, like all sports endeavors, contribute to physical development, good health, and a sound state of mind, while providing keen competition and team spirit. In addition, intramurals possess an inherent flexibility that allows for a limited commitment of time in light of academic priorities. The intramural program permits students from all departments to meet and socialize on an informal basis.

The following is a listing of the intramural sports offered by season:

Fall
Flag Football  Tennis  Golf
Co-Rec Volleyball  Cross-Country  Water Polo
Chess  Soccer  Bowling  Racquetball
Team Table Tennis  Darts  3-Person Volleyball  Foosball
Team Call Pool  Floor Hockey  Spades

Spring
Basketball  Table Tennis-Singles  Faculty/Grad. Volleyball
Polo  Individual Call Pool  Swimming  Indoor Soccer
Softball  Co-Rec Softball  Fencing  Co-Rec Kickball
Ultimate Frisbee  Track  Water Basketball
Co-Rec Badminton  Team Badminton  3-on-3 Basketball
Foul Shooting  3-Point Basketball  Pickleball
Euchre

Fitness and Health

Donna Morosky, Director
Office: 102A Gymnasium

The university is well aware that fitness is a vital contributor to an individual’s well-being and productivity. For this reason the department is committed to providing the entire campus community with the opportunity and resources to keep fit for the new century.

The Fitness and Health division provides educational services, programs, workshops and seminars. Programs include cardiorespiratory fitness, muscular strength, blood pressure and stress reduction. Workshops include the topics of nutrition, weight control, stress management and lower back care and prevention.
Recreation
Dr. David L. Belovich, Interim Director
Office: 204 Gymnasium

In addition to providing for its more formal programs and teams, Carnegie Mellon's athletic facilities are available for use by individual students on an extensive seven-day per week schedule. Hours for recreational use of all facilities are subject to change during varsity sports seasons.

The Gymnasium, which has facilities for basketball, volleyball, badminton, racquetball, weight lifting, stairmasters and aerobic bicycling, is open Monday through Friday, as well as weekends. Located within our newly constructed University Center are facilities for squash, basketball, racquetball, volleyball, badminton, a diving pool and a large swimming pool for lap swim, aerobic cycles, stairmasters, treadmills, Nordic Tracks, Cybex machines, dumbbells, a sauna and a whirlpool. These facilities are available to any student, faculty or staff person with a valid Carnegie Mellon ID. For hours, please contact the Athletic Office at (412) 268-2211.

Gesling Stadium provides soccer, football and track facilities. Tennis courts, located between the University Center and Margaret Morrison, are lighted for night play. During the school year they are open for use by students, faculty and staff.

Physical Education
Dr. David L. Belovich, Interim Director
Office: 204 Gymnasium

The Department of Physical Education provides an elective program with an emphasis on personal fitness and lifetime recreation, thus preparing students for physical activity after the college years. Most classes are offered on a mini-course system with each class running seven weeks in length.

This program of more than 20 courses is designed for all students, from the beginner to those students who have already developed some skill. Courses include personal fitness, racquetball, tennis, golf, weight training, karate, and aerobic fitness. Carnegie Mellon also provides courses for American Red Cross certification in the four levels of swimming (beginners, intermediate, swimmers, and lifeguarding), and First Aid and Cardiopulmonary Resuscitation (CPR). Instruction is also provided in several team sports.

Faculty
MARK ATHANAS, Athletic Trainer/Instructor — B.S., Duquesne University; Carnegie Mellon, 2003—.

DAVID BELOWICH, Interim Director, Head Men's/Women's Swim Coach/Instructor — Ph.D., Florida State University; Carnegie Mellon, 1996—.

JULIA BIGGER, Head Volleyball Coach/Instructor — B.A., University of Vermont; Carnegie Mellon, 1996—.

TERRY BODNAR, Assistant Football Coach/Instructor — B.S., Indiana University of PA; Carnegie Mellon, 1984—.

DREW DERSHIMER, Head Women's Cross-Country Coach and Assistant Track Coach/Instructor — M.S., Clarion University; Carnegie Mellon, 2001—.

DARIO DONATELLI, Head Men's Cross-Country & Track Coach/Instructor — B.S., Carnegie Mellon University; Carnegie Mellon, 1987—.

RICHARD ERDELYI, Assistant Football Coach and Head Golf Coach/Instructor — B.A., University of Pittsburgh; Carnegie Mellon, 1985—.

NICK CAUDIUSO, Head Soccer Coach/Instructor — B.S., University of Maine; Carnegie Mellon, 1981—.

ANDREW GIRARD, Head Men's and Women's Tennis Coach/Instructor — B.S., Michigan Tech University; Carnegie Mellon, 2003—.

MIKE GRZYWINSKI, Assistant Intramural Director — B.S., Carnegie Mellon University; Carnegie Mellon, 1994—.

REBECCA HUBERT, Athletic Trainer/Instructor — B.S., University of Pittsburgh; Carnegie Mellon 2001—.
Reserve Officers’ Training Corps (ROTC)

Department of Aerospace Studies (Air Force ROTC)

James R. Holaday, Colonel, U.S. Air Force
Office: 2917 Cathedral of Learning, University of Pittsburgh

In the four-year commissioning program, a student takes the general military course (GMC) during the freshman and sophomore years, attends a four-week summer training program, and then takes the professional officer course (POC) in the junior and senior years. In the two-year commissioning program, a student attends a five-week summer training program following his or her junior year and then enters the POC. A student undergoes a contractual obligation to the Air Force until entering the POC or accepting an Air Force scholarship. In addition to the academic portion of the curriculum, each student attends two hours of leadership lab each week. This lab utilizes a student organization designed for the practice of leadership and management techniques. Two to three and a half year scholarships are available on a competitive basis to qualified students. Many AFROTC scholarships cover all costs of tuition, incidentals and lab fees, $510 for books, plus pay each recipient $250-$400 per month.

General Military Course (GMC)

The subject matter for the freshman and sophomore years is developed from an historical perspective and focuses on the scope, structure, and history of military power with emphasis on the development of air power. The freshman courses explore the role of U.S. military forces, and the Air Force in particular, through a study of the total force structure, strategic offensive and defensive forces, general-purpose forces, and support forces. The sophomore courses include an introduction to the history of air power with emphasis on the development of concepts and doctrine governing the employment of U.S. air power.

Professional Officer Course (POC)

The Professional Officer Course, taken during the cadet’s junior and senior years, concentrates on three main themes: the concepts and practices of management, leadership, and national defense policy. During the first term of the junior year, the course concentrates on a study of the management functions: planning, organizing, coordinating, directing and controlling. Basic and advanced management techniques, as found in the military and industrial environment, are explored. The second term deals with the application of general concepts of leadership to Air Force situations. As a basic study of human behavior, human relationships, and professional ethics, the course emphasizes the similarities between the problems encountered in the military and civilian environment. The first term of the senior course concentrates on selected elements of the U.S. government and national security process engaged in producing national strategy as well as various elements of U.S. military forces, doctrine, and employment capabilities. During the second term, the course concentrates on the strategic options available to the U.S. and on the manner in which policy choices are made. The course also includes a review of the military justice system.

For details about the two programs as well as information on the courses, scholarships, and flying programs, interested students are encouraged to contact the Air Force ROTC detachment, or write to the Professor of Aerospace Studies, Air Force ROTC, 2917 Cathedral of Learning, University of Pittsburgh, Pittsburgh, PA 15260.

Faculty

SCOTT R. HARBULA, Assistant Professor of Aerospace Studies – M.B., Aeronautical University; Carnegie Mellon, 2004 —.

JAMES R. HOLADAY, Professor of Aerospace Studies — M.A., Central Michigan University; Carnegie Mellon, 2003 —.

CARLY R. SPERANZO, Assistant Professor of Aerospace Studies – M.A., Troy State University; Carnegie Mellon, 2004 —.

ANNE-MARIE T. SYKES, Assistant Professor of Aerospace Studies – M.B., Cornell University; M.A.. Webster University; Carnegie Mellon, 2003 —.

Department of Military Science (Army ROTC)

John N. Bender, Major, U.S. Army
Office: Bellefield Hall, Room 409, University of Pittsburgh

The Army Reserve Officers’ Training Corps (ROTC) program supporting Carnegie Mellon University is located at the University of Pittsburgh. It exists to train the future officer leadership of the United States Army and offers opportunities and challenges that can put college students on the fast track to success in life. ROTC provides a combination of academics and important hands-on training, in addition to physical and mental challenges that will help students succeed in college and beyond. Through the training in ROTC, students will develop the confidence, self-esteem, motivation and leadership skills they will need regardless of their career plans.

The Four-Year Program

The traditional Four-Year program is divided into two parts. The Basic Course is taken in the freshman and sophomore years. There is no commitment for non-scholarship students at this level. Upon successful completion of the Basic Course, students are eligible for the Advanced Course, taken in the junior and senior years. At the beginning of the Advanced Course, students will decide whether or not they wish to become officers in the Army and enter into a formal contract. During the summer between the junior and senior years, students are required to attend the the Leader Development and Assessment Course (LDAC). Upon successful completion of a University degree and the Army ROTC program, students are commissioned into the United States Army as a Second Lieutenant.

The Two-Year Program

If the first two years of ROTC are not taken, students can attend the Leader’s Training Course (LTC) during the summer between the sophomore and junior year. This camp will qualify students to begin the Advanced Course in their junior year or in the first year of a two-year graduate program. Or, if students have served in the active duty military, attended a military academy for one year, participated in JROTC for three years or belong to a Army National Guard or Army Reserve unit, they already qualify for entrance into the Advanced Course.

The Alternative Entry Program

The Alternative Entry Program is designed for academic junior students with no prior qualifying military training but are otherwise qualified. This option allows students to contract into the Advanced Course without receiving placement credit for the basic course. Students accepted into this program must complete the Leader’s Training Course and the Leader Development and Assessment Course during the summer months.

Curriculum

Freshman Year
30-00  Introduction to Military Leadership Fall
30-102 Foundations of Leadership Spring

Sophomore Year
30-201 Leadership Dynamics & Application Fall
30-202 Applications in Leadership & Combat Power Spring

Junior Year
30-301 Basic Leader Planning & Combat Operations Fall
30-302 Advanced Leader Planning & Combat Operations Spring

Leadership Development & Assessment Course (six-week required summer camp)
B.A., Iowa State University; Carnegie Mellon, 2001—.
Science — M.S., Duquesne University; Carnegie Mellon, 2000—.
M.A., Missouri Webster University; Carnegie Mellon, 2003 —.

BETH C. DIAZ, Captain, Assistant Professor of Military Science —

The Department of Naval Science was established 16 December 1987. Carnegie Mellon’s Naval Reserve Officers Training Corps (NROTC) is designed for young men and women who are seeking a challenging academic experience and who desire to serve their country as officers in the Navy or Marine Corps after graduation.

NROTC midshipmen lead the same campus life as other Carnegie Mellon students. They make their own arrangements for room and board, choose a preferred area of study and participate in extracurricular activities. Midshipmen wear civilian clothes to classes but wear uniforms one day of the week. NROTC students are active in all facets of university life; many are in positions of leadership in student government, on varsity and intramural sports teams, in campus clubs, and other student organizations. The NROTC program seeks students who are bright, ambitious, enthusiastic leaders whose lives are enriched by their education at Carnegie Mellon and by their involvement in NROTC.

Four-Year Scholarship Program

The four-year scholarship program provides full tuition, fees, $500 for textbooks per year, uniforms, and a $250 per month tax-free subsistence allowance to students during their freshman and sophomore year. This stipend then increases to $300 during their junior year and $350 for their senior year. Midshipmen must complete the university-approved curriculum of their choice, including courses in calculus and calculus-based physics (Navy Option Only), and specified courses in naval science subjects. Paid summer training periods are also provided. Scholarships are awarded on the basis of a nationwide competition before the start of the freshman year. Midshipmen commissioned through the scholarship programs become officers in the Navy or Marine Corps and incur a four-year active duty obligation in a selected area of the naval service.

Tweedale Scholarship Program

The three or two year scholarship programs provide full tuition, fees, $500 for textbooks per year, uniforms, and a $250 per month tax-free subsistence allowance to students during their freshman and sophomore year. This scholarship is targeted for Technical majors ONLY. This program allows a person who has never applied for a NROTC scholarship in the past to be nominated for this scholarship. The nominee will have an answer within 5 working days from submission. Midshipmen commissioned through the scholarship programs become officers in the Navy or Marine Corps and incur a four-year active duty obligation in a selected area of the naval service.

College (Non-Scholarship) Programs in NROTC

Qualified students may participate in NROTC as college program (non-scholarship) midshipmen and earn commissions in the Navy or Marine Corps Reserve upon graduation. The active duty obligation for this program is three years. Students receive all naval science textbooks, uniforms, and during their junior and senior years a tax-free subsistence allowance of $300 and $350 respectively, per month. A paid summer training period is provided between the junior and senior year. College program students may compete for three- and two-year scholarships described in the following paragraph.

College Program Three- and Two-Year Scholarships

Three-year scholarships are available on a competitive basis to those qualifying college program (non-scholarship) NROTC students who have demonstrated leadership and academic excellence during their freshman or sophomore year and are nominated for the scholarship by the Professor of Naval Science. Scholarship benefits are identical to those provided by the four-year scholarship program. Active duty obligation is four years upon commissioning.
Two-Year National Scholarship Program

Sophomores who have not participated in the NROTC program may apply for a nationally competitive two-year NROTC scholarship. The two-year scholarship program provides the same benefits as the four-year program for a period of 20 months. Students must apply for this program no later than February of their sophomore year. Students selected for this program attend the Naval Science Institute during the summer before their junior year to complete required naval science course material. A paid summer training period is provided between the junior and senior years. Commissionees incur a four-year active duty obligation upon graduation.

Curriculum

The sequence of Naval Science courses is the same for all officer candidates for the first two years. Midshipmen accepted into the Marine Corps option program will have curriculum variations starting with their third year. Additionally, some candidates may be required to complete courses in American military affairs, national security policy, English, mathematics, and/or the physical sciences. Descriptions of the course requirements for each candidate classification (scholarship/college program) may be obtained from the Department of Naval Science office.

All scholarship and college program students are required to attend a weekly 1.5 hour Naval Laboratory (32-100) where military drill, physical fitness, and leadership are emphasized.

Naval Science courses are open to all students. Since these are required courses for NROTC students, they will be given priority in enrollment. Remaining spaces will be filled through the normal university registration process.

Faculty

SCOT G. HUGHES, Assistant Professor of Naval Science — B.S., United States Naval Academy; Carnegie Mellon, 2003 —.

STEPHEN M. KENNEY, Assistant Professor of Naval Science — B.S., United States Naval Academy; Carnegie Mellon, 2003 —.

ROBERT J. PETAK, Assistant Professor of Naval Science — B.S., University of Illinois; Carnegie Mellon, 2004 —.

MICHAEL W. VIERS, Associate Professor of Naval Science – B.A., Muskingum College; M.A., Webster University; Carnegie Mellon, 2003 —.

KEITH L. WRAY, Professor of Naval Science — B.S., United States Naval Academy; M.A., NWC; Carnegie Mellon, 2003 —.

Naval Professional Academic Courses (Naval Science Courses)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Year Taken</th>
<th>Required of</th>
<th>Units</th>
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<tr>
<td>32-101</td>
<td>Introduction to Naval Science</td>
<td>Freshman</td>
<td>All</td>
<td>6</td>
</tr>
<tr>
<td>32-102</td>
<td>Sea Power and Maritime Affairs</td>
<td>Freshman</td>
<td>All</td>
<td>6</td>
</tr>
<tr>
<td>32-201</td>
<td>Leadership and Management</td>
<td>Sophomore</td>
<td>All</td>
<td>9</td>
</tr>
<tr>
<td>32-202</td>
<td>Naval Ships Systems I (Engineering)</td>
<td>Sophomore</td>
<td>Navy Option</td>
<td>9</td>
</tr>
<tr>
<td>32-301</td>
<td>Navigation and Naval Operations I</td>
<td>Junior</td>
<td>Navy Option</td>
<td>9</td>
</tr>
<tr>
<td>32-302</td>
<td>Navigation and Naval Operations II</td>
<td>Junior</td>
<td>Marine Option</td>
<td>9</td>
</tr>
<tr>
<td>79-340</td>
<td>History of Modern Warfare</td>
<td>Junior</td>
<td>Navy Option</td>
<td>9</td>
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<tr>
<td>32-401</td>
<td>Naval Ships Systems II (Weapons)</td>
<td>Senior</td>
<td>Navy Option</td>
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<tr>
<td>32-402</td>
<td>Leadership and Ethics</td>
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<td>All</td>
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<td>32-410</td>
<td>Amphibious Warfare</td>
<td>Senior</td>
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<td>32-100-400</td>
<td>Naval Laboratory</td>
<td>All</td>
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</tbody>
</table>
Intercollege Programs

Bachelor of Humanities and Arts Degree Program

Sponsored by the College of Humanities and Social Sciences and the College of Fine Arts

Patricia Maurides, Director
Office: Margaret Morrison Carnegie Hall, Room 107
www.cmu.edu/interdisciplinary

Carnegie Mellon University offers an interdisciplinary degree that combines the strengths of the College of Fine Arts (CFA) and the College of Humanities and Social Sciences (H&SS). The intercollege degree, called the Bachelor of Humanities and Arts (BHA), offers depth of study in both the fine arts and the humanities, social and behavioral sciences. The BHA Degree Program enables a student to receive broader exposure to the humanities and liberal arts than is generally possible through a Bachelor of Fine Arts degree in CFA, while obtaining deeper and more substantial training in the fine arts than is generally possible through a Bachelor of Arts or Bachelor of Science degree in H&SS. Students receive extensive training in one or more of the fine arts disciplines as well as related advanced training in areas such as writing, social sciences, behavioral sciences, or cultural studies. The program also provides enough flexibility to allow students to explore other areas of interest. The most important aspect of the BHA Program is for students to blend their interests, and to explore the connections between their chosen disciplines.

The BHA curriculum is divided into three parts: 1) General Education coursework, 2) CFA concentration coursework, and 3) H&SS concentration coursework. The General Education component is a modified version of the H&SS Revised General Education Program.

Students choose their fine arts concentration from among the five schools in CFA: Architecture, Art, Design, Drama, or Music. A student must meet the entry requirements for the particular CFA school of their choice. While in the BHA Program, a student may change their CFA concentration only if they pass all admission requirements for that particular school.

Students choose their humanities or social/behavioral sciences concentration from the list of majors and minors offered by H&SS, or by self-designing an interdepartmental concentration.

The BHA Degree Program is governed by faculty and administrators from both colleges and led by the director of the BHA and BSA Programs. The director and associate director of the BHA and BSA Programs are the primary advisors and liaisons between CFA and H&SS. Students receive extensive advising support. Each student has two additional academic advisors: an advisor in the admitting school of CFA for their fine arts concentration, and an advisor in H&SS for their humanities/social sciences concentration. This network of advisors guides each student through their curriculum.

Senior Project Course Option

The BHA Program offers a senior project option. The creation and completion of such a project can be an important, integrative and fulfilling capstone. It can also provide an academic goal for BHA “sub-seniors,” as well as influence the development of the BHA Program as a distinguished scholarly and creative undergraduate student community.

Masters of Arts Management (MAM) Option

BHA students who have an interest in arts management and wish to go on for an advanced degree may select courses in their sophomore and junior years to prepare for this area. A student in the junior year may apply to the Accelerated Master’s Program with the H. John Heinz III School of Public Policy and Management. In this program students take both graduate and undergraduate courses in the senior year, earn the BHA degree, and continue on for an additional year to complete the work for the Masters of Arts Management (MAM) degree.

Master of Information Systems Management (MISM)

Accelerated Master’s Program

Exceptional undergraduate students can earn a Master in Information Systems degree, along with their undergraduate degree, in less time than it would take to earn each degree separately. Carnegie Mellon students in their junior year of study are eligible to apply to the MISM accelerated master program. More information about the MISM program can be found at www.mism.cmu.edu.

I. BHA Curriculum: 246 units

A. General Education (GenEd) (10 courses, 84 units minimum)

The BHA General Education curriculum is a modified version of the H&SS Revised General Education program. BHA students are required to fulfill the following General Education requirements, an interdisciplinary seminar requirement, and a computing skills workshop.

1. Communicating: Language and Interpretations (3 courses, 27 units minimum, 76-101 required, two approved modern language courses required)
2. Reflecting: Societies and Cultures (1 course, 9 units minimum, 79-104 required)
3. Modeling: Mathematics and Experiments (1 course, 9 units minimum)
4. Deciding: Social Sciences and Values (3 courses, 27 units minimum, 76-201 required)
5. BHA & BSA Integrative Seminar (1 course, 9 units, 62-190 required)
6. University Requirement: Computing Skills Workshop (1 mini-course, 3 units, to be completed in first semester)

Communicating: Language and Interpretations (3 courses, complete 27 units minimum)

Courses in this category give special attention to the study of language as interpretation, expression and argument within and across multiple discourses. Students examine language for its internal logics and structures.

76-101 Interpretation and Argument - REQUIRED
If a score of 5 is obtained on the either of the English Advanced Placement examinations, the approved substitutions for FALL 2004 are: 76-230, 76-232, 76-245, 76-319, 76-320, 76-333. The approved substitution for non-native English speakers is: 82-085, Reading and Writing in a Multi-Cultural Setting

Modern Languages - REQUIRED to complete two courses taught in a language offered by the Modern Language Department. A wide selection of courses are offered in Chinese, French, German, Italian, Japanese, Russian, and Spanish. Students must complete two courses in the same language. Languages taught at other institutions are also acceptable (with advisor approval).
Reflecting: Societies and Cultures  
(1 course, complete 9 units minimum)  
This category emphasizes the study of history, society, and culture from local and global perspectives.  
79-104 Introduction to World History - REQUIRED

Modeling: Mathematics and Experiments  
(1 course, complete 9 units minimum)  
Courses in this category stress the interplay of mathematical (formal) theories and experimental work. Some courses investigate the internal structure of theories, whereas others use them as models for producing real-world knowledge. Such models may be drawn from a variety of disciplines including the natural sciences, but also, for example, psychology and computer science. The interactions between theorizing and experimenting (observing) can be understood within an intellectual framework that invites comparative assessment. Select from the following course options:

- **Mathematics**
  - 21-110 Problem Solving in Recreational Mathematics
  - 21-111 Calculus I
  - 21-112 Calculus II*
  - 21-120 Differential and Integral Calculus
  - 21-121 Integration and Differential Equations*
  - 21-122 Integration, Differential Equations and Approximation*
  - 21-123 Calculus of Approximations (5 units)
  - 21-127 Concepts of Mathematics
  - 21-129 Calculus of Three Dimensions*
  - 21-256 Multivariate Analysis and Approximation*

- **Natural Science**
  - 03-121 Modern Biology
  - 03-122 Organismic Botany*
  - 03-125 Evolution and the History of Life*
  - 03-130 Biology of Organisms*
  - 03-231 Biochemistry I*
  - 03-232 Biochemistry I*
  - 03-310 Introduction to Computational Biology*
  - 03-360 The Biology of the Brain*
  - 09-101 Introduction to Experimental Chemistry (3 units)
  - 09-103 Atoms, Molecules and Chemical Change (non-major)
  - 09-104 Fundamental Aspects of Organic Chemistry and Biochemistry (non-major)
  - 09-104 Fundamental Aspects of Organic Chemistry & Biochemistry (non-major)
  - 09-105 Introduction of Modern Chemistry I
  - 09-106 Modern Chemistry II*
  - 09-217 Organic Chemistry I*
  - 33-102 Concepts of Modern Physics (non-major)
  - 33-xxx Physics for Engineering Students I*
  - 33-xxx Physics for Engineering Students II*
  - 33-xxx Physics for Science Students I*
  - 33-xxx Physics for Science Students II*
  - 33-114 Physics of Musical Sound
  - 33-115 Energy and the Environment
  - 33-124 Introduction to Astronomy
  - 33-211 Physics III: Modern Essentials*
  - 33-213 Mini-Courses in Special Relativity* (4 units)
  - 33-224 Stars, Galaxies, and the Universe*

- **Other Courses**
  - 05-291 Human-Computer Interaction for Non-Majors
  - 05-413 Human Factors
  - 06-100 Introduction to Chemical Engineering
  - 12-090 Technology and the Environment
  - 12-100 Introduction to Civil and Environmental Engineering
  - 15-100 Introductory/Intermediate Programming
  - 15-111 Intermediate/Advanced Programming
  - 18-100 Introduction to Electrical & Computer Engineering
  - 19-101 Introduction Engineering & Public Policy
  - 24-101 Introduction to Mechanical Engineering
  - 27-100 Engineering Materials of the Future
  - 36-202 Statistical Methods*
  - 36-310 Fundamentals of Statistical Modeling*
  - 36-350 Data Mining*
  - 42-101 Introduction to Biomedical Engineering
  - 66-210 Science, Technology and the Environment
  - 79-100 History of Biomedical Research
  - 80-110 Nature of Mathematical Reasoning
  - 80-210 Logic and Proofs
  - 80-211 Arguments and Inquiry
  - 80-212 Logic and Philosophical Analysis
  - 80-220 Philosophy of Science
  - 80-222 Measurement and Methodology
  - 80-312 Philosophy of Mathematics
  - 80-313 Philosophy of Logic
  - 80-322 Philosophy of Physics
  - 80-333 Philosophy of Biology
  - 85-412 Cognitive Modeling
  - 62-100 Introduction to Parallel Distributed Processing
  - 88-251 Empirical Research Methods*

* Indicates co-requisites and/or prerequisites required.

Deciding: Social Sciences and Values  
(3 courses, complete 27 units minimum)  
The theme of this category is the exploration of cognitive, behavioral and ethical dimensions of decision-making on both the individual and social level. Making decisions requires a broad understanding of human rationality and social interaction. Some courses examine the critical collection and analysis of data for achieving such an understanding, whereas others emphasize the historical development of policies and values, which form the matrix for decision-making.

- 36-201 Statistical Reasoning - REQUIRED
- 36-303 Sampling Surveys and Society*
- 73-100 Principles of Economics
- 79-222 Religion in American Society
- 79-337 Educational Policy in Historical Perspective
- 79-348 Objects of Value
- 79-386 The Global Environment: Historical Perspectives and Policy Dilemmas

- 80-130 Introduction to Ethics
- 80-136 Ethics and Public Policy
- 80-221 Philosophy of Social Science
- 80-230 Ethical Theory
- 80-235 Political Philosophy
- 80-236 Philosophy and the Law
- 80-241 Ethical Judgments in Professional Life
- 80-242 Conflict, Dispute Resolution
- 80-245 Medical Ethics
- 80-270 Philosophy of Mind
- 80-271 Philosophy and Psychology
- 80-305 Rational Choice
- 80-321 Causation and Social Policy
- 80-330 Research Ethics
- 80-335 Philosophy, Politics, and Economics
- 80-340 Environmental Ethics
- 80-341 Computers and Ethics
- 80-342 Ethics and Oppression
- 80-346 Value, Fact, and Policy
- 85-102 Introduction to Psychology
- 85-211 Cognitive Psychology
- 85-213 Human Information Processing and Artificial Intelligence
- 85-219 Biological Foundations of Behavior
- 85-221 Principles of Child Development
- 85-241 Social Psychology
- 85-251 Personality
- 85-261 Abnormal Psychology
- 88-104 Decision Processes in American Political Institutions
- 88-120 Reason, Passion, and Cognition
- 88-220 Policy Analysis I
- 88-307 Principles of Individual and Collective Irrationality
- 88-324 Electoral Systems and Processes
- 88-330 Political Economy of Inequality and Redistribution
- 88-343 Economics of Technological Change*
- 88-358 Policy Making Institutions*

* Indicates co-requisites and/or prerequisites required.

Integrative Seminar (1 course, 9 units)  
This interdisciplinary seminar is designed for BHA and BSA students to be taken in the fall semester of their freshman or sophomore year. If necessary, this seminar can be substituted with another approved interdisciplinary course. This course is designed to create an environment for interdisciplinary learning and collaboration. It provides a forum for BHA and BSA freshmen/sophomores to discuss their own projects and begin collaborations with other students. BHA & BSA Integrative Seminar begins the connection of students within BHA and BSA to the interdisciplinary culture at Carnegie Mellon and beyond.

62-190 BHA & BSA Integrative Seminar - REQUIRED
University Requirement (1 mini-course, 3 units)
This is a mini-course, pass/no credit, to be completed in the 1st semester.


B. College of Humanities and Social Sciences Concentration (6 courses, 54 units minimum)
Each student meets individually with a BHA H&S Academic Advisor to design a 54-unit H&S concentration based on existing H&S majors/minors, or by creating a self-defined interdepartmental concentration. Please refer to the H&S section of this catalog to review the individual majors and minors offered.

C. College of Fine Arts Concentration (number of courses vary, 108 units minimum)
BHA students choose one of the following concentrations:
- Architecture
- Art
- Design
- Drama
- Music

ARCHITECTURE CONCENTRATION (108 units minimum)
Required Courses (54 units minimum)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-100</td>
<td>Design Fundamentals</td>
<td>12</td>
</tr>
<tr>
<td>or 48-095</td>
<td>Architecture for Non-Majors</td>
<td>9</td>
</tr>
<tr>
<td>48-132</td>
<td>Drawing I</td>
<td>9</td>
</tr>
<tr>
<td>48-135</td>
<td>Architectural Drawing (Drawing II)</td>
<td>9</td>
</tr>
<tr>
<td>48-240</td>
<td>Survey of World Architecture &amp; Urbanism</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History Lecture (varying topics)</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History Lecture (varying topics)</td>
<td>9</td>
</tr>
</tbody>
</table>

Complete one of the following Elective Foci (54 units minimum):

Elective Focus: General Education in Architecture (54 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-120</td>
<td>Computer Modeling I</td>
<td>9</td>
</tr>
<tr>
<td>48-210</td>
<td>Statics (prerequisite: 33-106)</td>
<td>9</td>
</tr>
<tr>
<td>48-217</td>
<td>Materials and Assembly (prerequisite: 48-210)</td>
<td>9</td>
</tr>
<tr>
<td>48-310</td>
<td>Structures I (prerequisite: 48-217)</td>
<td>9</td>
</tr>
<tr>
<td>48-315</td>
<td>Environment I: Climate and Energy (prerequisite: 33-106)</td>
<td>9</td>
</tr>
</tbody>
</table>

Elective Focus: Architectural Representation and Visualization (54 units)

This sequence is intended to develop particular skills in architectural representation.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-120</td>
<td>Computer Modeling I</td>
<td>9</td>
</tr>
<tr>
<td>48-125</td>
<td>Computer Modeling II</td>
<td>9</td>
</tr>
<tr>
<td>48-230</td>
<td>Drawing III: Perspective (prerequisite: 48-135)</td>
<td>9</td>
</tr>
<tr>
<td>48-563</td>
<td>Building Virtual Worlds</td>
<td>9</td>
</tr>
<tr>
<td>48-7xx</td>
<td>Graduate Elective</td>
<td>9</td>
</tr>
<tr>
<td>48-7xx</td>
<td>Graduate Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

Elective Focus: Architectural Technology (54 units)
This sequence is intended to develop intellectual links to the technical aspects of the profession.

Prerequisite Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>33-xxx</td>
<td>Physics I for Engineering Students</td>
<td>12</td>
</tr>
</tbody>
</table>

Elective Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-210</td>
<td>Statics (prerequisite: 33-106)</td>
<td>9</td>
</tr>
<tr>
<td>48-215</td>
<td>Materials and Assembly (prerequisite: 48-210)</td>
<td>9</td>
</tr>
<tr>
<td>48-217</td>
<td>Structures I (prerequisite: 48-217)</td>
<td>9</td>
</tr>
<tr>
<td>48-310</td>
<td>Structures II (prerequisite: 48-217)</td>
<td>9</td>
</tr>
<tr>
<td>48-315</td>
<td>Environment I: Climate and Energy (prerequisite: 33-106)</td>
<td>9</td>
</tr>
<tr>
<td>48-410</td>
<td>Environment II: Space, Sound, and Light (prerequisite: 33-106)</td>
<td>9</td>
</tr>
<tr>
<td>48-412</td>
<td>Environment III: Mechanical Systems</td>
<td>9</td>
</tr>
<tr>
<td>48-415</td>
<td>Advanced Building Systems (prerequisite: 48-315)</td>
<td>9</td>
</tr>
<tr>
<td>48-4xx</td>
<td>Designated Departmental Technical Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

Elective Focus: Architectural History (six varying topics, 54 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-xxx</td>
<td>Architectural History</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History</td>
<td>9</td>
</tr>
</tbody>
</table>

ART CONCENTRATION (108 units minimum)
PORTFOLIO REVIEW REQUIRED FOR ADMISSION

Concept Studios (2 courses, 20 units)
Complete two courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-101</td>
<td>Concept Studio I</td>
<td>10</td>
</tr>
<tr>
<td>60-102</td>
<td>Concept Studio II</td>
<td>10</td>
</tr>
<tr>
<td>60-201</td>
<td>Concept Studio III</td>
<td>10</td>
</tr>
</tbody>
</table>

Media Studios (3 courses, 30 units)
Complete three courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-150</td>
<td>2-Dimensional Studio I</td>
<td>10</td>
</tr>
<tr>
<td>60-151</td>
<td>2-Dimensional Studio II</td>
<td>10</td>
</tr>
<tr>
<td>60-250</td>
<td>2-Dimensional Studio III</td>
<td>10</td>
</tr>
<tr>
<td>60-251</td>
<td>2-Dimensional Studio IV</td>
<td>10</td>
</tr>
<tr>
<td>60-130</td>
<td>3-Dimensional Studio I</td>
<td>10</td>
</tr>
<tr>
<td>60-230</td>
<td>3-Dimensional Studio II</td>
<td>10</td>
</tr>
<tr>
<td>60-110</td>
<td>Electronic Media Studio I</td>
<td>10</td>
</tr>
</tbody>
</table>

Advanced Studios (4 courses, 40 units)
Complete four courses. Courses may be offered in the fall and/or spring. Students may take courses in any media area (ETB, PDP or SIS). They may take all courses in one media area if a focus is desired.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-410-29</td>
<td>Advanced Electronic and Time-Based Work (ETB)</td>
<td>10</td>
</tr>
<tr>
<td>60-430-49</td>
<td>Advanced Sculpture, Installation and Site-Work (SIS)</td>
<td>10</td>
</tr>
<tr>
<td>60-450-98</td>
<td>Advanced Painting, Drawing and Printmaking (PDP)</td>
<td>10</td>
</tr>
<tr>
<td>60-499</td>
<td>Studio- Independent Study (one only)</td>
<td>10</td>
</tr>
</tbody>
</table>

Art History/Theory (2 courses, 18 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-205</td>
<td>Modern Visual Culture: 1789-1945</td>
<td>9</td>
</tr>
<tr>
<td>60-206</td>
<td>Contemporary Visual Culture: 1945 to the Present</td>
<td>9</td>
</tr>
</tbody>
</table>

NOTE: To complete the full three-semester historical sequence, take 60-105, Pre-Industrial Visual Cultures, 9 units.

Review Requirement (Complete 2 required reviews, 0 units)
A review is required at the end of the sophomore and senior years. Pass/fail only.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-200</td>
<td>Sophomore Review (Spring)</td>
<td>9</td>
</tr>
<tr>
<td>60-400</td>
<td>Senior Review (Spring)</td>
<td>9</td>
</tr>
</tbody>
</table>
INCLUDE DESIGN (108 units minimum)

PORTFOLIO REVIEW REQUIRED FOR ADMISSION

Design Required Courses (81 units)

54-101 Design Studio I (Fall) 9 units
54-102 Design Studio II (Spring) 9 units
54-121 Design Drawing I (Fall) 9 units
54-122 Design Drawing II (Spring) 9 units
54-132 Introduction to Photo Design (Spring) 9 units
54-171 Human Experience in Design (Fall) 9 units
54-174 History of Objects and Images (Spring) 9 units
54-271 Design History I (Fall) 9 units
54-272 Design History II (Spring) 9 units

Design Electives (27 units)

Choose three (3) additional Design courses in consultation with the Design advisor.

NOTE: BHA Design students have 114 units of electives built into their program, any portion of which can be taken in Design. These additional courses must also be chosen in consultation with the Design advisor and respect all prerequisite requirements, etc.

DRAMA CONCENTRATION (108 units minimum)

AUDITION/INTERVIEW REQUIRED FOR DIRECTING OPTION

PORTFOLIO REVIEW/INTERVIEW REQUIRED FOR DESIGN OR PRODUCTION TECHNOLOGY AND MANAGEMENT OPTION

There is no BHA/BSA acting or musical theatre option.

The BHA/BSA Drama candidate may choose from the three options offered by The School of Drama and successfully pass the audition/ interview for directing, or the portfolio review/interview for the design or production technology and management options. All BHA/BSA students are required to take courses 54-177 Text to Stage and 54-163 Introduction to Production in the freshman year, course 54-259 Crew in one of the semesters of the sophomore year (4-6 weeks per term), and two semesters of History of Drama Survey during the sophomore or junior year.

Drama Required Courses (36 units)

54-177 Text to Stage 12 units
54-163 Introduction to Production 6 units
54-151 Principles to Counterpoint (Fall) 6 units
54-154 18th Century Counterpoint (Spring) 6 units
54-132 Dance I (Fall)* 12 units
54-123 Dance I (Spring)* 3 units
54-124 Dance I (Spring)*~ 3 units
54-151 Electrics Stagecraft (Fall) 3 units
54-152 Scenery Stagecraft (Spring) 3 units
54-153 Costume Stagecraft (Fall) 3 units
54-168 Theatre Icons (Spring) 3 units
54-171/172 Media Studio (portfolio review required, full year classes)
- Basic Design 6 units
- Drafting 6 units
- Drawing 4 units

(Upper level design courses require this Media Studio prerequisite and are available with instructor’s permission)

Drama Elective Courses (78 units)

54-103 Speech I * 2 units
54-105 Voice I + 6 units
54-107 Intro to Movement (Fall) 4 units
54-108 Intro to Movement (Spring) 4 units
54-113 Ballet Elective (Fall) 6 units
54-114 Ballet Elective (Spring) ~ 6 units
54-154 Intro to Directing* 12 units
54-123 Dance I (Fall)* 3 units
54-124 Dance I (Spring)*~ 3 units
54-151 Electrics Stagecraft (Fall) 3 units
54-152 Scenery Stagecraft (Spring) 3 units
54-153 Costume Stagecraft (Fall) 3 units
54-168 Theatre Icons (Spring) 3 units
54-171/172 Media Studio (portfolio review required, full year classes)
- Basic Design 6 units
- Drafting 6 units
- Drawing 4 units

(Upper level design courses require this Media Studio prerequisite and are available with instructor’s permission)

54-173 Intro to Performance Tech. and Man. (Fall) 6 units
54-174 Intro to Performance Tech. and Man. (Sp)~ 6 units
54-187 Introduction to Playwriting (Fall) 6 units
54-188 Advanced Playwriting (Fall)+ 9 units
54-190 Advanced Playwriting (Spring)+ 9 units
54-191 Acting Elective (Fall) 9 units
54-192 Acting Elective (Spring) 9 units
54-205 Acting Lab section BH or CH (Fall)+ 4 units
54-206 Acting Lab section BH or CH (Spring)+~ 4 units
54-214 Elementary Dance (Spring) 3 units
54-215 Dance for Actors (Fall) 3 units
54-222 Directing II * 9 units
54-231 Design for the Stage (Fall)* 9 units
54-232 Design for the Stage (Spring)*~ 9 units
54-237 Scene Painting I (Fall)* 6 units
54-238 Scene Painting I (Spring)*~ 6 units
54-239 History of Architecture and Decor (Fall) 6 units
54-240 History of Architecture and Decor (Spring) 6 units
54-245 History of Clothing (Fall and Spring) 6 units
54-267 Sound Design * 9 units
54-269 Computer Applications-AutoCad (Fall) 6 units
54-270 Computer Apps-Photoshop/Dreamweaver (Sp) 6 units
54-277 Stage Management 4 units
54-279 Production Planning (Spring) 6 units
54-283 Fundamentals of Directing (Fall)* 4 units
54-284 Fundamentals of Directing (Spring)*~ 4 units
54-289 Growing Theatre Outreach (Fall and Spring) 9 units
54-293 Make-up 2 units
54-297 Independent Study 2-12 units
54-341 Costume Design I (Fall)* 9 units
54-342 Costume Design I (Spring)*~ 9 units
54-410 Theatre Lab - New Play Workshop (Fall)* 4 units
54-410 Theatre Lab - New Play Workshop (Spring)*~ 4 units
54-449 Theatre Planning Project * 18 units
54-475 Theatre Management 9 units
54-490 Edinburgh Summer Practicum/Study Abroad TBA units

* These courses require the permission of the instructor.
~ The fall semester is a required prerequisite for the spring.
+ Prerequisites are required. See advisor for prerequisite information.

MUSIC CONCENTRATION (108 units minimum)

AUDITION REQUIRED FOR ADMISSION

Options available in the following areas: Performance (Instrumental, Piano, Organ), or Composition.

There is no BHA/BSA voice option.

Required Academic Courses (24 units)

57-152 Harmony I (Fall) 6 units
57-161 Eurhythmics I (Fall) 3 units
57-173 Survey of Western Music History (Fall) 9 units
57-181 Harmony I (Spring) 6 units

Required Performance (60 units)

57-xxx Studio (Fall or Spring) 9 units
57-xxx Studio (Fall or Spring) 9 units
57-xxx Studio (Fall or Spring) 9 units
57-xxx Studio (Fall or Spring) 9 units
57-xxx Major Ensemble (Fall or Spring) 6 units
57-xxx Major Ensemble (Fall or Spring) 6 units
57-xxx Major Ensemble (Fall or Spring) 6 units
57-xxx Major Ensemble (Fall or Spring) 6 units

Additional Academic Courses (24 units minimum)

57-151 Principles to Counterpoint (Fall) 6 units
57-152 Harmony II (Spring) 6 units
57-154 18th Century Counterpoint (Spring) 6 units
57-162 Eurhythmics II (Spring) 3 units
57-163 Eurhythmics III (Fall) 3 units
57-164 Eurhythmics IV (Spring) 3 units
57-182 Solfege II (Spring) 6 units
57-183 Solfege III (Fall) 6 units
57-184 Solfege IV (Spring) 6 units
57-202 Opera History (Spring) 9 units
57-203 Medieval, Renaissance and Baroque Music History (Spring) 9 units
57-204 18th and 19th Century Music History (Fall) 9 units
57-205 20th Century Music History (Spring) 9 units
INTERDISCIPLINARY CONCENTRATION (108 units minimum)

BHA students may combine a minimum of 108 units from two or more areas in the fine arts, with a complementary 54 units from two or more areas in the humanities and/or social sciences. Interdisciplinary areas to consider: arts and society, visual and verbal communication, the arts and organizations, performance and theory, comparative arts.

II. BHA Electives:
(approximately 13 courses, 114 units)

Take any Carnegie Mellon course. Many BHA students use their electives to broaden or deepen their concentrations. A maximum of 9 units of physical education and/or military science may be counted toward this requirement. Physical education and military science courses will not be calculated in a student’s QPA.

BHA Degree Requirements: 360 units

Bachelor of Science and Arts Degree Program

Sponsored by the Mellon College of Science and the College of Fine Arts

Patricia Maurides, Director
Office: Margaret Morrison Carnegie Hall, Room 107
www.cmu.edu/interdisciplinary

Carnegie Mellon University recognizes that there are students who are naturally gifted in both the fine arts and the natural sciences or mathematics. In order to accommodate students who want to pursue an education simultaneously in these areas, we offer a degree that combines the strengths of the College of Fine Arts (CFA) and the Mellon College of Science (MCS). The intercollege degree, called the Bachelor of Science and Arts (BSA), is a rigorous program that offers a unique group of qualified students the opportunity to develop their talents and interests in an area of the fine arts and an area of the natural sciences or mathematics.

The BSA curriculum is divided into three parts: 1) BSA Core requirements, 2) CFA concentration coursework, and 3) MCS concentration coursework.

Students choose their fine arts concentration from among the five schools in CFA: Architecture, Art, Design, Drama or Music. A student must meet the entry requirements for the particular CFA school of their choice. While in the BSA Program, a student may change their CFA concentration only if they pass all admission requirements for that particular school.

Students choose their science concentration from among the four departments in MCS: Biological Sciences, Chemistry, Mathematical Sciences, or Physics.

The BSA Degree Program is governed by faculty and administrators from both colleges and led by the director of the BHA & BSA Programs. The director and associate director of the BHA and BSA Programs are the primary advisors and liaisons between CFA and MCS. Students receive extensive advising support. Each student has two additional academic advisors: an advisor in the admitting school of CFA for their fine arts concentration, and an advisor in MCS for their natural sciences/mathematics concentration. This network of advisors guides each student through their curriculum.

Senior Research/Project Course Option

The BSA program offers a senior project option. The creation and completion of such a project can be an important integrative and fulfilling capstone. It can also provide an academic goal for BSA “sub-seniors,” as well as influence the development of the BSA program as a distinguished scholarly and creative undergraduate student community.

I. BSA Curriculum: 334-352 units

A. BSA Core Requirements (12 courses, 108 units minimum)

1. Writing/Expression (1 course, 9 units, 76-101 required)
2. BHA & BSA Integrative Seminar (1 course, 9 units, 62-190 required)
3. Cultural Analysis (1 course, 9 units minimum)
4. Economic, Political, & Social Institutions OR Cognition, Choice & Behavior (1 course, 9 units minimum)
5. Two additional courses from one of the following departments: English, History, Modern Languages, Philosophy, or Psychology (2 courses, 18 units)
6. Mathematics (2 courses, 20 units, 21-120 and 21-122 required)
7. University Requirement: Computing Skills Workshop (1 mini-course, 3 units, to be completed in first semester)

Writing/Expression (1 course, 9 units)

Broadly considered, language is a tool used to communicate, as well as a way to organize non-visible and non-mathematical thinking. This requirement focuses on the social nature of language and the ways in which writing constitutes thinking.

76-101 Interpretation and Argument - REQUIRED
If a score of 5 is obtained on the either of the English Advanced Placement examinations, the approved substitutions for FALL 2004 are: 76-230, 76-232, 76-245, 76-319, 76-320, 76-333. The approved substitution for non-native English speakers is: 82-085, Reading and Writing in a Multi-Cultural Setting.

Integrative Seminar (1 course, 9 units)

This interdisciplinary seminar is designed for BHA and BSA students to be taken in the fall semester of their freshman or sophomore year. If necessary, this seminar can be substituted with another approved interdisciplinary course. This course is designed to create an environment for interdisciplinary learning and collaboration. It provides a forum for BHA and BSA freshmen/sophomores to discuss their own projects and begin collaborations with other students. BHA & BSA Integrative Seminar begins the connection of students within BHA and BSA to the interdisciplinary culture at Carnegie Mellon and beyond.

62-190 BHA & BSA Integrative Seminar - REQUIRED

Cultural Analysis (1 course, complete 9 units minimum)

This category explores definitions of culture and the role culture plays in producing different actions and institutions as well as the roles of institutions, systems and human actions in shaping cultural contexts. Listed below are examples of courses that meet the requirement for this category.

66-250 Introduction to Religion
70-342 Managing Across Cultures
76-230 19th-Century American Literature and Culture
76-231 20th Century American Literature and Culture
76-232 African-American Studies
76-233 Post-Colonial Literature
76-235 British Literature and Culture Before 1800
76-236 19th Century British Literature and Culture
76-241 Introduction to Gender Studies
76-246 British and American Literature and Culture
79-104 Introduction to World History
79-113 Culture and Identity in American Society
79-201 Introduction to Anthropology
79-204 Twentieth Century America
79-206 Development of American Culture
79-207 Development of European Culture
79-209 Theory and Practice in Anthropology
79-218 The Roots of Rock & Roll
79-241 African-American History I
79-242 African-American History II
79-260 Mayan America
79-270 Chinese Culture and Society
79-271 Modern China  
79-272 Modern Japan  
79-280 Russian History from the First to the Last Tsar  
79-281 Modern Soviet History  
79-356 Introduction to African History  
79-384 Medicine and Society  
80-100 What Philosophy Is  
80-250 Ancient Philosophy  
80-251 Modern Philosophy  
80-253 Continental Philosophy  
80-254 Analytical Philosophy  
80-255 Pragmatism  
80-261 Aesthetics of Mass Art  
82-2xx Any 200 level or greater course from Modern Languages

**Economic, Political & Social Institutions *Or* Cognition, Choice, & Behavior**

(1 course from either category, complete 9 units minimum)

**Economic, Political & Social Institutions**

This category examines the ways in which institutions organize individual preferences and actions into collective outcomes using model-based reasoning.

- 36-303 Sampling, Surveys, and Society
- 66-184 Topics in Law: The Bill of Rights
- 70-332 Business and Society
- 73-100 Economic Principles
- 73-110 Experiments with Economic Principles
- 79-219 The Holocaust in Historical Perspective
- 79-222 Religion in American Society
- 79-223 Protest and Dissent in American History
- 79-266 Times of Feast/Famine: Population and Family in History
- 79-331 Crime and Punishment
- 79-337 Educational Policy in Historical Perspective
- 79-335 Drug Use and Drug Policy
- 79-345 American Environmental History: Critical Issues
- 79-350 Theories of International Relations
- 79-386 The Global Environment: Historical Perspectives and Policy Dilemmas
- 80-135 Introduction to Political Philosophy
- 80-136 Ethics and Public Policy
- 80-235 Political Philosophy
- 80-236 Philosophy and the Law
- 80-340 Environmental Ethics and Decision Processes
- 80-341 Computers, Society, and Ethics
- 88-104 Decision Processes in American Political Institutions

**Cognition, Choice, and Behavior**

This category use model-based analysis to broaden an understanding of human thinking, choices, and behavior on an individual basis across a variety of settings.

- 80-130 Introduction to Ethics
- 80-150 Nature of Reason
- 80-180 The Nature of Language
- 80-221 Philosophy of Social Science
- 80-230 Ethical Theory
- 80-241 Ethical Judgments in Professional Life
- 80-242 Conflict, Dispute Resolution
- 80-243 Business Ethics
- 80-245 Medical Ethics
- 80-270 Philosophy of Mind
- 80-271 Philosophy and Psychology
- 85-100 Introduction to Intelligence in Humans, Animals and Machines
- 85-102 Introduction to Psychology
- 85-211 Cognitive Psychology
- 85-213 Human Information Processing and Artificial Intelligence
- 85-221 Principles of Child Development
- 85-241 Social Psychology
- 85-251 Personality
- 85-261 Abnormal Psychology
- 88-120 Reason, Passion, and Cognition

**Complete TWO additional courses from one of the following departments: English, History, Modern Languages, Philosophy, or Psychology**

(2 courses, complete 18 units minimum)

**Mathematics (2 courses, 20 units)**

Complete these two courses in Calculus:
- 21-120 Differential & Integral Calculus
- 21-122 Integration, Differential Equations, and Approximation

**Science (3 courses, 31 units)**

Complete the following science courses:
- 03-121 Modern Biology
- 09-105 Introduction to Modern Chemistry
- 33-xxx Physics for Science Students I

**University Requirement (1 mini-course, 3 units)**

This is a mini-course, pass/no credit, to be completed in the 1st semester.

**B. Mellon College of Science Concentration**

(number of courses vary, 120-134 units)

BSA students choose one of the following concentrations:
- Biological Sciences 120-123 units
- Chemistry 122 units
- Mathematical Sciences 121 units
- Physics 134 units

**BIOLOGICAL SCIENCES CONCENTRATION**

(120-123 units minimum)

**Required Courses (102 units)**

- 03-240 Cell Biology 9 units
- 03-231 or 03-232 Biochemistry 9 units
- 03-330 Genetics 9 units
- 03-124 or 03-343 Biology Laboratory 9-12 units
- 03-201 and/or 03-202 Undergraduate Colloquium 2 units
- 09-106 Modern Chemistry II 10 units
- 09-217 Organic Chemistry I 9 units
- 09-218 Organic Chemistry II 9 units
- 09-221 Chem Lab I 12 units
- 09-222 Chem Lab II 12 units
- 33-xxx Physics for Science Students II 12 units

**Biology Electives (2 courses, 18 units)**

Must be selected from 03-3xx, excluding 03-445

**CHEMISTRY CONCENTRATION**

(122 units minimum)

**Required Courses (104 units)**

- 09-106 Modern Chemistry II 10 units
- 09-217 Organic Chemistry I 9 units
- 09-218 Organic Chemistry II 9 units
- 09-214, 344 or 345 Physical Chemistry 9 units
- 09-348 Inorganic Chemistry 10 units
- 09-221 Chem Lab I 12 units
- 09-222 Chem Lab II 12 units
- 09-321 Chem Lab III 12 units
- 09-204 Issues in Chemistry 3 units
- 09-201, 202 and 301 Undergraduate Seminars (1 unit each) 3 units
- 09-402 Undergraduate Seminar 3 units
- 33-xxx Physics for Science Students II 12 units
BSA students choose one of the following concentrations:

**MATHEMATICAL SCIENCES CONCENTRATION** (121 units minimum)

**Required Courses (85 units)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-127</td>
<td>Concepts of Mathematics</td>
<td>9</td>
</tr>
<tr>
<td>21-228</td>
<td>Discrete Mathematics</td>
<td>9</td>
</tr>
<tr>
<td>21-241</td>
<td>Matrix Algebra I (or 21-341 Linear Algebra)</td>
<td>9</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
<td>9</td>
</tr>
<tr>
<td>21-355</td>
<td>Principles of Real Analysis</td>
<td>9</td>
</tr>
<tr>
<td>21-373</td>
<td>Algebraic Structures</td>
<td>9</td>
</tr>
<tr>
<td>33-xxx</td>
<td>Physics for Science Students II</td>
<td>12</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
</tbody>
</table>

**Math Sciences Electives** (2 courses, 18 units)

Students with a music focus should take 21-372 (Partial Differential Equations).

**Math Sciences, Statistics, or Computer Science Electives** (2 courses, 18 units)

May be computer science course above the 100 level other than 15-347, mathematical science courses beyond the calculus sequence, and statistics courses having 36-225 as a prerequisite.

**PHYSICS CONCENTRATION** (134 units minimum)

**Required Courses (125 units)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-xxx</td>
<td>Physics for Science Students II</td>
<td>12</td>
</tr>
<tr>
<td>33-104</td>
<td>Experimental Physics</td>
<td>9</td>
</tr>
<tr>
<td>33-211</td>
<td>Physics III</td>
<td>10</td>
</tr>
<tr>
<td>33-231</td>
<td>Physical Analysis</td>
<td>10</td>
</tr>
<tr>
<td>33-234</td>
<td>Quantum Physics</td>
<td>10</td>
</tr>
<tr>
<td>33-331</td>
<td>Physical Mechanics I</td>
<td>10</td>
</tr>
<tr>
<td>33-338</td>
<td>Intermediate Electricity and Magnetism I</td>
<td>10</td>
</tr>
<tr>
<td>33-340</td>
<td>Modern Physics Lab</td>
<td>10</td>
</tr>
<tr>
<td>33-341</td>
<td>Thermal Physics</td>
<td>10</td>
</tr>
<tr>
<td>33-439</td>
<td>Intermediate Electricity and Magnetism II</td>
<td>10</td>
</tr>
<tr>
<td>33-201, 202, 301, 302, 401, and 402</td>
<td>Undergraduate Colloquium (1 unit each)</td>
<td>6</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
<td>9</td>
</tr>
</tbody>
</table>

**Technical Elective (1 course, 9 units)**

May be any physics or computer science course

**Elective Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-xxx</td>
<td>Physics I for Engineering Students</td>
<td>12</td>
</tr>
</tbody>
</table>

**C. College of Fine Arts Concentration**

*(number of courses vary, 108 units minimum)*

BSA students choose one of the following concentrations:

- Architecture
- Art
- Design
- Drama
- Music

**ARCHITECTURE CONCENTRATION** (108 units minimum)

**Required Courses (54 units minimum)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-100</td>
<td>Design Fundamentals</td>
<td>12</td>
</tr>
<tr>
<td>48-095</td>
<td>Architecture for Non-Majors</td>
<td>9</td>
</tr>
<tr>
<td>48-132</td>
<td>Drawing I</td>
<td>9</td>
</tr>
<tr>
<td>48-135</td>
<td>Architectural Drawing (Drawing II)</td>
<td>9</td>
</tr>
<tr>
<td>48-240</td>
<td>Survey of World Architecture &amp; Urbanism</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History Lecture (varying topics)</td>
<td>9</td>
</tr>
</tbody>
</table>

Complete one of the following Elective Foci (54 units minimum):

**Elective Focus: General Education in Architecture (54 units minimum):**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-120</td>
<td>Computer Modeling I</td>
<td>9</td>
</tr>
<tr>
<td>48-210</td>
<td>Statics (prerequisite: 33-106)</td>
<td>9</td>
</tr>
<tr>
<td>48-215</td>
<td>Materials and Assembly (prerequisite: 48-210)</td>
<td>9</td>
</tr>
<tr>
<td>48-217</td>
<td>Structures I (prerequisite: 48-210)</td>
<td>9</td>
</tr>
<tr>
<td>48-230</td>
<td>Perspective (Drawing III)(prerequisite: 48-135)</td>
<td>9</td>
</tr>
<tr>
<td>48-315</td>
<td>Environment I: Climate and Energy (prerequisite: 33-106)</td>
<td>9</td>
</tr>
<tr>
<td>48-351</td>
<td>Psychology of Habitation</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History Lecture (varying topics)</td>
<td>9</td>
</tr>
<tr>
<td>48-452</td>
<td>Design Economics (prerequisite: 73-100)</td>
<td>9</td>
</tr>
<tr>
<td>48-453</td>
<td>Urban Design</td>
<td>9</td>
</tr>
<tr>
<td>48-551</td>
<td>Ethics and Decision Making in Architecture (prerequisite: 36-201 or 73-100)</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Departmental Elective (prerequisites vary)</td>
<td>9</td>
</tr>
</tbody>
</table>

**Elective Focus: Architectural Representation and Visualization (54 units minimum):**

This sequence is intended to develop particular skills in architectural representation.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-120</td>
<td>Computer Modeling I</td>
<td>9</td>
</tr>
<tr>
<td>48-125</td>
<td>Computer Modeling II</td>
<td>9</td>
</tr>
<tr>
<td>48-230</td>
<td>Perspective (Drawing III)(prerequisite: 48-135)</td>
<td>9</td>
</tr>
<tr>
<td>48-563</td>
<td>Building Virtual Worlds</td>
<td>9</td>
</tr>
<tr>
<td>48-7xx</td>
<td>Graduate Elective</td>
<td>9</td>
</tr>
<tr>
<td>48-7xx</td>
<td>Graduate Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

**Elective Focus: Architectural Technology (54 units minimum):**

This sequence is intended to develop intellectual links to the technical aspects of the profession.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-120</td>
<td>Computer Modeling I</td>
<td>9</td>
</tr>
<tr>
<td>48-125</td>
<td>Computer Modeling II</td>
<td>9</td>
</tr>
<tr>
<td>48-230</td>
<td>Perspective (Drawing III)(prerequisite: 48-135)</td>
<td>9</td>
</tr>
<tr>
<td>48-563</td>
<td>Building Virtual Worlds</td>
<td>9</td>
</tr>
<tr>
<td>48-7xx</td>
<td>Graduate Elective</td>
<td>9</td>
</tr>
<tr>
<td>48-7xx</td>
<td>Graduate Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

**Elective Focus: Architectural History (six varying topics, 54 units):**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-xxx</td>
<td>Architectural History</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History</td>
<td>9</td>
</tr>
<tr>
<td>48-xxx</td>
<td>Architectural History</td>
<td>9</td>
</tr>
</tbody>
</table>

**Portfolio Review Required for Admission**

**Concept Studios** (2 courses, 20 units)

Complete two courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-101</td>
<td>Concept Studio I</td>
<td>10</td>
</tr>
<tr>
<td>60-102</td>
<td>Concept Studio II</td>
<td>10</td>
</tr>
<tr>
<td>60-201</td>
<td>Concept Studio III</td>
<td>10</td>
</tr>
</tbody>
</table>
Media Studios (3 courses, 30 units)

Complete three courses:
- 60-150 2-Dimensional Studio I 10 units
- 60-151 2-Dimensional Studio II 10 units
- 60-250 2-Dimensional Studio III 10 units
- 60-251 2-Dimensional Studio IV 10 units
- 60-130 3-Dimensional Studio I 10 units
- 60-131 3-Dimensional Studio II 10 units
- 60-110 Electronic Media Studio I 10 units

Advanced Studios (4 courses, 40 units)

Complete four courses. Courses may be offered in the fall and/or spring. Students may take courses in any media area (ETB, PDP or SIS). They may take all courses in one media area if a focus is desired.

- 60-410-29 Advanced Electronic and Time-Based Work (ETB) 10 units
- 60-430-49 Advanced Sculpture, Installation and Site-Work (SIS) 10 units
- 60-450-98 Advanced Painting, Drawing and Printmaking (PDP) 10 units
- 60-499 Studio - Independent Study (one only) 10 units

Art History/Theory (2 courses, 18 units)

- 60-205 Modern Visual Culture: 1789-1945 9 units
- 60-206 Contemporary Visual Culture: 1945 to the Present 9 units

NOTE: To complete the full three-semester historical sequence, take 60-105, Pre-Industrial Visual Cultures, 9 units.

Review Requirement (Complete 2 required reviews, 0 units)

A review is required at the end of the sophomore and senior years. Pass/fail only.

- 60-200 Sophomore Review (Spring)
- 60-400 Senior Review (Spring)

DESIGN CONCENTRATION (108 units minimum)

PORTFOLIO REVIEW REQUIRED FOR ADMISSION

Design Required Courses (81 units)

- 51-101 Design Studio I (Fall) 9 units
- 51-102 Design Studio II (Spring) 9 units
- 51-121 Design Drawing I (Fall) 9 units
- 51-122 Design Drawing II (Spring) 9 units
- 51-132 Introduction to Design I (Spring) 9 units
- 51-171 Human Experience in Design (Fall) 9 units
- 51-174 History of Objects and Images (Spring) 9 units
- 51-271 Design History I (Fall) 9 units
- 51-272 Design History II (Spring) 9 units

Design Electives (27 units)

Choose three (3) additional Design courses in consultation with the Design advisor.

DRAMA CONCENTRATION (108 units minimum)

AUDITION/INTERVIEW REQUIRED FOR DIRECTING OPTION

PORTFOLIO REVIEW/INTERVIEW REQUIRED FOR DESIGN OR PRODUCTION TECHNOLOGY AND MANAGEMENT OPTION

There is no BHA/BSA acting or musical theatre option. The BHA/BSA Drama candidate must choose from the three options offered by The School of Drama and successfully pass the audition/interview for directing, or the portfolio review/Interview for the design or production technology and management options. All BHA/BSA students are required to take courses 54-177 Text to Stage and 54-163 Introduction to Production in the freshman year, course 54-259 Crew in one of the semesters of the sophomore year (4-6 weeks per term), and two semesters of History of Drama Survey during the sophomore or junior year.

Drama Required Courses (36 units)

- 54-177 Text to Stage 12 units
- 54-163 Introduction to Production 6 units
- 54-259 Crew (required of all sophomores) 6 units
- 54-281 History of Drama (Fall) 6 units
- 54-282 History of Drama (Spring) 6 units

Drama Elective Courses (78 units)

- 54-103 Voice I * 2 units
- 54-105 Voice II * 6 units
- 54-107 Intro to Movement (Fall) 6 units
- 54-108 Intro to Movement (Spring) 6 units
- 54-113 Ballet Elective (Fall) 6 units
- 54-114 Ballet Elective (Spring) 6 units
- 54-121 Intro. to Directing* 12 units
- 54-123 Dance I (Fall)* 3 units
- 54-124 Dance I (Spring)*(+) 3 units
- 54-151 Electrics Stagecraft (Fall) 3 units
- 54-152 Scenery Stagecraft (Spring) 3 units
- 54-153 Costume Stagecraft (Fall) 3 units
- 54-157 Theatre Icons (Spring) 3 units
- 54-171/51-172 Media Studio (portfolio review required, full year classes)

MUSIC CONCENTRATION (108 units minimum)

AUDITION REQUIRED FOR ADMISSION

Options available in the following areas: Performance (Instrumental, Piano, Organ), or Composition.

- 54-009 Edinburgh Summer Practicum/Study Abroad TBA units

* These courses require the permission of the instructor.
*~ These semesters are a required prerequisite for the spring.
+ Prerequisites are required. See advisor for prerequisite information.
Bachelor of Science in Computational Finance

The Mellon College of Science and the Heinz School of Public Policy and Management jointly offer a degree uniquely designed to meet the quantitative needs of the finance industry. Modeled after the highly successful Carnegie Mellon Master of Science in Computational Finance, this degree allows students to develop a deep knowledge of mathematics, probability, statistics, and the applications of these disciplines to finance. Students who complete this degree may directly enter the finance industry, enter other industries where an applied mathematics training is appropriate, or pursue advanced degrees in economics, finance or the mathematical sciences. Students entering the work force upon completion of this degree may wish to later complement their undergraduate degree with a Master’s degree in Business Administration or other professional degree. Students who might eventually pursue doctoral degrees in economics, finance, statistics or mathematics should seek advising on how to use their electives in order to prepare for graduate work in their chosen disciplines. Students apply for admission to the B.S. program in Computational Finance in the second semester of the sophomore year. Later application is also possible.

Science Requirements

Students intending to apply to the B.S. program in Computational Finance should follow the science curriculum outlined below. Specifically, students should take two semesters of calculus, 21-120 Differential and Integral Calculus and 21-122 Integration, Differential Equations and Approximation; and 15-100 Introductory/Intermediate Programming.

In addition, in the freshman year students should complete two of the following three courses:

- 33-111 Physics I for Science Students
- 03-121 Modern Biology
- 09-105 Introduction to Modern Chemistry

Humanities, Social Sciences and Fine Arts Requirements

Candidates for the B. S. in Computational Finance must complete 72 units offered by the College of Humanities and Social Science and/or the College of Fine Arts. Of these 72 units, 36 are specified by the detailed curriculum in below. These are:

- 76-101 Interpretation and Argument
- 73-100 Principles of Economics
- 73-200 Microeconomics
- 73-251 Economic Theory

Two of the remaining four courses must be in specific categories as listed in the section on general requirements for a Bachelor’s degree in the Mellon College of Science. One in Category 1: Cognition, Choice and Behavior; and one in Category 3: Cultural Analysis.

Depth Electives

The detailed curriculum below includes three depth electives. These are to be chosen from among the following:

- 21-365 Projects in Applied Mathematics
- 21-372 Partial Differential Equations
- 36-401 Modern Regression
- 36-402 Topic in Data Analysis
- 36-461 Statistics Topic
- 36-495 Independent Study
- 70-393 FAST I
- 70-492 Investment Analysis
- 70-496 Corporate Finance
- 70-497 Options
- 73-372 International Money and Finance
- 73-392 Financial Economics
- 73-420 Monetary Theory and Policy

Detailed Curriculum

What follows is the detailed curriculum for the degree Bachelor of Science in Computational Finance. The courses listed are required. The semesters in which the courses are to be taken are suggested.

## Required Academic Courses (24 units)
- 57-152 Harmony I (Fall) 6 units
- 57-161 Eurhythmics I (Fall) 3 units
- 57-173 Survey of Western Music History (Fall) 9 units
- 57-181 Solfege I (Fall) 6 units

## Required Performance (60 units)
- 57-xxx Studio (Fall or Spring) 9 units
- 57-xxx Studio (Fall or Spring) 9 units
- 57-xxx Major Ensemble (Fall or Spring) 6 units
- 57-xxx Major Ensemble (Fall or Spring) 6 units
- 57-xxx Major Ensemble (Fall or Spring) 6 units

## Additional Academic Courses (24 units minimum)
- 57-151 Principles to Counterpoint (Fall) 6 units
- 57-152 Harmony II (Spring) 6 units
- 57-154 18th Century Counterpoint (Spring) 6 units
- 57-162 Eurhythmics II (Spring) 3 units
- 57-163 Eurhythmics III (Fall) 3 units
- 57-164 Eurhythmics IV (Spring) 3 units
- 57-182 Solfege II (Spring) 6 units
- 57-183 Solfege III (Fall) 6 units
- 57-184 Solfege IV (Spring) 6 units
- 57-202 Opera History (Spring) 9 units
- 57-203 Medieval, Renaissance and Baroque Music History (Spring) 9 units
- 57-204 18th and 19th Century Music History (Fall) 9 units
- 57-205 20th Century Music History (Spring) 9 units

## II. BSA Electives: 28-46 units

Take any Carnegie Mellon course. A maximum of 9 units of physical education and/or military science may be counted toward this requirement. Physical education and military science courses will not be calculated in a student’s QPA.

## BSA Degree Requirements: 380 units
### Minor in Computational Finance

Students in other degree programs may minor in Computational Finance by taking the following six courses:

- 21-270 Introduction to Mathematical Finance
- 21-241 Matrix Algebra
- 21-259 Calculus in Three Dimensions
- or 21-256 Multivariate Analysis and Approximations
- 21-260 Differential Equations
- 21-370** Discrete-Time Finance
- 21-420** Continuous-Time Finance

Students majoring in Mathematical Sciences are also required to take 21-365 Projects in Applied Mathematics, due to double counting of courses.

Students minoring in Computational Finance are strongly encouraged to take one or two economics courses, e.g., 73-100, 73-200 or 73-251.

*Pre-requisite for 21-370 is a course in finance, 21-270 or 70-391, and a course in probability, 36-225, 21-325, 36-217, or 70-207, and an optimization course, 21-257 or 21-292.

**Pre-requisite for 21-420 is background in differential equations, 21-260 or 18-202, and 21-370, and a calculus based course in probability, 36-225, 21-325, or 36-217.

### Science and Humanities Scholars Program

Advisors:
- Dr. Joseph Devine, Associate Dean of H&SS
- Dr. Eric Grotzinger, Associate Dean of MCS

The Science and Humanities Scholars (SHS) program is an innovative program designed to enable talented students to develop an under-graduate curricular program that builds upon their interests and achievements in the humanities, natural sciences, mathematics or social/behavioral sciences.

The curriculum is based on a general education program that provides a foundation for majors in the Mellon College of Science (MCS), the College of Humanities and Social Sciences (H&SS), interdisciplinary programs and student-defined majors.

Entering first-year students who have outstanding credentials and who are admitted to either H&SS or MCS are invited to join the SHS program. Current students can be admitted to the program and applications are accepted at mid-semester of each term.

### Science and Humanities General Education Program

There are 14 requirements in the SHS General Education Program. The program is designed to expose students to a variety of subjects and methodologies, that will not only make them better-informed citizens of the world, but also broaden their range of possible subsequent major choices. The SHS General Education Program is structured to provide a great deal of flexibility and independence in selecting courses to fulfill these requirements.

#### Mathematical Sciences (29 units)

1. 21-120 Differential and Integral Calculus or 21-131 Analysis I
2. 21-122 Integration, Differential Equations, and Approximation or 21-132 Analysis II
3. 36-247 Statistics for Lab Sciences (or appropriate substitute)

#### Writing/Expression (9 units)

Broadly considered, language is a tool used to communicate, as well as a way to organize non-visual and non-mathematical thinking. This requirement focuses on the social nature of language and the ways in which writing constitutes thinking.

4. 76-101 Interpretation & Argument

Notes: This is the designated course for this requirement and is to be completed in the first year. Non-native English speakers may take the course 82-085, Reading and Writing in a Multicultural Setting instead. Exception: if a score of 5 is obtained on the either of the English Advanced Placement examinations, a set of approved course substitutions (revised annually) are made available to SHS students (none of these may double-count toward any other requirement).
### World Cultures (9 units)
This requirement seeks to recognize cultures that have shaped and continue to shape the human experience, as well as analyze material that provide clues as to how these cultures work.

5. 79-104 Introduction to World History

### Freshman Seminar (6-9 units)
6. Choose one full-semester freshman seminar from H&SS, or two half-semester freshman seminars from MCS and/or H&SS.

### Computational Reasoning (9-10 units)
7. Choose from the following courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-100</td>
<td>Introductory / Intermediate Programming</td>
</tr>
<tr>
<td>15-111</td>
<td>Intermediate / Advanced Programming</td>
</tr>
<tr>
<td>21-127</td>
<td>Concepts of Mathematics</td>
</tr>
<tr>
<td>80-210</td>
<td>Introduction to Logic</td>
</tr>
<tr>
<td>80-211</td>
<td>Arguments &amp; Inquiry</td>
</tr>
</tbody>
</table>

### Science Core (28 units)
8-10. Choose three of the following courses. Science majors must take at least two that are outside their major and in different departments.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-121</td>
<td>Modern Biology</td>
</tr>
<tr>
<td>03-130</td>
<td>Biology of Organisms</td>
</tr>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry</td>
</tr>
<tr>
<td>09-106</td>
<td>Modern Chemistry II</td>
</tr>
<tr>
<td>33-111</td>
<td>Physics I for Science Students</td>
</tr>
<tr>
<td>33-112</td>
<td>Physics II for Science Students</td>
</tr>
</tbody>
</table>

### Distribution Requirements (36 units)
11-14. Choose a minimum of four courses, minimum 9 units per category, totaling at least 36 units. Below are examples of courses satisfying these categories. You are encouraged to identify other courses that could fulfill these requirements. Please see your academic advisor for approval.

### Cognitive, Choice, and Behavior
11. This category uses model-based analysis to broaden an understanding of human thinking, choices, and behavior on an individual basis across a variety of settings.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>80-130</td>
<td>Introduction to Ethics</td>
</tr>
<tr>
<td>80-150</td>
<td>Nature of Reason</td>
</tr>
<tr>
<td>80-180</td>
<td>Nature of Language</td>
</tr>
<tr>
<td>80-181</td>
<td>Language and Thought</td>
</tr>
<tr>
<td>80-221</td>
<td>Philosophy of Social Science</td>
</tr>
<tr>
<td>80-230</td>
<td>Ethical Theory</td>
</tr>
<tr>
<td>80-241</td>
<td>Ethical Judgments in Professional Life</td>
</tr>
<tr>
<td>80-242</td>
<td>Conflict, Dispute Resolution</td>
</tr>
<tr>
<td>80-270</td>
<td>Philosophy of Mind</td>
</tr>
<tr>
<td>80-271</td>
<td>Philosophy and Psychology</td>
</tr>
<tr>
<td>85-100</td>
<td>Introduction to Intelligence in Humans, Animals and Machines</td>
</tr>
<tr>
<td>85-102</td>
<td>Introduction to Psychology</td>
</tr>
<tr>
<td>85-211</td>
<td>Cognitive Psychology</td>
</tr>
<tr>
<td>85-221</td>
<td>Principles of Child Development</td>
</tr>
<tr>
<td>85-241</td>
<td>Social Psychology</td>
</tr>
<tr>
<td>85-251</td>
<td>Personality</td>
</tr>
<tr>
<td>85-261</td>
<td>Abnormal Psychology</td>
</tr>
<tr>
<td>88-120</td>
<td>Reason, Passion, and Cognition</td>
</tr>
</tbody>
</table>

### Economic, Political, and Social Institutions
12. This category examines the ways in which institutions organize individual preferences and actions into collective outcomes using model-based reasoning.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-303</td>
<td>Sampling, Surveys, and Society</td>
</tr>
<tr>
<td>70-332</td>
<td>Business and Society</td>
</tr>
<tr>
<td>73-100</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td>79-223</td>
<td>Protest and Dissent in American History</td>
</tr>
<tr>
<td>79-331</td>
<td>Crime and Punishment</td>
</tr>
<tr>
<td>79-335</td>
<td>Drug Use and Drug Policy</td>
</tr>
<tr>
<td>79-345</td>
<td>American Environmental History: Critical Issues</td>
</tr>
<tr>
<td>79-350</td>
<td>Theories of International Relations</td>
</tr>
<tr>
<td>80-135</td>
<td>Introduction to Political Philosophy</td>
</tr>
<tr>
<td>80-136</td>
<td>Social Structure, Public Policy, and Ethical Dilemmas</td>
</tr>
<tr>
<td>80-235</td>
<td>Political Philosophy</td>
</tr>
<tr>
<td>80-236</td>
<td>Philosophy and the Law</td>
</tr>
<tr>
<td>80-243</td>
<td>Environment Management and Ethics</td>
</tr>
<tr>
<td>80-341</td>
<td>Computers, Society, and Ethics</td>
</tr>
<tr>
<td>88-104</td>
<td>Decision Processes in American Political Institutions</td>
</tr>
</tbody>
</table>

### Creative Production and Reflection
13. This category is designed to encourage exploration of the artistic and intellectual creation of others while allowing for personal expression, and reflection upon the creative process.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx-xxx</td>
<td>Any course from the College of Fine Arts</td>
</tr>
<tr>
<td>76-206</td>
<td>Introduction to Creative Writing</td>
</tr>
<tr>
<td>80-220</td>
<td>Reflections on Science</td>
</tr>
<tr>
<td>80-260</td>
<td>Philosophy and Art</td>
</tr>
<tr>
<td>82-1xx</td>
<td>Any Elementary Modern Language course</td>
</tr>
<tr>
<td>82-2xx</td>
<td>Any Intermediate Modern Language course</td>
</tr>
</tbody>
</table>

### Cultural Analysis
14. This category explores definitions of culture and the role culture plays in producing different actions and institutions, as well as the roles of institutions, systems, and human actions in shaping cultural contexts.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>57-173</td>
<td>Survey of Western Music History</td>
</tr>
<tr>
<td>66-250</td>
<td>Introduction to Religion</td>
</tr>
<tr>
<td>70-342</td>
<td>Managing Across Cultures</td>
</tr>
<tr>
<td>76-227</td>
<td>Comedy</td>
</tr>
<tr>
<td>76-232</td>
<td>African-American Studies</td>
</tr>
<tr>
<td>76-241</td>
<td>Introduction to Gender Studies</td>
</tr>
<tr>
<td>79-113</td>
<td>Culture and Identity in American Society</td>
</tr>
<tr>
<td>79-201</td>
<td>Introduction to Anthropology</td>
</tr>
<tr>
<td>79-206</td>
<td>Development of American Culture</td>
</tr>
<tr>
<td>79-207</td>
<td>Development of European Culture</td>
</tr>
<tr>
<td>79-209</td>
<td>Theory and Practice in Anthropology</td>
</tr>
<tr>
<td>79-218</td>
<td>The Roots of Rock &amp; Roll</td>
</tr>
<tr>
<td>79-241</td>
<td>African-American History I</td>
</tr>
<tr>
<td>79-242</td>
<td>African-American History II</td>
</tr>
<tr>
<td>79-260</td>
<td>Mayan America</td>
</tr>
<tr>
<td>79-270</td>
<td>Chinese Culture and Society</td>
</tr>
<tr>
<td>79-368</td>
<td>Poverty, Charity, and Welfare</td>
</tr>
<tr>
<td>79-384</td>
<td>Medicine and Society</td>
</tr>
<tr>
<td>80-100</td>
<td>What Philosophy Is</td>
</tr>
<tr>
<td>80-151</td>
<td>God in the West</td>
</tr>
<tr>
<td>80-250</td>
<td>Ancient Philosophy</td>
</tr>
<tr>
<td>80-251</td>
<td>Modern Philosophy</td>
</tr>
<tr>
<td>80-253</td>
<td>Continental Philosophy</td>
</tr>
<tr>
<td>80-254</td>
<td>Analytical Philosophy</td>
</tr>
<tr>
<td>80-255</td>
<td>Pragmatism</td>
</tr>
<tr>
<td>80-261</td>
<td>Aesthetics of Mass Art</td>
</tr>
<tr>
<td>82-273</td>
<td>Introduction to Japanese Language &amp; Culture</td>
</tr>
<tr>
<td>82-294</td>
<td>Topics in Russian Language and Culture</td>
</tr>
<tr>
<td>82-303</td>
<td>French Culture</td>
</tr>
<tr>
<td>82-304</td>
<td>Francophone World</td>
</tr>
<tr>
<td>82-325</td>
<td>Introduction to German Studies</td>
</tr>
<tr>
<td>82-333</td>
<td>Introduction to Chinese Language &amp; Culture</td>
</tr>
<tr>
<td>82-342</td>
<td>Spain: Language and Culture</td>
</tr>
<tr>
<td>82-343</td>
<td>Latin America: Language and Culture</td>
</tr>
<tr>
<td>82-344</td>
<td>US Latinos: Language and Culture</td>
</tr>
<tr>
<td>82-345</td>
<td>Hispanic Literary and Cultural Studies</td>
</tr>
</tbody>
</table>

### Major Programs
A number of majors that reflect the interdisciplinary nature of research and teaching between the physical and natural sciences, humanities, mathematics, and social/behavioral sciences have been introduced, or are under development, inspired in part by the SHS program. Two are presented here (in Biological Sciences and Psychology, and in Mathematical and Statistical Sciences) that are now available to students.

### The Major in Mathematical and Statistical Sciences (B.S.)
This degree program is administered under the joint Science & Humanities Scholars Program between the Mellon College of Science and the College of Humanities & Social Sciences. To qualify, a student must be accepted for admission to both colleges.

#### Mathematical Sciences:
- **85 Units**
  - 21-120 Differential and Integral Calculus
  - 21-122 Integration, Differential Equations, and Approximation
  - 21-127 Concepts of Mathematics
  - 21-241 Matrix Algebra
  - 21-259 Calculus in Three Dimensions
  - 21-201 Undergraduate Colloquium
  - 21-292 Operations Research I
### Probability and Statistics: 36 Units

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-325</td>
<td>Probability</td>
</tr>
<tr>
<td>36-226</td>
<td>Introduction to Probability and Statistics I</td>
</tr>
</tbody>
</table>

Note: 21-325 Probability is preferred.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-410</td>
<td>Introduction to Probability and Statistics II</td>
</tr>
<tr>
<td>36-410</td>
<td>Models</td>
</tr>
<tr>
<td>36-461</td>
<td>Undergraduate Seminar</td>
</tr>
</tbody>
</table>

### Data Analysis: 27 Units

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-247</td>
<td>Statistics for Laboratory Sciences</td>
</tr>
<tr>
<td>36-309</td>
<td>Experimental Design for Behavioral and Social Sciences</td>
</tr>
<tr>
<td>or</td>
<td>36-303 Surveys, Sampling &amp; Society</td>
</tr>
<tr>
<td>36-401</td>
<td>Advanced Data Analysis I</td>
</tr>
</tbody>
</table>

### Statistics and Data Analysis Electives: 18 Units

Complete two courses from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-393</td>
<td>Operations Research</td>
</tr>
<tr>
<td>36-402</td>
<td>Advanced Data Analysis II</td>
</tr>
<tr>
<td>36-462</td>
<td>Applied Multivariate Methods</td>
</tr>
</tbody>
</table>

In consultation with his/her advisor, the student may also arrange to take Statistics graduate courses (36-7xx) to satisfy part of this requirement.

### Joint MCS/H&SS Core other than Mathematical Science or Statistics courses: 103-107 Units

### Free Electives:

Enough to reach 360 Units

### Sample Course Sequence: Math & Statistical Sciences

#### Freshman Year: Fall

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
</tr>
<tr>
<td>21-127</td>
<td>Concepts of Mathematics</td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument</td>
</tr>
<tr>
<td>33-111</td>
<td>Physics for Science Students I</td>
</tr>
<tr>
<td>99-10x</td>
<td>Computer Skills Workshop</td>
</tr>
</tbody>
</table>

#### Freshman Year: Spring

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-122</td>
<td>Integration, Differential Equations, and Approximation</td>
</tr>
<tr>
<td>36-247</td>
<td>Statistics for Laboratory Sciences</td>
</tr>
<tr>
<td>79-104</td>
<td>World History</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Science</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Freshman Seminar</td>
</tr>
</tbody>
</table>

#### Sophomore Year: Fall

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-201</td>
<td>Undergraduate Colloquium</td>
</tr>
<tr>
<td>21-241</td>
<td>Matrix Algebra</td>
</tr>
<tr>
<td>36-309</td>
<td>Experimental Design</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Economic, Political and Social Institutions</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Science</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Elective</td>
</tr>
</tbody>
</table>

#### Sophomore Year: Spring

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-201</td>
<td>Undergraduate Colloquium</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
</tr>
<tr>
<td>21-292</td>
<td>Operations Research I</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Cultural Analysis</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Electives</td>
</tr>
</tbody>
</table>

#### Junior Year: Fall

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-355</td>
<td>Principles of Real Analysis I</td>
</tr>
<tr>
<td>21-325</td>
<td>Probability</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Cognition, Choice and Behavior</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Electives</td>
</tr>
</tbody>
</table>

#### Junior Year: Spring

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-xxx</td>
<td>Mathematical Science Elective</td>
</tr>
<tr>
<td>36-226</td>
<td>Introduction to Probability and Statistics II</td>
</tr>
<tr>
<td>36-410</td>
<td>Introduction to Probability Models</td>
</tr>
</tbody>
</table>

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### The Undergraduate Additional Major in Human-Computer Interaction

**Richard Scheines, Undergraduate Advisor**  
Office: Baker Hall 135  
For up to date information, see: www.hcii.cs.cmu.edu/

#### Overview

Human-Computer Interaction (HCI) is still a fast growing field devoted to the design, implementation, and evaluation of interactive computer-based technology. Examples of HCI products include intelligent computer tutors, wearable computers, and internet connected personal digital assistants (PDAs). Constructing an HCI product is a cyclic, iterative process that has at least three stages: Design, Implementation, and Evaluation.

The Design stage involves principles of design and human behavior, the Implementation stage principles of computer science, and the Evaluation stage empirical research methods common to several disciplines. There are thus four topical areas to cover in this major: Human Behavior, Design, Implementation, and Evaluation. In slightly more detail, the major involves the following sorts of knowledge and skill:

#### Design

- Eliciting from the client, formulating, and articulating functional specifications
- Knowing how human factors and cognitive models should inform design
- Knowing the principles of, and having experience with, communication design
- Understanding how implementation constraints should inform design
- Incorporating evaluation results into iterated designs

#### Implementation Programming Skills

- Standard programming languages - e.g., C++, Java
- Rapid prototyping skill (e.g., Visual Basic, Flash)
- Computational literacy, i.e., knowledge sufficient for effective communication and decision making about:
  - interface construction tools and languages
  - multimedia authoring tools
  - data structures and algorithms
- Operating systems, platforms, etc.

#### Evaluation

- Experimental design
- Focus Groups
- Surveys
- Usability Testing (Cognitive walkthroughs, user models, heuristic evaluation, GOMS)
- Statistical Analysis

There are over 45 courses relevant to these areas that are now offered by eight different departments in four different colleges at Carnegie Mellon (the School of Computer Science, the College of Humanities and Social Sciences, and the College of Fine Arts, and the Tepper School of Industrial Administration).

#### Curriculum

**Required Courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-211</td>
<td>Cognitive Psychology</td>
</tr>
<tr>
<td>or</td>
<td>85-213 Human Information Processing and Artificial Intelligence</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
</tr>
<tr>
<td>05-430</td>
<td>Interface Programming</td>
</tr>
<tr>
<td>or</td>
<td>431 Interface Programming</td>
</tr>
<tr>
<td>51-261</td>
<td>Communication Design Fundamentals</td>
</tr>
<tr>
<td>51-421</td>
<td>Visual Interface Design</td>
</tr>
<tr>
<td>05-410</td>
<td>Introduction to Human-Computer Interaction Methods</td>
</tr>
<tr>
<td>05-571</td>
<td>Project Course</td>
</tr>
</tbody>
</table>
Statistics Requirement:
The Statistics requirement can be satisfied by taking any of the following one or two-semester courses, or by receiving credit for courses taken elsewhere.
- 36-201 Statistical Reasoning, Statistical Methods
- or 36-247 Intro to Biostatistics
- or 36-220 Engineering Statistics and Quality Control
- or 36-225 & 226 Introduction to Probability and Statistics I and II
- or 36-207 Prob. and Statistics for Business Applications

Evaluation Requirement:
The Evaluation requirement can be satisfied by taking any of the following courses, or by receiving credit for courses taken elsewhere.
- 36-303 Sampling, Surveys, and Society
- 36-208 Regression Analysis
- 36-309 Experimental Design for Behavioral & Social Science
- 85-310 Research Methods in Cognitive Psychology
- 88-250 Regression Methods in the Social Sciences
- 88-251 Empirical Research Methods
- 70-481 Market Research

Electives (18 Units):
From the following list, or by permission from the major advisor:

Design
- 39-648 Wearable Computer Design
- 51-223 Computer Basics for CD
- 51-241 How People Work: Human Factors
- 51-247 Color and Communication
- 51-251 Digital Prototyping
- 51-348 Building Virtual Worlds
- 51-442 Integrated Product Development
- 51-4xx Interaction Design Seminar
- 60-414-422 Computer Animation - Robotic Art, etc.
- 76-273 Writing for Multi-media
- 76-479 Computers and Writing
- 76-487 On-line Information Design
- 76-491 Planning and Testing Documents
- 80-291 Issues in Multimedia Authoring

Computer Science
- 15-211 Fundamental Data Structures and Algorithms
- 15-212 Principles of Programming
- 15-499 Media Technology
- 15-880 Speech Recognition
- 70-459 Distributed Virtual Business

Human Behavior
- 45-392 Human Behavior in Organizations
- 45-453 Organizational uses of information systems
- 85-393 Human Factors
- 85-370 Perception
- 85-408 Visual Cognition
- 85-411 Cognitive Processes & Problem Solving
- 85-412 Production System Models of Thought
- 85-417 Intelligent Computer-Assisted Instruction
- 85-419 Computer Supported Cooperative Work
- 85-411 Cognitive Modeling
- 88-367 Computers and Organizations
- 70-311 Organization Behavior
- 70-451 Management Information Systems

Multimedia
- 80-291 Issues in Multimedia Authoring
- 76-482 Multimedia Authoring I
- 76-483 Multimedia Authoring II
- 76-273 Writing for Multimedia

Double Counting
Neglecting the three courses at the prerequisite level (51-261, Stats, & 15-100), at most three courses can be double-counted toward your primary major and the HCI second major. For example, if you are majoring in Cognitive Psychology, then you might want to take 85-211 (Intro to Cognitive Psychology) as one of your three double counts. If more than three of the requirements are already in your primary major, then you must add electives until you have eight HCI courses not required as part of your primary major.

Accelerated Master’s Programs
The HCI Institute currently offers a three-semester (12-month), 15 course Masters in HCI. Undergraduates who have taken the core courses, and an elective on the 400 level or above will be considered eligible for the Accelerated Masters program. These students, which include all undergraduate HCI majors, can apply for the Accelerated Masters program by November 1st of their Senior year, and can begin the Masters program in the Spring of their Senior year. They can finish the Masters degree after the Summer and Fall.

Admission to the Major
The HCI undergraduate major is currently available only as a second major. Because space is limited in the major’s required courses, enrollment in the HCI undergraduate major is currently limited to 25 students in each graduating class. 6 with a primary major in Design, 6 in H&SS, 6 in SCS, and 7 anywhere. Applications are processed once a year, during Spring Break. For more detail, see the website: www.hcii.cs.cmu.edu/Academics/Undergrad/undergrad.html
The Minor in Arts in Society

Sponsored by:
The Center for the Arts in Society
College of Humanities and Social Sciences
College of Fine Arts

Faculty Advisor: Judith Schachter, Director
Center for the Arts in Society

The arts communicate a society’s vision, voice its ethos, and simultaneously reflect and alter the political, social and economic realities of the times. The Center for the Arts in Society’s “Arts in Society” minor (AIS) provides students with the opportunity to enter into the studio as well as reflect and analyze the role that creativity plays in the creation of culture.

By definition, the Arts in Society program is multidisciplinary and draws upon the resources of the College of Fine Arts as well as the College of Humanities and Social Sciences. Under the guidance of the program advisor, students can investigate the history, context, and production of an aesthetic or social issue.

Curriculum (minimum) 54 Units

The AIS Minor requires six courses from the three themes outlined below, as well as meetings at the AIS Monthly Seminar.

I. Perspectives (minimum) 2 courses

These courses offer students two different approaches to understanding the role of the arts in society. The first perspective is historical; these courses offer a survey of an art or arts over time in diverse social contexts. The second approach is contextual; these courses offer students an approach to the functions the arts play may play in varying social contexts — as renewal, for example, or as a form of protest.

Distribution Requirement:

One course must be historical in nature; one course must offer a contextual perspective. Please see attached list.

II. Project Courses (minimum) 2 courses

These courses offer students an opportunity to put what they have learned into practice in two ways. Studio/Research courses provide the students with research experience that will culminate either in a substantial written work or an artistic product. Practice courses allow the student to apply previously learned experience in a community-based project. Choice of particular courses should be made in consultation with the AIS advisor.

Distribution Requirement:

At least one course must be a studio/research course; one course must fulfill the practice requirement.

III. Independent Study/Capstone (minimum) 1 course

This is where a student brings it all together. The student develops an independent project and produces an installation, paper, composition or other major work that reflects his or her understanding of the role of the arts in society. The topic for an independent study should be done in consultation with the AIS advisor.

Distribution Requirement:

At least one course must be an independent study course.

IV. AIS Seminar and Advising

Facilitated by the Director of the Center to insure cohesion and continuity in the minor, the non-credit seminar meetings are to be attended while students are concurrently enrolled in AIS courses. During these seminars, CAS faculty and students discuss what they have learned in their respective disciplines and explore issues pertaining to the arts in society.

Courses that can fulfill the AIS minor can come from either college, and are available to all undergraduate students. Courses can come from the catalog or be offered by visiting fellows and scholars. Interested students should consult with the advisor to develop an individual course sequence that fulfills their needs and the requirements of the AIS minor. In a given semester, for example, courses might include the following:

Architecture
48-240  Historical Survey of World Arch. and Urbanism
48-340  Modern Architecture
48-440  The American Built Environment to 1860

Art
60-103  Concept Studio I/II: EcoArt
60-205  Modern Visual Culture 1789-1945
60-301  Art in Context
60-387  An Aesthetics of Dysfunction
60-398  Theory and Practice of the Art Museum

CFA Interdisciplinary
62-148  Art and Culture
62-248  Music in American Society
62-323  The Sink has Dripped Dry: A Sound Art Class
62-371  Photography; The First 100 Years

University Studies
99-431  Green Visions/Grey Infrastructure

Design
51-171  Human Experience in Design
51-271  Design History
51-379  Emotion and reason in Design
51-472  Globalization and Design

Drama
54-177  Text to Stage
54-281  History of Drama I
54-389  Speech and Theatre Community Outreach
54-506  Abnormality in Performance

English
76-235  Black Enlightenment
76-238  Introduction to Media Studies
76-245  Shakespeare; Histories and Tragedies
76-320  Cultural History of Print in Britain and America
76-322  Global Suffering; Interdisciplinary Perspectives

History
79-213  Introduction to the History of Art
79-226  Cultural Memory in Urban Space
79-325  The Arts in Pittsburgh

Modern Languages
82-304  The Francophone World
82-325  Introduction to German Studies
82-492  The Historical Imagination in 19th Century Russia

Music
57-204  18th and 19th Century Music History
57-399  Music, Cinema, Culture
57-404  String Quartet; A Social History

Intercollege
The Minor in Health Care Policy and Management

Sponsored by:
H. John Heinz III School of Public Policy and Management
College of Humanities and Social Sciences
Mellon College of Science

Faculty Advisors: Caroline Acker, Naum Kats, and Stephanie Wallach,
College of Humanities and Social Sciences
Brenda Peyser, H. John Heinz III School of Public Policy and Management
Amy Burkert, Mellon College of Science

The face of health care is changing. The practice of medicine is being fundamentally altered by the forces of change in public policy, health care organizations and in the industry as a whole. The role of individual professionals in this industry is changing as rapidly as the industry itself. Traditional career paths have disappeared overnight to be replaced by new opportunities that require new skills. New organizations are placing new demands on their professional and medical staffs. The criteria of efficiency and financial stability are entering the domains of diagnosis and treatment.

This minor is designed to provide students considering a career in the health professions with an understanding of how these changes are likely to affect their careers. Students will become familiar with the critical policy and management issues and will begin to learn to operate effectively in the emerging health care environment. The curriculum combines economic, organizational, managerial, historical and psychological perspectives on these issues to provide a foundation for a deepened understanding of the changing structure of health care organizations and policy.

Curriculum (minimum) 60 units

Six courses (a minimum of 60 units) are required to complete this minor. Entry into the minor requires completion of 73-250, Intermediate Microeconomics or 88-220, Policy Analysis I or the equivalent by approval.

Required Courses 33 units

Students are required to take the following courses.

79-384 Medicine and Society
90-761 Introduction to Health Care Policy and Management
90-735 Health Economics

Elective Courses 27 units

Complete three courses totaling a minimum of 27 units.

Heinz School Courses (12 units each)

90-721 Non-Profit and Health Marketing
91-830 Financial Management of Health Systems
91-836 Legal Issues in Health Systems Management
91-844 Managing Quality Improvement
91-853 Health Care Information Systems
91-861 Health Policy
91-862 Managed Care

Humanities and Social Sciences Courses (9 units each)

76-494 Medical Communications
79-335 Drug Use and Drug Policy
79-336 Epidemic Disease and Public Health
80-245 Medical Ethics
85-241 Social Psychology
85-442 The Social Psychology of Health
85-446 The Psychology of Gender
85-451 The Psychology of Purpose
88-373 Mental Health Ideologies

Please note that some of these courses have prerequisites that will not count toward the completion of the requirements for this minor.
Carnegie Institute of Technology

Pradeep Khosla, Dean
Kurt Larsen, Assistant Dean for Undergraduate Studies

Carnegie Institute of Technology, the engineering college of the university, has three main activities - undergraduate education, graduate education, and research. Its continuing goal has been to maintain excellence in all these activities. The degree to which this goal has been achieved is attested to by the demand for its graduates, the success of its alumni, the quality of its students and faculty, the adoption elsewhere of its innovations, and the national and international recognition it receives in educational and research activities.

The college offers the degree of bachelor of science in chemical engineering, civil engineering, electrical and computer engineering, mechanical engineering, and materials science and engineering. All of these programs are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). A student may also choose to pursue a minor in one of the CIT designated minor programs, or a double major in engineering and public policy or biomedical engineering, or to design minor, double-major or double-degree programs with other non-engineering departments.

From its earliest days, Carnegie Institute of Technology (CIT) has considered undergraduate education to be the key element in the development of future leaders. In this regard, CIT has adopted a plan for education that is designed to equip students with the capacity to learn and to continue the process of self-education throughout their lives. The present curriculum incorporates this philosophy by providing the opportunity for both breadth in a number of engineering and science areas as well as depth in a major area of concentration.

To achieve these goals, the curriculum has been designed to help each student acquire:

A thorough and integrated understanding of fundamental knowledge in fields of a student’s major interest and the ability to use this knowledge;

Skill in quantitative analysis, particularly with the widespread use of computers, which, in all engineering disciplines, increases the applicability and impact of modern computational methods;

A genuine competence in the orderly way of thinking, which professionals and scientists have always used in reaching sound, creative conclusions, with the goal that after graduation the student can, by such thinking, reach decisions both as a professional and as a citizen;

An ability to learn independently with scholarly orderliness, so that after graduation the student will be able to grow in wisdom and keep abreast of the changing knowledge and problems of the profession and the society in which he or she participates;

The philosophical outlook, breadth of knowledge, and sense of values which will increase the student’s understanding and enjoyment of life and enable each student to recognize and deal effectively with the human, economic, and social aspects of professional problems; and

The ability to communicate ideas to others in a comprehensive and understandable manner.

The curriculum encourages students to confront professional problems, accomplished through problem-oriented courses, as well as courses which emphasize design or individual projects. These classes stress creativity and independent thought and require the student to define the problem, propose a solution or a design in the presence of technical and socioeconomic constraints, to make judgments among alternative solutions, and to explore innovative alternatives to more conventional solutions.

In addition to the strong graduate and research programs specific to the various departments, interdisciplinary graduate studies are pursued also in energy and environmental studies, materials design, robotics, biomedical engineering, planning and management, design research, and other specialized areas. These programs benefit undergraduates through course offerings in special and advanced topics and through projects for undergraduate research. Because of their contribution to undergraduate education, some of the engineering activities not leading to an undergraduate degree are described following the degree curricula in this section.

First Year for Engineering Students

The Carnegie Mellon engineering education is based on engineering and science fundamentals that give you the skills to face new and challenging situations. The first year in engineering provides a broad foundation upon which you will build a curriculum in your eventual major. Since students in CIT do not select a major until the end of the first year, all first year students share a common experience consisting of introductory courses in the engineering majors (one each semester), calculus, physics, other science courses which compliment specific introductory engineering courses, and courses in the College of Humanities and Social Sciences (General Education). This curriculum helps you make an informed decision about your final major. Below is a standard schedule for a first year engineering student.

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Units</th>
<th>Spring Semester</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Engineering Elective</td>
<td>12</td>
<td>Introductory Engineering Elective</td>
<td>12</td>
</tr>
<tr>
<td>Restricted Technical Elective</td>
<td>10-12</td>
<td>Restricted Technical Elective</td>
<td>10</td>
</tr>
<tr>
<td>Differential and Integral Calculus</td>
<td>10</td>
<td>Integration, Differential Equations, Approximation</td>
<td>10</td>
</tr>
<tr>
<td>A Writing/Expression Course</td>
<td>9</td>
<td>General Education Course</td>
<td>9</td>
</tr>
<tr>
<td>Computer Skills Workshop</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
1. Each semester every CIT department offers its Introductory Engineering Elective. Every first year CIT student must select one such course each semester.
2. Restricted Technical Electives include the following courses: Units
   - 09-105 Modern Chemistry I 10
   - 15-100 Introductory/Intermediate Programming 10
   - or
   - 15-111 Intermediate/Advanced Programming 10
   - 33-106 Physics for Engineering Students I 12
   - 33-107 Physics for Engineering Students II 12
3. Each Introductory Engineering Elective requires a specific Restricted Technical Elective (to be taken prior to or contemporarily with the Introductory Engineering Elective) chosen from the above set as follows

   **Introductory Engineering Course**

<table>
<thead>
<tr>
<th>Restricted Technical Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomedical Engineering</td>
</tr>
<tr>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>Civil &amp; Environmental Engineering</td>
</tr>
<tr>
<td>Electrical &amp; Computer Engineering</td>
</tr>
<tr>
<td>Engineering &amp; Public Policy</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Materials Science and Engineering</td>
</tr>
</tbody>
</table>

4. All students must complete Physics for Engineering Students I by the end of the first year. Therefore, if a student chooses to take Introduction to Chemical Engineering (with 09-105 as a co-requisite) during one semester and Introduction to Electrical and Computer Engineering (with 15-100 as a co-require), the student must take 33-106 in place of the General Education requirement in the Spring semester of the first year and take the General Education course in a subsequent semester. Alternatively, a student entering the university with AP credit in a required first year course may substitute 33-106 in its place.
Program in General Education for CIT Students

Breadth Requirement

Humanistic Studies (Cultural Analysis)* 9 units
79-104 Introduction to World History

Cognitions and Institutions* 9 units
73-100 Principles of Economics
or
85-100 Introduction to Intelligence
88-104 Decision Process in American Political Institutions

* A list of alternative courses for Humanistic Studies and Cognitions and Institutions is available in the CIT Dean’s Office.

Writing/Expression 9 units
76-101 Interpretation and Argument
82-085 Reading and Writing in a Multicultural Setting*

* By permission only

Depth Sequence in Humanities, Social Science, or Fine Arts

A sequence of humanities, social science, or fine arts courses which provides depth in a specific area. Usually, 27 units from a single department meet this requirement. However, related courses from different departments may also satisfy this requirement. At least 9 of these units should be beyond the introductory or elementary level and CFA performance courses, if chosen, must also include theory or history of the subject. A depth sequence in language must include at least three nine-unit courses in the same language. Business Administration, GSIA, Heinz School, and Statistics Department courses may not be used to satisfy this requirement. Although this requirement is typically satisfied by completing 3 courses of at least 9 units each, some acceptable courses are greater than 9 units (e.g. 6-unit Art courses). While mini courses of fewer than 9 units may be combined to equal 9 unit courses, the excess units from courses greater 9 units may NOT be used to satisfy this requirement. For example, a 12 unit, 6 unit, 9 unit combination is not acceptable. A 6 unit, 3 unit, 9 unit, 9 unit combination is acceptable.

Non-Technical Electives 18 units

Two unrestricted humanities, social science or fine arts courses. Non-technical courses from GSIA, Business Administration, or the Heinz School may also satisfy this requirement. Accounting, finance, management, marketing, production, and statistics courses are regarded as technical courses and may NOT be used to satisfy this requirement. Although this requirement is typically satisfied by completing 2 courses of at least 9 units each, some acceptable courses are greater than 9 units (e.g. 6-unit Art courses). While mini courses of fewer than 9 units may be combined to equal 9 unit courses, the excess units from courses greater 9 units may NOT be used to satisfy this requirement. For example, a 12 unit, 6 unit, 9 unit combination is not acceptable. A 6 unit, 3 unit, 9 unit, 9 unit combination is acceptable.

Free Elective Courses

A free elective is any graded Carnegie Mellon course. However, a maximum of nine units in the form of pass/fail grading (including physical education, StuCo and military science) may be taken as free electives in most CIT degree programs. (Except for ECE)

Double Majors and Double Degrees in CIT

A major is defined as a program that must be completed for the granting of a degree. Double majors comprise a single degree with majors in two separate areas; for example, the degree of Bachelor of Science in Chemical Engineering and a double major in English. Although the double major requires the completion of two designated programs, they may have overlapping requirements that can be met simultaneously. The general principle used to measure eligibility for a Carnegie Institute of Technology double major is that the major (core) requirements of both departments must be completed. Finally, although the student is formally enrolled as an undergraduate in one of the departments (the parent department, which is responsible for scheduling and other administrative actions for the student), the requirements for CIT students wishing to complete Double Majors

The student must satisfactorily pass requirements of the regular and complete program (with the permissible exceptions) leading to a degree in CIT. The minimum number of units required for the double major is the number required by the parent department or major. The student takes and satisfactorily completes the courses specified by a second department, usually using elective space available in the first program.

The second department, on the basis of the specified number of courses plus the courses comprising the parent department’s regular degree requirements, then certifies that the student has completed the requirements for a major in the second department. At the CIT advisor’s discretion, equivalent technical electives may be substituted from either MCS or SCS departments.

Non-technical courses in the curricula can be altered to meet the requirements of the second major. But if the second major is not an HBSS department, the program must include a minimum of 72 units of General Education courses to meet CIT requirements for graduation.

Designated Minors Offered by CIT (for engineering students)

In addition to their regular majors for B. S. degrees, undergraduate students in the Carnegie Institute of Technology can elect to complete an interdisciplinary Designated Minor. These minors have been added to the Carnegie Institute of Technology curriculum to promote flexibility and diversity among the college’s engineering students. Independent of major, a student is free, but not required, to select a selected designated minor from the following list:

* Automation and Control
* Biomedical Engineering*
* Colloids, Polymers and Surfaces
* Data Storage Systems Technology
* Electronic Materials
* Engineering Design
* Environmental Engineering
* International Engineering
* Manufacturing Engineering
* Material Science and Engineering
* Mechanical Behavior of Materials
* Robotics (described on the following page)*

* Also available for non-CIT students

Complete descriptions of the designated minors can be found on p. 89-92. To add a CIT Designated Minor, please go to the CIT Dean's Office (Scaife Hall 110).
Biomedical Engineering Minor
(for non-engineering students)

Todd Przybycien, Director Office: Doherty Hall A-220

General Requirements (five courses, 51-57 units, plus pre- and co-requisite courses including 03-121, Modern Biology). Students must earn a cumulative QPA of 2.00 in these five courses. Double counting of core courses in student’s primary major is not permitted.

- Introduction to BHE (42-101) 12 units
- A secondary Introductory Engineering Course 12 units
- BME Elective or Domain* 9-12 units
- BME Elective or Domain** 9-12 units
- BME Elective or Domain** 9-12 units

*Cannot be a course required by your home department.

** Courses marked with an (*) must be offered by any of the CIT Departments

(06-xxx, 12-xxx, 18-xxx, 19-xxx, 24-xxx, 27-xxx or 42-xxx)

BME Domain Courses

03-121 Modern Biology
03-240 Cell Biology
03-310 Introduction to Computational Biology
03-311 Computational Molecular Biology
03-330 Genetics
03-343 Experimental Genetics and Molecular Biology
03-344 Experimental Biochemistry
03-345 Experimental Cell and Developmental Biology
03-350 Developmental Biology
03-438 Physical Biochemistry
03-439 Introduction to Biophysics
03-441 Molecular Biology of Prokaryotes
03-442 Molecular Biology of Eukaryotes
03-510 Computational Biology
03-533 NMR in Biomedical Sciences
03-534 Bio Imaging Fluorescence Spectroscopy
09-245 Physical Chemistry II
15-211 Fundamental Structures of Computer Science I
42-301 Physiology
42-377 Rehabilitation Engineering
42-501 Special Topics: Biomaterials I & II
42-560 Research Project (at CMU or UPMC)
42-604 Biological Transport
42-621/06-621 Biotechnology & Environmental Processes
42-622/06-622 Bio Process Design
42-644 Medical Devices
42-651/12-651 Air Quality Engineering
42-652 Introduction to Biomechanics
42-723/12-723 Biological Processes in Environmental Systems

BME Electives

06-607 Phys Chem of Colloids and Surfaces
06-609/09-509 Physical Chemistry of Macromole
06-313/06-315 Exp Colloid Science
08-314 Exp Polymer Science
08-426 Experimental Colloid Surface Science
08-466 Experimental Polymer Science
18-3XX* Special Topics in Biotechnology
19-607 General Robotics
24-354 Human Systems and Control
24-342 Electrical, Magnetic, and Optical Properties of Materials

Engineering Studies Minor
(for non-engineering students)

Kurt Larsen, Director Office: Scaife Hall 110

Carnegie Mellon undergraduate students enrolled in colleges other than engineering can complete a Minor in Engineering Studies in addition to their regular majors. Students pursuing this minor are required to complete courses from at least two different engineering departments in order to assure some breadth of exposure to engineering. In addition, the minor provides students the opportunity to pursue an in-depth concentration in a particular field of engineering.

For the Minor in Engineering Studies, students must complete five engineering courses as follows and must earn a cumulative QPA of 2.00 in these five courses.

Double counting of core courses in student’s primary major is not permitted.

1. Two of the following:
   - 06-101 Introduction to Chemical Engineering
   - 12-100 Introduction to Civil and Environmental Engineering
   - 18-100 Introduction to Electrical & Computer Engineering
   - 19-101 Introduction to Engineering & Public Policy
   - 24-101 Introduction to Mechanical Engineering
   - 27-100 Engineering the Materials of the Future
   - 42-101 Introduction to Biomedical Engineering

2. Three courses of at least 9 units each from one or more CIT departments

   NOTE: The following courses may NOT be included as part of the Minor in Engineering Studies
   - 12-090 Technology and the Environment
   - 18-200/18-202 Math Foundations of Electrical Engineering
   - 19-519 Law and the Engineer
   - 19-321 Engineering Graphics
   - 42-500 Physiology
   - 42-501 Physiology

Although a student generally can complete the minor in Engineering Studies without increasing the number of required units for graduation, early planning in selecting courses is important. Students interested in this minor are encouraged to seek advice in their own home department or college and in the CIT Office of Undergraduate Studies, Scaife Hall 110.

Technology and Policy Minor
(for non-engineering students)

Mark Kieler, Director Office: Baker Hall 129

The Technology and Policy Minor is administered by the Department of Engineering and Public Policy (EPP) for students who are majoring in areas other than engineering or computer science. The T&P Minor is designed to give students a basic understanding of the interactions between technology, society and policy and some project experience in problems involving technology and policy.

The T&P Minor requires satisfactory completion of a set of six courses totaling a minimum of 51 units. These courses are:

- 19-102 EPP Sophomore Seminar (Fall) 3 units
- 19-451 or 452 EPP Project (Fall or Spring) 12 units
- 73-100 Principles of Economics (Fall or Spring) 9 units
- 73-140 Principles of Economics (Spring) 9 units
- 88-223 Decision, Analysis & Decision Support Systems (Spring) 9 units
- 88-302 Behavioral Decision Making (Fall) 9 units
- 19-426 Environmental Decision Making (Fall) 9 units

Two EPP Technical Electives totaling 18 units Page 149 shows examples of EPP technical electives. This is only a representative sample and should not be used for course selection. Always refer to the current list of EPP technical electives. EPP distributes this list prior to registration each semester.

Decision Science Course* 9 units

*Choose one of the following:

- 88-223 Decision, Analysis & Decision Support Systems (Spring)
- 88-302 Behavioral Decision Making (Fall)
- 19-426 Environmental Decision Making (Fall)

Students who are interested in the T&P Minor should contact the Department of Engineering and Public Policy early in their course of study.

Robotics Minor
(for engineering and non-engineering Students)

Howie Choset, Director Office: Scaife Hall 315

As its name suggests, the robotics minor focuses on robotics. It is open to students in all colleges of the University. This minor will have a prerequisite: basic programming skills, and familiarity with basic algorithms. Typically, students get these by taking Introductory/Intermediate Programming (15-100). Students should be able to demonstrate programming experience from other courses or independent study work.
A central course for the minor is a new one entitled, General Robotics (24-354). This course will give students the big picture of what is going on in robotics through topics such as kinematics, mechanisms, motion planning, sensor based planning, mobile robotics, sensors, and vision. The minor also has two other required courses: (1) a controls class and (2) a manipulation, dynamics, or mechanism class. These courses provide students with the necessary intuition and technical background to move on to more advanced robotics courses.

Students may satisfy the elective requirement by taking an upper level Robotics Institute course and an independent research project under Mechanical Engineering Project (24-391/392), Mechanical Engineering Department Research Honors (24-291/492), CIT Honors (39-500), or Undergraduate Research in Robotics (16-597). In any event, the student must have course selection approved by the director of the minor. In order to be awarded the Minor in Robotics, a student must earn a cumulative QPA of 2.0 in these courses.

Following is the list of courses that must be completed for the Minor in Robotics:

**Overview**

24-354 General Robotics

One of the following courses:

- 24-451 Feedback Control Systems
- 18-370 Fundamentals of Control
- 06-362 Chemical Engineering Process Control
- 16-299 Introduction to Controls (Computer Science)

**Manipulation, Dynamics, Mechanisms**

One of the following courses:

- 15-384/18-384 Manipulation
- 24-353 Intermediate Dynamics
- 24-355 or Kinematics and Dynamics of Mechanisms
- 24-248

**Electives**

Two of the following courses:

- 24-384 Special Topics in Design: Computational Geometry
- 15-385 Computer Vision
- 60-422 Advanced ETB: Robotic Art Studio
- 16-362/16-862 Introduction to Mobile Robot Programming
- 24-700/16-735 Robotic Sensor Based Motion Planning
- 18-778 Mechatronic Design
- 15-381 Artificial Intelligence: Representation and Problem Solving
- 15-881/15-499 Introduction to Geometry
- 85-213 Information Processing and Artificial Intelligence
- 85-420 Perception and Perceptual Development

One Independent study course

An upper level RI course

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**Academic Standards Grading Practices**

Undergraduate grading regulations are detailed on pages 54.

**CIT Dean’s Honor List**

Each semester, Carnegie Institute of Technology recognizes students who have earned outstanding academic records by naming them to the dean’s honor list. The criterion for such recognition is a semester quality point average of at least 3.75 while completing at least 36 factorable units and earning no incomplete grades.

**Transfer into CIT Departments**

Undergraduate students admitted to colleges other than CIT who wish to transfer into a CIT department during their first year should consult with the assistant dean of CIT. Students admitted to CIT but excluded from certain departments must also consult with the assistant dean if they wish to transfer into a restricted CIT department. No first year student will be considered for transfer until after mid-semester grades for the spring semester have been posted. At that time, a decision will be based on availability of space and the student’s academic performance.

CIT undergraduate students beyond the first year wishing to transfer into another CIT department may do so if they are not on academic probation and if there is room in the department of their choice. If the demand for any department exceeds the space available, then the department will admit students based on a comparative evaluation of all applicants at the end of each semester, up to the limit of available space.

Undergraduate students not in CIT who wish to transfer into a CIT department beyond the first year will be considered for transfer on a space available/academic performance basis.

Procedure for transfer of students from another university into CIT departments: A student first applies through the Office of Admission.

If the Office of Admission believes the applicant is acceptable, the student’s record is sent to the appropriate department for evaluation and a decision on acceptance. The CIT department head has the right to refuse to accept the student if there are space restrictions and/or if the student’s chance for success in the CIT department is determined to be questionable based on past academic performance.

**Academic Actions**

In the first year, a student’s quality point average below 1.75 in either semester invokes an academic action. For all subsequent semesters, a student’s semester QPA or the cumulative QPA (excluding the first year) below 2.0 invokes an academic action.

**Probation**

The action of probation occurs in the following cases:

One semester QPA of the first year falls below 1.75.

The semester QPA of a student in good standing beyond the first year falls below 2.00.

The term of probation is one semester as a full-time student. First year students are no longer on probation at the end of the semester if their semester QPA is 1.75 or above. Students in the third or subsequent semester of study are no longer on probation at the end of one semester if the semester QPA AND cumulative QPA (excluding the first year) are 2.00 or above.

**Probation Continued**

A student who is currently on one semester of probation but whose record indicates that the standards are likely to be met by the end of the next semester may be continued on probation at the discretion of the associate dean.

**Suspension**

A student who does not meet minimum standards at the end of one semester of probation will be suspended.

A first year student will be suspended if the QPA from each semester is below 1.75.

A student in the third or subsequent semester of study will be suspended if the semester QPA or the cumulative QPA (excluding the first year) is below 2.00 for two consecutive semesters.

The normal period of suspension is one academic year (two semesters). At the end of that period a student may return to school (on probation) by completing the following steps:

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1. Receiving permission in writing from the assistant dean for undergraduate studies.

2. Completing a Return from Leave of Absence form from Enrollment Services; and

3. Providing transcripts and clearance forms if the student has been in a degree program at another college or university even though academic credit earned will not transfer back to Carnegie Mellon.

Students who are suspended, take a leave of absence or withdraw are required to vacate the campus (including residence halls and fraternity and sorority houses) within a maximum of two days after the action and to remain off the campus for the duration of the time specified. This action includes debarment from part-time or summer courses at the university for the duration of the period of the action.

**Drop**

This is a permanent severance. A student is dropped when it seems clear that the student will never be able to meet minimum standards. A student who has been suspended and fails to meet minimum standards after returning to school is dropped.

If students are dropped, they are required to vacate campus (including dormitories and fraternity houses) within a maximum of two days after the action. This action includes debarment from part-time or summer courses.

The relation indicated above between probation, suspension, and drop is normal, not binding. In unusual circumstances, College Council may suspend or drop a student without prior probation.

**Graduation Requirements**

For graduation, students must complete the requirements for their specified degrees with a cumulative quality point average of 2.00 or higher for all courses taken after the freshman year. In addition, a student is expected to achieve a cumulative quality point average of 2.00 in core departmental courses.

Students must be recommended for a degree by the faculty of CIT.

A candidate must meet the residence requirement of having completed at least 180 units at Carnegie Mellon University.

Students must meet all financial obligations to the university before being awarded a degree.

**Modification of Graduation Requirements:** A student may seek permission to modify graduation requirements by petition to the CIT College Council.

**Other Regulations Affecting Students Status**

Schedule Changes

(See page 29 for add/drop procedure information and page 55 for grading procedures for dropped courses)

**Course Add Deadline**

The last date to ADD courses is stipulated for each semester on the university calendar - about two weeks after the beginning of a term. This applies to all courses with the following exception: the final date to add half-semester mini-courses is the last class day of the first week of the course.

**Course Drop/Withdraw Deadline**

CIT undergraduate students may DROP a course on-line on or before the deadline published in the official university calendar. This deadline is two weeks after mid-semester grades are due in The HUB. The deadline to drop a half-semester mini course is the last day of the fourth week of the mini course. When a course is dropped by the deadlines, the course is removed entirely and disappears from a student’s academic record. After the official university deadline to drop, undergraduate students may WITHDRAW from a course on-line on or before the last day of classes, excluding final examinations. The deadline to withdraw from a half-semester mini course is the last class day of the mini course. When a student withdraws from a course between the official university deadline to drop a course and the last day of classes, a “W” (Withdrawal) is assigned as a grade, which appears on the student’s academic record.

CIT undergraduates who are registered as full time students as of the tenth class day are expected to remain full time for the duration of a semester. Full time is defined by being registered for a minimum of 36 factorable units. Students may not drop or withdraw from courses that will reduce their factorable units below 36 unless there are extenuating circumstances for which they obtain approval from the CIT College Council. Undergraduates who are registered as part time (those carrying fewer than 36 factorable units) as of the 10th class day are also subject to the above deadlines to drop or withdraw from a course.

Exceptions to the regulations above will be granted only upon approval of a petition to the College Council.
Undergraduate Designated Minors in Carnegie Institute of Technology

Undergraduate students in the Carnegie Institute of Technology can elect to complete an interdisciplinary Designated Minor in addition to their regular majors for B.S. degrees. Designated minors have been added to the curriculum of the Carnegie Institute of Technology to promote flexibility and diversity among the college's engineering students. Independent of a student's major, he or she is able to pursue a selected designated minor from the following list:

* Automation and Control
* Biomedical Engineering
* Colloids, Polymers and Surfaces Technology
* Data Storage Systems Technology
* Electronic Materials
* Engineering Design
* Environmental Engineering
* International Engineering
* Manufacturing Engineering
* Materials Science and Engineering
* Mechanical Behavior of Materials
* Robotics (previously described)

An engineering student may elect to complete a CIT designated minor. Generally, the student takes all the required courses in an engineering major but uses electives to take courses needed to fulfill the requirements of the designated minor. Upon completion of the requirements of a CIT designated minor and the engineering degree, the minor is a formally recognized on the student's transcript.

Each of the CIT designated minors is administered by a Program Committee consisting of faculty from all major engineering departments who serve as faculty advisors. Each Program Committee certifies the completion of requirements of the designated minor. But the student's major department is responsible for approving the degree with a designated minor after reviewing a student's entire academic record. Any substitution or departure from the published curriculum should be avoided. For example, non-technical courses may not be substituted for required technical courses or electives. Equivalent technical electives offered by a designated minor as substitutions for required courses in a major must be approved by the Head of the student's major department.

Although a student generally can complete a designated minor without increasing the number of required units for graduation, early planning in electing a designated minor is important. A student also may find that some minors are more compatible than others with his/her major because of different relations between various major and minor requirements. The requirements for these CIT designated minors are listed below.

**Automation and Control Engineering Designated Minor**

Bruce Krogh, Director Office: Porter Hall 822

The objective of the Designated Minor in Automation and Control Engineering is to expose CIT students to the breadth of knowledge required by the modern practice of control and automation. With this objective in mind, the requirements include not only two courses in control system analysis and design, but also courses on real-time computation, software engineering, hardware implementation, and applications. The minor is expected to attract primarily students from Chemical Engineering, Electrical and Computer Engineering, and Mechanical Engineering. The main interdisciplinary component of the minor is between engineering and computer science, although many opportunities exist for creating a program across several CIT departments.

**Faculty Advisors**

Electrical & Computer Engineering - Pradeep K. Khosla
Civil & Environmental Engineering - James Garrett
Mechanical Engineering - William Messner
Chemical Engineering - Erik Ydstie

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**Course Requirements for Automation and Control Engineering Minor**

The minor requires a minimum of six courses as described below:

**Note:** The course lists below are not necessarily current or complete. Appropriate courses not listed below may be counted toward the requirements for the minor upon approval by one of the departmental faculty advisors. Students interested in the Automation and Control Engineering Designated Minor are encouraged to look for applicable courses each semester in CIT, CS, and Robotics.

**One basic control course:**

- 06-362 Chemical Engineering Process Control
- 18-370 Fundamentals of Control
- 24-451 Feedback Control Systems

**One course on control system analysis and design:**

- 06-708 Advanced Process Dynamics and Control
- 18-771 Linear Systems

**One course on computing and software:**

- 15-200 Advanced Programming/Practicum
- 15-211 Fundamental Structures of Computer Science I
- 15-212 Fundamental Structures of Computer Science II
- 12-741 Advanced Programming Concepts in CAE
- 18-549 Distributed Embedded Systems

**One course on hardware implementation:**

- 06-311 Unit Operations Laboratory
- 18-474 Real-time Computer Control System Design
- 18-578 Mechatronic Design

**One course on applications:**

- 06-606 Computational Methods for Large Scale Process Design and Analysis
- 12-615 Traffic Flow Theory and Operations
- 24-354 General Robotics
- 16-743 Robot Control
- 16-761 Introduction to Mobile Robots
- 24-356 Engineering Vibrations
- 24-351 Engineering Dynamics
- xx-xxx 12 independent project units

**One elective course:**

- xx-xxx Any course in the list above excluding the basic control course category

**Course R Requirements for Automation and Control Engineering Minor**

12-748 Design of CAE Systems
15-381 Artificial Intelligence: Representation and Problem Solving
15-385 Computer Vision
15-413 Software Engineering
15-498 Introduction to Real-Time Software
18-349 Introduction to Embedded Systems
18-772 Multivariable Control Systems
18-773 Adaptive Control
18-775 Optimal and Stochastic
18-791 Digital Signal Processing I
24-341 Manufacturing Sciences
24-772 Multivariable Process and Nonlinear Control
Biomedical Engineering Designated Minor

Todd Przybycien, Director Office: Doherty Hall A-220

Biomedical Engineering (BME) at Carnegie Mellon is designed to train engineering students to apply the techniques of mathematics and science to the solution of problems in medicine and biology. Emphasis is placed on describing biological organisms as engineering systems and on applying engineering technology to clinical and laboratory situations. Students graduate with an accredited engineering degree in a traditional engineering major with a minor in biomedical engineering.

What Can a Student Do After Completing the Bachelor's Degree?

Upon completing the Biomedical Engineering Minor, the student may elect to continue graduate studies in Bioengineering at either the Masters or Ph.D. levels, or continue in medical school for the MD degree. Many of the courses in the BME minor will assist in preparing you for medical school. Students who remain in the field of biomedical engineering and are involved with developing and improving medical instruments and devices, automating medical procedures using computers, characterizing the operation of physiological systems, designing artificial organs and altering microbes and mammalian cells so that useful drugs and chemicals can be produced.

The graduate may secure employment in areas of bioinstrumentation, biocompatibility, optics, pharmacology, or the environment.

Faculty Advisors

The Biomedical Engineering Program provides a focus for faculty from diverse engineering backgrounds. There is also extensive collaboration with investigators in the local health care community. Clinical collaborations are seen as vehicles to keep research responsive to clinical needs, enhance the exposure of our students to a variety of clinical environments, and assist the clinical community in solving engineering problems.

One faculty member will be assigned the advisor to each engineering department. Hilda Diamond in Doherty Hall 2100 will also help with the bookkeeping aspects of advising and attention to details (student course requirements, scheduling of BME courses, working with departments to avoid conflict). Coordination with advising in the other major of the student is essential. Students will need to have traditional engineering advisor to approve final schedules. Following are advisors in departments:

Chemical Engineering: Dr. Todd Przybycien, Dr. Michael Domach, Dr. Lynn Walker Civil & Environmental Engineering: Dr. Jean VanBriesen Electrical & Computer Engineering: Dr. Richard Stern, Dr. Chuck Neuman Materials Science & Engineering: Dr. Lisa Porter; Dr. Henry Piehler Mechanical Engineering: Dr. Cristina Amon, Dr. Jon Cagan

A summer opportunities program is available to students pursuing the minor at the completion of their sophomore year.

Course Requirements for Biomedical Engineering Designated Minor

General Requirements (five courses, 48-51 units)

- Introduction to BME (42-101) 12 units
- Modern Biology (03-121) or Biochemistry (03-231 or 232) 9 units
- BME Elective or Domain 9-12 units
- BME Elective or Domain 9-12 units
- BME Elective or Domain 9-12 units

BME Domain Courses

03-121 Modern Biology
03-240 Cell Biology
03-310 Introduction to Computational Biology
03-311 Computational Molecular Biology
03-330 Genetics
03-343 Experimental Generics and Molecular Biology
03-344 Experimental Biochemistry
03-345 Experimental Cell and Developmental Biology
03-350 Developmental Biology
03-438 Physical Biochemistry
03-439 Introduction to Biophysics
03-441 Molecular Biology of Proteins
03-442 Molecular Biology of Eukaryotes
03-510 Computational Biology
03-533 NMR in Biomedical Sciences
03-534 Bio Imaging Fluorescence Spectroscopy
09-245 Physical Chemistry II
15-211 Fundamental Structures of Computer Science I
24-779 Human Systems and Control
27-432 Electrical, Magnetic, and Optical Properties of Materials
27-441 Deformation and Fracture of Materials
36-247 Statistics for Lab Sciences
39-319 Law and the Engineer
88-270 Networking: Organizations, Knowledge, and Technology
88-302 Behavioral Decision Making
88-340 Economics of Entrepreneurship in High Technology Industries
90-830 Financial Management of Health System
90-831 Health Management Systems
90-836 Legal Issues in Health Systems Management
90-837 Health Project Planning & Management
90-850 Introduction to Health Care Management
90-853 Health Care Information Systems
90-861 Health Policy

*Since most Electrical and Computer Engineering courses are electives and circuits and signals integral to many medical technologies, a student could use just about any 18-XYZ course where X is greater than 1 and a student can satisfy prerequisites or obtain permission from the instructor.

Students are encouraged to select an interdisciplinary capstone course or independent research project for one of the BME electives.

Like the requirements for the BME double major, the requirements for the BME minor satisfy various categories of electives in the curriculum and should not increase the total number of units/courses required for the primary CIT degree.

Colloids, Polymers and Surfaces

Annette Jacobson, Director Office: Doherty Hall 3102B

The sequence of courses in the Colloids, Polymers and Surfaces (CPS) minor provides an opportunity to explore the science and engineering of fine particles and macromolecules as they relate to complex fluids and interfacially engineered materials. These topics are very relevant to technology and product development in industries that manufacture pharmaceuticals, coatings, and paints, pulp and paper, biomaterials, surfactants and cleaning products, cosmetics and personal care products, food, textiles and fibers, nanoparticles, polymer/plastics, composite materials.

Course Requirements for Colloids, Polymers and Surfaces Minor

One course from the following list:
06-221 Thermodynamics
24-221 Thermodynamics I
27-215 Thermodynamics of Materials
33-341 Thermal Physics I
09-345 Physical Chemistry II (Thermo)

The following four courses are required:
06-609/09-509 Physical Chemistry of Macromolecules
06-607 Physical Chemistry of Colloids and Surfaces
06-426 Experimental Colloid and Surface Science
06-466 Experimental Polymer Science
Data Storage Systems Technology Designated Minor

William C. Messner, Director Office: Scaife Hall 312

To complete the minor in Data Storage Systems Technology a student must take at least five courses from the list below. Two of the courses must come from the Required Courses list. Introduction to Data Storage Systems Technology (18-316), Data Storage Systems Management and Design Laboratory (18-517), and Introduction to Solid State Physics (33-448). The student must also take at least three of the elective courses. The various fields related to data storage technology are grouped in to five designated concentration areas — Materials and Chemistry; Physics of Data Storage; Dynamics, Control, and Signal Processing; Computer Systems; and Circuit Design. At least two of the elective courses must be in one of the concentration areas. The required introduction courses provide students with the overview needed for them to develop their interests in a manner consistent with the important aspects of the topic. Completing the courses from a concentration will guarantee that a student will have developed sufficient skill and knowledge to be useful for either employment in industry or for further study at the graduate level.

Course Requirements for Data Storage Systems Technology Minor

Required Courses (Two Undergraduate Courses):
18-316 Introduction to Data Storage System Technology
18-517 Data Storage Systems Management and Design Laboratory
33-448 Introduction to Solid State Physics

Elective Courses

Materials and Chemistry Concentration
06-607 Physical Chemistry of Colloids and Surfaces
06-609 Physical Chemistry of Macromolecules
06-619 Semiconductor Processing 06-709 Polymeric Materials
06-714 Surfaces and Adsorption 09-248 Inorganic Chemistry
09-511 Solid State Materials Chemistry
27-432 Electrical, Magnetic, and Optical Properties of Materials
27-542 Structure and Properties of Thin Films

Physics of Data Storage Concentration
33-225 Quantum Physics and the Structure of Matter
33-448 Introduction to Solid State Physics
33-453 Intermediate Optics

Dynamics, Control and Signal Processing Concentration
18-575 Control System Design
09-461 Feedback Control Systems
24-356 Engineering Vibrations
18-396 Signals and Systems
18-474 Computer Control Systems Design Laboratory

Computer Systems Concentration
15-412 Operating Systems
18-349 Introduction to Embedded Systems
18-549 Complex Embedded/Multimedia Computing

Circuit Design Concentration
18-523 Analog Integrated Circuit Design
18-525 Integrated Circuit Design Project
18-545 Advanced Digital Design Project

Other Non-Concentration Courses

An independent study project approved by the coordinator of the minor.
Other regular course approved by the coordinator of the minor.

Electronic Materials Designated Minor

David W. Greve, Director Office: Hamerschlag Hall B204
Lisa A. Porter, Co-Director Office: Roberts Engineering Hall 145

Many of the technological changes in recent decades—notably the rise of digital data processing—have been made possible by continuing advances in the performance of electronic devices. These advances include continuous improvement in microprocessor performance, optical communication bandwidth, and magnetic disk storage capacity. Other new areas of innovation include the development of microelectromechanical systems and the development of flat panel display technology. These advances depend on interactions between engineers from many different disciplines. In particular, there is a strong interaction between device design and materials engineering and processing.

The Electronic Materials Minor is intended to provide students with a firm basis for the application of electronic materials in advanced systems. This minor is well suited for students who intend to pursue careers in the electronics industry (included, but not limited to, semiconductor integrated circuit design and manufacturing, and magnetic storage engineering). The minor also provides an excellent preparation for students interested in pursing graduate work in MSE, ECE, or Applied Physics.

This minor is primarily intended to offer ECE and MSE students an understanding of the important features that must be built into a material during processing so that it will function as required in an electronic or magnetic device. Other students interested in pursuing this minor should consult their advisors to determine whether it will be practical in their own curriculum. Such students are expected to take both 18-100 and 27-201 as introductory courses.

Students in the Electronic Materials program are urged to consider registering for an undergraduate project in addition to the requirements below, especially if they intend to apply to graduate school. The co-directors will make every effort to arrange a suitable project for interested students.

Faculty Advisors

The designated minor will be administered by the co-directors listed above. Current faculty advisors are:

Chemical Engineering - Paul Sides Civil and Environmental Engineering - Jacobo Bielak Michael Reed and T. E. Schlesinger Engineering and Public Policy - M. Granger Morgan Materials Science and Engineering - Marek Skowronski

Course Requirements for Electronic Materials Minor

The minor requires an introductory course together with a minimum of 48 additional units as specified below.

Required Introductory Courses:
18-100 Introduction to Electrical & Computer Engineering (MSE students)
27-201 Perfect Crystals including lab (ECE students)

Elective Courses

48 additional units, with 24 units from Group A and 24 units from Group B. Some courses are a required part of one of the curricula and consequently cannot be counted again for the minor program.

We have determined that "courses which are a required part of a curriculum" are those which are specifically named in the curriculum requirements. Consequently technical electives and breadth and depth electives may be double-counted.

Group A
27-202 Defects in Materials (ECE students only)
06-619 Semiconductor Processing Technology
27-542 Thin Films
27-217 Phase Relations (ECE students only)
27-533 Principles of Growth and Processing of Semiconductors
27-432 Electronic, Magnetic, and Optical Properties (only if not required in your curriculum)
27-551 Properties of Ceramics and Glasses
27-216 Transport in Materials (ECE students only)
33-225 Quantum Physics and Structure of Matter (ECE students only)

Group B
18-575 Control System Design
27-201 Perfect Crystals including lab (ECE students)
06-609 Physical Chemistry of Macromolecules

45 units is required for the minor, including required and elective courses. A total of 39 units is required for the minor. Courses can be chosen from the list below, the previous list, or by permission of the Minor Advisors.

Other appropriate courses may be substituted with the approval of the coordinators in the event that limited course offerings make it impossible to satisfy the requirements as described above.

### Engineering Design Designated Minor

Cristina Amon, Director Office: Hamburg Hall 1201

Design is a pervasive activity in all engineering disciplines. Insuring quality, timeliness, manufacturability, and marketability of engineering designs is a crucial concern in product development. The CIT designated minor in Engineering Design is intended to provide a firm methodological basis for engineering design that will be broadly applicable in numerous specialty domains. The minor is intended primarily for engineering undergraduates who want a broader and more formal foundation in design. The requirements for the minor consist of two interdisciplinary design courses which emphasize design methodology, team work, and real-world problem solving, and three elective courses, at least one should involve CAD and at least one should be outside the student’s major.

### Faculty Advisors

The designated minor in Engineering Design is administered by the Director of the Institute for Complex Engineered Systems. Students undertaking the designated minor can consult with the program advisor in their major department.

Current faculty advisors are:

- Chemical Engineering - Larry Biegler, Ignacio Grossman and Arthur W. Westerberg
- Civil Engineering and Environmental Engineering - Susan Finger and Jim Garrett
- Electrical and Computer Engineering - Robert A. Rutenbar and Daniel P. Siewiorek
- Engineering and Public Policy - Kathleen Westerberg
- Materials Science and Engineering - Kenji Shimada and Tom Stahovic

Science and Engineering - Christina Amon, Director Office: Hamburg Hall 1201

The requirements include two science-oriented courses, three engineering courses, and two policy courses. The requirements are intended to provide a firm methodological basis for engineering design that will be broadly applicable in numerous specialty domains. The minor is intended primarily for engineering undergraduates who want a broader and more formal foundation in design. The requirements for the minor consist of two interdisciplinary design courses which emphasize design methodology, team work, and real-world problem solving, and three elective courses, at least one should involve CAD and at least one should be outside the student’s major.

### Course Requirements for Engineering Design Minor

#### Required Courses:

- Select at least two of the following courses.
  - 39-424 Rapid Prototype Design
  - 39-405 Engineering Design: Creation of Products and Processes
  - 39-600 Integrated Product Development
  - 39-605/606 Engineering Design Projects Courses
  - 39-648 Rapid Prototyping of Computer Systems

#### Elective Courses:

Additional elective courses are required, including at least 9 units outside the student’s major department and at least one course involving applications of computer-aided design methods. A total of 39 units is required for the minor, including required and elective courses. Courses can be chosen from the list below, the previous list, or by permission of the Minor Advisors.

### Undergraduate Elective Courses:

- 06-421 Chemical Process Systems Design
- 06-461 Design Project
- 12-401 Engineering Synthesis and Design
- 12-605 Design and Construction
- 12-631 Structural Design
- 18-474 Computer Control Systems Design Laboratory
- 18-517 Data Storage Design Project
- 18-523 Analog Integrated Circuit Design
- 18-525 Interated Circuit Design Project
- 18-545 Advanced Digital Design Project
- 18-551 Digital Communications and Signal Processing Systems Design
- 18-575 Control System Design
- 24-441 Engineering Design
- 24-442 Engineering Design - EPP
- 24-443 Design for Manufacture
- 27-357 Introduction to Materials Selection
- 27-421 Processing Design
- 39-647 Independent Study in Engineering Design
- 39-350/750 Computational Modeling and Analysis of Societies, Organizations and Technologies
- 42-580 Medical Instrumentation Design

### Graduate Elective Courses:

- 06-606 Computational Methods for Large Scale Design & Analysis
- 06-715 Advanced Process Synthesis
- 12-747 CAE Software Project
- 12-740 CAE Tools
- 18-723 Advanced Analog Integrated Circuit Design
- 18-725 Digital Integrated Circuit Design
- 18-728 Applications of Analog Integrated Circuits
- 18-745 Rapid Prototyping Computer Systems
  - (cross-listed with 39-648)
- 18-747 Superscalar Processor Design
- 18-778 Mechatronic Design
  - (cross-listed with 18-778 and 24-778)
- 24-778 Design Procedures
- 24-784 Computational Design Tools

### Environmental Engineering Designated Minor

David Dzombak, Director Office: Porter Hall 119

Concern for the environment now influences a wide range of public, private, and engineering decisions. Environmental Engineering is widely recognized as a discipline at the graduate and professional level, and undergraduate training in environmental issues and processes can provide the preparation necessary to pursue this career path, or serve as a useful complement to a career in any of the traditional areas of engineering. Effective preparation in Environmental Engineering requires broad knowledge and skills in the areas of environmental science, environmental engineering and environmental policy. Course requirements from each of these areas are thus included as part of the program for the Environmental Engineering Minor.

### Faculty Advisors

The Environmental Engineering program is a focus for faculty from diverse engineering backgrounds. The faculty are actively engaged in teaching and conducting research in this field. Current faculty advisors are:

- Chemical Engineering – Neil M. Donahue Civil and Environmental Engineering - Sarosh Talukdar and Mark Kieler

### Course Requirements for Environmental Engineering Minor

The requirements include two science-oriented courses, three engineering courses, and two policy courses. The requirements are intended to provide a firm methodological basis for engineering design that will be broadly applicable in numerous specialty domains. The minor is intended primarily for engineering undergraduates who want a broader and more formal foundation in design. The requirements for the minor consist of two interdisciplinary design courses which emphasize design methodology, team work, and real-world problem solving, and three elective courses, at least one should involve CAD and at least one should be outside the student’s major.

### A. Environmental Science Courses

Two from the following list of science-oriented courses:

- 03-121 Modern Biology
- 03-122 Organismic Botany
- 03-130 Biology of Organisms
- 03-231 Biochemistry
- 03-310 Introduction to Computational Biology; or
- 03-510 Computational Biology
- 06-221 Thermodynamics; or
- 24-221 Thermodynamics 1; or
- 27-215 Thermodynamics of Materials
- 06-426 Experimental Colloid and Surface Science
- 06-807 Physical Chemistry of Colloids and Surfaces
- 09-106 Modern Chemistry II; or
- 09-206 Physical Principles of Analytical Chemistry
- 09-214 Physical Chemistry
B. Environmental Engineering Courses

Three from the following list of engineering-oriented courses:

- 06-620 Special Topics in Atmospheric Chemistry
- 06-622 Bioprocess Design (also 42-622)
- 12-251 Introduction to Environmental Engineering [for non-CEE students only]
- 12-651 Air Quality Engineering
- 12-653 Water Quality Engineering
- 12-656 Water Quality Engineering Laboratory [3 units; must be combined with additional 6 units]
- 12-657 Water Resources Engineering
- 12-658 Hydraulic Structures Design
- 19-422 Radiation, Health and Public Policy
- 19-446 Quantitative Risk Analysis
- 19-440 Combustion and Air Pollution Control (also 24-382)
- 19-614 Life Cycle Assessment [6 units; must be combined with additional 3 units]
- 19-650 Climate and Energy: Science, Economics, and Public Policy
- 24-424 Energy and the Environment (also 19-424)
- 27-322 Processing of Metals
- 27-557 Selection and Performance of Materials
- 42-604 Biological Transport
- 42-621 Biotechnology and Environmental Processes (also 06-621)
- 42-622 Bioprocess Design (also 06-622)
- 48-315 Environment I: Climate and Energy
- 48-415 Advanced Building
- 48-569 GIS/CAFM

(Note 1: The 48-xxx courses may not be acceptable as technical electives by some CIT engineering departments. At most one of these courses can be used as a Type B course.)

(Note 2: Course 12-251, Introduction to Environmental Engineering, can be counted toward completion of the environmental engineering course requirements for non-CEE students only.)

(Note 3: At least three of the five Type A + Type B courses counted toward the Environmental Engineering Minor must be from outside the student’s major department.)

C. Environmental Policy Courses

Two from the following list of humanities/social science-oriented courses:

- 19-291 From Local Pollution to Planetary Management: Environmental Problems and Prospects
- 19-319 Law and the Engineer
- 19-426 Environmental Decision Making
- 19-448 Science, Technology, and Ethics
- 48-453 Urban Design
- 48-567 Sustainable Design and Development
- 48-596 LEED Buildings and Green Design Concepts
- 66-210 Science, Technology, and the Environment
- 70-332 Business, Society and Ethics
- 70-361 Foundations of Law
- 70-363 Law in Modern American Society
- 73-248 Environmental Economics
- 73-357 Regulation: Theory and Policy
- 73-358 Economics of the Environment and Natural Resources
- 73-359 Benefit-Cost Analysis
- 79-111 Cultural Perspectives on the Environment
- 79-244 Pittsburgh and the Transformation of Modern Urban America
- 79-343 Environmental Policy and Development in the Tropical World
- 79-345 American Environmental History
- 79-346 International Environmental Law and Policy (also 88-352)
- 79-365 Climate Change, Energy Policy, and Environmental Protection
- 79-471 American Built Environment
- 79-475 Perspectives on the City and the Environment (also 90-762)
- 80-241 Ethical Judgments in Professional Life
- 80-242 Conflict and Dispute Resolution
- 80-243 Business Ethics
- 80-244 Environmental Management and Ethics
- 80-306 Social Choice Theory
- 80-340 Environmental Ethics and Decision Processes
- 85-241 Social Psychology
- 85-442 Health Psychology
- 88-220 Policy Analysis I
- 88-221 Policy Analysis II
- 88-223 Decision Analysis and Decision Support Systems
- 88-302 Behavioral Decision Making
- 88-323 Legislative Processes
- 88-352 International Environmental Law and Policy (also 79-346)
- 88-425 Politics of Economic Deregulation
- 90-779 Design, Environment, and Economic Development
- 90-784 Geographic Information Systems
- 90-789 Sustainable Community Development
- 90-798 Environmental Policy and Regulation

(Note 4: Other humanities and social science courses with similar or related content may be substituted for these environmental policy courses with permission of the student’s departmental advisor for the Environmental Engineering Minor and the Director. A group of three of these environmental policy courses may be counted as fulfilling the H&SS depth requirement required of all CIT students.) A list of relevant courses offered in particular semesters is provided at the Environmental Engineering Minor web site: http://www.ce.cmu.edu/~dozomb/EnvMinor.html

International Engineering Studies

Designated Minor

Many engineers work on international projects or for multi-national companies. Carnegie Mellon is an international community, with a significant fraction of international students and many events featuring foreign speakers and cultural experiences. This minor is intended for engineering students interested in broadening their background in international experiences. Requirements for the minor include:

**International Management (1 course)**

Complete one course in international management such as 70-430 International Management, 70-365 International Trade and International Law or equivalent.

**Regional Specialization (1 course)**

Complete one course in non-US History, international politics, or literature in a single region of the world. (See page 222 in the undergraduate catalog for a list of courses suggested for Africa, Asia, Europe, Latin America/Caribbean, Middle East and Russia).

**Ethics (1 course)**

Any ethics course that provides some exposure to international ethics issues. For example, the 80-243 Business Ethics course discusses the differences between what is considered ethical business practice in different cultures.

**Modern Languages**

Demonstration of basic competency in a foreign language via one of the three options listed below:

1. Complete one (1) Modern Languages course at the 200 level, with a minimum grade of C, or
2. Achieve a score of 4 or higher in one foreign language Advanced Placement examination, or
3. Demonstrate equivalent proficiency to the satisfaction of the Department of Modern Languages

**Study/Work Abroad**

Study or engineering internship work abroad for a semester or a summer. Study abroad should include an engineering course involving teamwork. The region visited should be consistent with the language and regional culture/history studied.

Undergraduate Designated Minors in Carnegie Institute of Technology 111
Manufacturing Engineering Designated Minor

Bruce H. Krogh, Director Office: Porter Hall B22
The Designated Minor in Manufacturing Engineering provides the student with a background in the basic engineering issues that arise in all manufacturing enterprises, from product design through production processes, to issues in marketing and management.

Faculty Advisors
A faculty member from each department will serve as the faculty advisor for the students who are pursuing the minor degree in their respective departments. Current faculty advisors are:


Course Requirements for Manufacturing Engineering Minor

Note: The course lists below are not necessarily current or complete. Appropriate courses not listed below may be counted toward the requirements for the minor upon approval by one of the departmental faculty advisors. Students interested in the Manufacturing Engineering Designated Minor are encouraged to look for applicable courses each semester in CIT, CS, and Robotics.

Two Core Courses:

24-341 Manufacturing Sciences
27-357 Introduction to Materials Selection (non MSE Majors)
OR
27-401 & 402 MSE Capstone Course, I & II (MSE Majors)

Note: Instructor’s permission to waive the prerequisites for the core courses will be considered for students pursuing the Manufacturing Engineering Designated Minor.

Technical Electives:
A total of three courses must be selected from at least two of the following categories. Courses taken to fulfill requirements for the student’s major, other than technical elective requirements, cannot be used to fulfill this requirement.

Real-Time Systems and Robotics
16-721 Advanced Robot Perception
16-741 Mechanics of Manipulation
16-743 Robot Control
18-349 Introduction to Embedded Systems
18-474 Real-Time Computer Control System Design
18-549 Distributed Embedded Systems
18-778 Mechatronic Design

Design, Materials and Processes
06-362 Chemical Engineering Process Control
24-443 Design for Manufacture 24-789 Advanced Topics in Manufacturing
27-322 Processing of Metals
27-323 Processing of Ceramic Materials
27-421 Design in Process Metallurgy
27-422 Deformation Processing
27-592 Solidification Processing
27-322 Processing Methods
27-421 Processing Design
27-442 Deformation Processing
27-533 Principles of Growth and Processing of Semiconductors
36-600 Design, Manufacturing and Marketing of New Products
39-245 Special Topics: Rapid Prototype Design
39-405 Engineering and Design: the Creation of Products and Processes

Production Management and Control
12-411 Engineering Economics
12-611 Project Management for Construction
36-220 Engineering Statistics and Quality Control
70-430 International Management
70-371 Production and Operations Management
70-471 Production II

Language:
Because of the international nature of manufacturing enterprises, students are strongly encouraged to complete one of the following:
82-221/222 Intermediate German: Culture and Society
82-271/272 Intermediate Japanese

Materials Science and Engineering Designated Minor

Michael E. McHenry, Director Office: Roberts Engineering Hall 243

The Designated Minor in Materials Science and Engineering provides the CIT student with a background in the field of Materials Science and Engineering. This minor is open to all CIT students, with the exception of MSE majors. All required and elective courses are taught within the MSE Department.

Course Requirements: The minor requires a minimum of 45 units, with two semester long required courses (the first being a sequence of two minis).

Prerequisites: Students wishing to take the MSE minor must have prerequisite thermodynamics and transport courses. The prerequisite MSE courses may be substituted for by a thermodynamics and transport course in another engineering discipline.

Core Courses (21 units)

Course One (consisting of two half semester minis): Perfect Crystals, 27-201 (6 units), 27-202 Defects in Materials (6 units). The laboratories with these courses are not required as core but will be counted as elective units if desired.

Course Two: 27-217, Phase Relations and Phase Diagrams (9 units), again the laboratory with this course will not be required as core but will be counted as elective units if desired.

Elective Courses (24 units minimum)

The student must select a minimum of 24 units from the following list:
27-100 Introduction to Materials Science
27-201(a) Perfect Crystals Laboratory (3 units)
27-202(a) Defects in Materials Laboratory (3 units)
27-217(a) Phase Relations and Phase Diagrams Laboratory (3 units)
27-301 Microstructure and Properties 27-302 Microstructure and Properties II
27-322 Processing of Metals
27-323 Processing of Ceramic Materials
27-357 Introduction to Materials Selection
27-510 Bio-Materials I
27-511 Bio-Materials II
27-582 Phase Transformations in Solids
27-421 Processing Design
27-432 Electrical, Magnetic and Optical Properties of Materials
27-591 Mechanical Behavior of Materials
27-560 Physical Chemistry of Metallurgical Reactions
27-454 Supervised Reading
27-530 Physical Metallurgy with Applications
27-533 Principles of Growth and Processing of Semiconductors
27-542 Processing and Properties of Thin Films
27-551 Properties of Ceramics and Glasses
27-566 Special Topics
27-592 Solidification Processing
42-644 Medical Devices

Mechanical Behavior of Materials Designated Minor

Paul Steif, Director Office: Scaife Hall 304

An understanding of mechanical behavior is important to both the development of new materials and the selection of appropriate materials for many applications. The mechanical behavior of materials is best investigated and understood by integrating solid mechanics with the microstructural basis of flow and fracture. The purpose of this minor is to allow a formal basis for students to pursue an integrated approach to the mechanical behavior of materials.

Although this minor is open to all CIT students, only students in the departments of Civil Engineering, Materials Science and Engineering, and Mechanical Engineering can take advantage of the double
counting permitted for some courses in their department majors. Students in other departments may have difficulty in fulfilling the requirements in four years.

Faculty Advisors
Chemical Engineering - Paul Sides
Electrical and Computer Engineering - David W. Greve
Mechanical Engineering - Paul S. Steif
Materials Science and Engineering - Warren M. Garrison, Jr
Biomedical engineers apply engineering principles to advance our understanding of living systems and to improve human health. Biomedical engineers accomplish this by integrating fundamental engineering science knowledge with knowledge of biology, physiology or the fundamentals of medical practices; biomedical engineering is inherently interdisciplinary. Biomedical engineers are employed in the pharmaceutical, biopharmaceutical, biotechnical and medical device industrial sectors as well as in clinical healthcare settings. A significant number of successful biomedical engineers in these sectors and settings will be deeply trained in both engineering and the life sciences.

As a collection of related fields, Biomedical Engineering is currently undergoing explosive growth. At this writing, there are over one hundred biomedical engineering programs and departments at colleges and universities across the United States with more programs and departments to be added in the coming years. In July 2002, Carnegie Mellon launched the Department of Biomedical Engineering (BME). However, Carnegie Mellon is not a newcomer to biomedical engineering education. This new department replaces the Biomedical & Health Engineering Program and its predecessor programs which can be traced back to 1967.

The centerpiece of our undergraduate education program is our dual B.S. degree program in biomedical engineering. Carnegie Institute of Technology undergraduates may select any one of these following majors jointly with Biomedical Engineering: Chemical Engineering, Civil & Environmental Engineering, Electrical & Computer Engineering, Materials Science & Engineering, and Mechanical Engineering. All biomedical engineering double majors will share a common exposure to the many facets of biomedical engineering in the BME Intro and Seminar courses and will build a common life sciences background in the Modern Biology/Biochemistry and Physiology courses that comprise the BME core requirement. Students may then choose to specialize or further sample the breadth of biomedical engineering via the BME domain and elective course requirements.

The BME domain courses are drawn from a specific list of courses offered by BME and by the Department of Biological Sciences. These courses are explicit in their biomedical engineering content or in the fundamental life sciences content that underpins biomedical engineering. BME elective courses are also drawn from an approved list and span many different departments across the University. These courses have significant biomedical engineering technique, science or policy contents. Lists of both approved BME domain and elective courses are given below; a dynamic list is maintained on the departmental web site. The double major program culminates in the BME Design course. This course pulls together biomedical engineering students from all engineering backgrounds. The design projects tackle industry-sponsored projects to develop products and product concepts relevant to human health care and the life sciences. Each double major program is designed to be completed in four, very full and rich, years without overloading.

The breadth of the BME domain courses currently offered permits BME students to explore specific aspects of biomedical engineering in more detail. The areas of biomedical engineering represented in the BME domain list correspond to those areas in which Carnegie Mellon has coordinated research strengths. These areas include: tissue engineering and biomaterials; pharmaceutical, biopharmaceutical and environmental processing; computational biomechanics and devices; biosignal sensing and processing; and medical robotics and assistive technologies. As a result, the courses are taught by experts who have direct, current experience and active research in that specialty. Many of these courses also have natural alignments with one or more of the traditional engineering curricula. For example, the biomaterials sequence might be most appealing to students pursuing a MSE-BME double major, the biotechnology and bioprocessing sequence might be most appealing to students pursuing the CHE-BME or CEE-BME double majors and so on. These alignments are not intended to be exclusive; double majors with any engineering department are welcome in any of the domain courses. Thus, double major students may tailor their studies to suit their particular engineering and biotechnical interests.

Several questions naturally arise. Why the double major? Why not a stand-alone BME degree? Where’s the medical school? We aim to graduate students who are educated deeply in the use of traditional, fundamental engineering tools and analytical techniques as well as in the life sciences and clinical applications of technology. Due to its polycultural nature, the field of biomedical engineering requires broad exposure to a wide variety of engineering principles. We feel this breadth of exposure should be complemented by in-depth training in engineering fundamentals. At Carnegie Mellon, we capitalize on the tremendous strength of the Carnegie Institute of Technology (CIT) in traditional undergraduate engineering education and enrich with in-depth training in the life sciences and clinical applications driven by faculty research expertise. While Carnegie Mellon does not have a medical school, the western Pennsylvania area is rich in medical research activity. We leverage our efforts with extensive collaboration with researchers from the University of Pittsburgh Medical Center, Allegheny General Hospital, The Western Pennsylvania Hospital and Children’s Hospital. Not only do these collaborations expose our students to a clinical working environment, they also keep our research responsive to patient needs and assist the clinical community in solving relevant bioengineering problems. Our approach is very different from that of the biomedical engineering educational community at large. And as the number of biomedical engineering degree programs continues to grow, we expect that this difference, in particular the dual degree training of our graduates, will confer a distinct and marketable advantage. Our graduates will shape the future of industrial, clinical and academic biomedical engineering and healthcare.

The Department of Biomedical Engineering also offers a minor program for those students who desire coordinated training in biomedical engineering but who may not have the time available in their schedules to permit pursuit of the double major. The minor aims to provide undergraduates from within CIT and outside CIT with significant and meaningful exposure to specific biomedical engineering and health policy applications. Participants in the minor program can choose from a broad menu of course offerings to build marketable skills in a particular area of biomedical engineering.

The dynamism of biomedical engineering has created an incredibly exciting environment for students, faculty and staff alike at Carnegie Mellon. We invite you to share your educational experience with us.

**Objectives**

- Introduce engineering students to the basics of life sciences at the cellular and human physiology levels.
- Provide an avenue for students to acquire depth in a particular area, integrating their traditional engineering courses into solving problems in biomedical engineering.
Course Requirements for the Double Major Degree

The requirements include four core courses, three domain, two elective courses, and the BME Design course.

Core courses will be taken by all students to insure that a basic foundation is acquired in the life sciences and its vocabulary. A domain sequence will allow students to explore an area of biomedical engineering or the associated life sciences that complements their primary major; these courses are explicitly focused on technical aspects of biomedical engineering or the underpinning life sciences. The elective courses include technical and policy courses that have substantial biomedical engineering content, but are broader in scope than the domain courses. The design course is a project course where students with some common background, yet different expertise, work on a substantial problem in biomedical engineering. These requirements satisfy various categories of electives in your curriculum and should not increase the total number of units/courses required for your primary degree. Below are the courses that can fulfill these requirements.

Courses (all required)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>42-101</td>
<td>Introduction to Biomedical Engineering - Fall and Spring</td>
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<tr>
<td>42-201</td>
<td>BME Seminar - Fall and Spring (once a week)</td>
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<tr>
<td>42-301</td>
<td>Physiology - Fall (prereq: general biology class)</td>
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<tr>
<td>03-121</td>
<td>Modern Biology - Fall and Spring</td>
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<tr>
<td>03-231</td>
<td>Biochemistry - Fall (prereqs. 03-121 and 09-117)</td>
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<tr>
<td>03-232</td>
<td>Biochemistry - Spring (prereq. 09-105; 09-106 or 06-221)</td>
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<tr>
<td>42-401</td>
<td>BME Design - Spring (prereq. senior status)</td>
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</tbody>
</table>

Domain

(a minimum of three courses required from the following list)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>42-334/03-310</td>
<td>Introduction to Computational Biology - Spring (prereqs: 03-121, 21-118 or 21-112), or permission of instructor.</td>
<td></td>
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<tr>
<td>42-377/42-501</td>
<td>Special Topics: Bone Tissue Regeneration - Fall (prereqs: 42-301 or 42-735 Physiology)</td>
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<tr>
<td>42-502/24-759</td>
<td>Special Topics: Cellular Biomechanics - Spring</td>
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<tr>
<td>42-503/42-703</td>
<td>Special Topics: Advanced Bioimaging - Fall</td>
<td></td>
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<tr>
<td>42-504/06-905</td>
<td>Special Topics: Biomaterial Interfaces - Spring (will meet with 06-905 Advanced Topics in Colloid and Surface Phenomena and will count as equivalent of 42-510 Biomaterials I)</td>
<td></td>
</tr>
<tr>
<td>42-505/42-511/27-511</td>
<td>Special Topics: Variational Image Processing - Fall</td>
<td></td>
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<tr>
<td>42-560</td>
<td>Research Project - Fall and Spring (prereq. consent of advisor) Up to 18 units of research may be counted.</td>
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<tr>
<td>42-604</td>
<td>Biological Transport - Spring (prereq. ordinary differential equations)</td>
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<tr>
<td>42-621/06-621</td>
<td>Biotechnology &amp; Environmental Processes - Fall (prereq. 03-121 or 03-231 or 03-252)</td>
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<tr>
<td>42-622/06-622</td>
<td>BioProcess Design - Spring (prereq. 42-621)</td>
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<tr>
<td>42-644/42-744</td>
<td>Medical Devices - Spring</td>
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<tr>
<td>42-652</td>
<td>Introduction to Biomechanics - Spring (prereq. 21-260, useful but not required: 24-141; 24-202)</td>
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</tr>
<tr>
<td>42-723/12-723</td>
<td>Biological Processes in Environmental Systems - Spring (prereq. 12-720, 03-121 or 03-232)</td>
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<tr>
<td>03-124</td>
<td>Modern Biology Laboratory - Fall or Spring (prereq. or concurrent 03-121)</td>
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<tr>
<td>03-240</td>
<td>Cell Biology - Spring (prereq. 03-121)</td>
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<tr>
<td>03-311</td>
<td>Computational Molecular Biology - Spring (prereq. 03-121 or 99-101)</td>
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<tr>
<td>03-315</td>
<td>Introduction to Magnetic Resonance Imaging in Neuroscience - Spring</td>
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<tr>
<td>03-330</td>
<td>Genetics - Fall (prereq. 03-231, 03-240)</td>
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</tbody>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-441</td>
<td>Molecular Biology of Prokaryotes - Spring (prereq. 03-231 and 03-330)</td>
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<tr>
<td>03-442</td>
<td>Molecular Biology of Eukaryotes - Fall (prereq. 03-441)</td>
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<tr>
<td>03-343</td>
<td>Experimental Genetics and Molecular Biology - Fall (prereq. 03-330 or concurrently 03-321, 09-132)</td>
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<tr>
<td>03-344</td>
<td>Experimental Biochemistry - Spring (prereq. 03-121 and 03-343)</td>
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<tr>
<td>03-345</td>
<td>Experimental Cell and Developmental Biology - Spring (prereq. 03-232, 03-240, 03-343 and 03-330)</td>
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<tr>
<td>03-350</td>
<td>Developmental Biology - Spring (prereq. 03-231, 03-240 and 03-330)</td>
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<tr>
<td>03-380</td>
<td>Virology - Fall (prereq. 03-340; Co-req. 03-330)</td>
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<tr>
<td>03-438</td>
<td>Physical Biochemistry - Spring (prereq. 03-112 or 03-107, 03-231 and 09-144)</td>
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<tr>
<td>03-439</td>
<td>Introduction to Biophysics - Fall (prereq. MCS science core classes)</td>
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<tr>
<td>03-441</td>
<td>Molecular Biology of Prokaryotes - Spring (prereq. 03-231 and 03-330)</td>
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<tr>
<td>03-442</td>
<td>Molecular Biology of Eukaryotes - Fall (prereq. 03-441)</td>
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<tr>
<td>03-510</td>
<td>Computational Biology - Spring (prereq. 03-121, 15-200 or 15-211)</td>
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<tr>
<td>03-533</td>
<td>NMR in Biomedical Sciences - Fall (prereq. 03-231, 09-144)</td>
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<tr>
<td>03-534</td>
<td>Biological Imaging and Fluorescence Spectroscopy - Fall (prereq. 03-231, 03-240, 09-144, 09-218)</td>
<td></td>
</tr>
</tbody>
</table>

Electives

(up to two technical and/or policy related courses required from the following list): **

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-607</td>
<td>Physical Chemistry of Colloids and Surfaces - Spring</td>
<td></td>
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<tr>
<td>06-609/09-509</td>
<td>Physical Chemistry of Macromolecules - Fall (prereq. 09-245)</td>
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<tr>
<td>06-313</td>
<td>Experimental Colloid Science - Fall (prereq. 09-131 and 06-607)</td>
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<tr>
<td>06-314</td>
<td>Experimental Polymere Science - Spring (prereq. 09-131, and 09-609)</td>
<td></td>
</tr>
<tr>
<td>16-725</td>
<td>Methods in Medical Image Analysis - Spring (prereq. None. You must receive permission from instructor to register for this course.)</td>
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<tr>
<td>18-3XX</td>
<td>As circuits and signals are integral to many medical technologies, most ECE electives are allowed as long as a student can satisfy the prereq or obtain permission.</td>
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</tr>
<tr>
<td>19-607</td>
<td>Special Topics in Biotechnology</td>
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<tr>
<td>24-354</td>
<td>General Robotics - Fall (prereq. 21-122 or 21-118)</td>
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<tr>
<td>24-700</td>
<td>Heat Transfer in Biology &amp; Medicine (prereqs. 24-322 or equivalent; 24-231 or equivalent; 24-311 or equivalent)</td>
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<tr>
<td>24-779</td>
<td>Human Systems and Control - Spring</td>
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<tr>
<td>27-432</td>
<td>Electrical, Magnetic, and Operational Properties of Materials - Fall (prereq. 33-225 or equivalent introductory quantum mechanics course)</td>
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<tr>
<td>27-441</td>
<td>Deformation and Fracture of Materials - Fall (prereq. 33-106 and 27-210)</td>
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<tr>
<td>36-247</td>
<td>Statistics for Lab Sciences - Spring (prereq. 21-121 or 21-116)</td>
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<tr>
<td>39-319</td>
<td>Law and the Engineer - Spring (prereq. junior standing or permission from instructor)</td>
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<tr>
<td>79-312</td>
<td>Medical Anthropology, Fall</td>
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<tr>
<td>79-334</td>
<td>Health Policy: Historical Perspectives, Spring</td>
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<tr>
<td>79-385</td>
<td>History of Biomedical Research, Spring</td>
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<tr>
<td>80-245</td>
<td>Medical Ethics, Fall</td>
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<tr>
<td>85-429</td>
<td>Cognitive Brain Imaging (pre-req: 85-211 Cognitive Psychology) - Spring</td>
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<tr>
<td>85-442</td>
<td>Health Psychology, Fall</td>
<td></td>
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<tr>
<td>88-270</td>
<td>Networking: Organizations, Knowledge, and Technology, Spring</td>
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<tr>
<td>88-302</td>
<td>Behavioral Decision Making, Fall</td>
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<tr>
<td>88-340</td>
<td>Economics of Entrepreneurship in High Technology Industries, Spring</td>
<td></td>
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<tr>
<td>90-650</td>
<td>Introduction to Health Care Management - Fall (90-735 Health Economics - Spring (prereq. 90-710 or 91-803 or 73250.)</td>
<td></td>
</tr>
</tbody>
</table>

** The 79-XXX, 80-XXX, 85-XXX, 88-XXX or 90-XXX courses can additionally count towards the fulfillment of general education requirements as well as Biomedical Engineering electives. These courses rotate and are not offered every semester.

Design course (required)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>42-401</td>
<td>Biomedical Engineering Design - Spring (prereq. senior standing)</td>
<td></td>
</tr>
</tbody>
</table>
Undergraduate Course Requirements for the Minor

For CIT students

General Requirements: (five courses, 57 units)

42-101 Introduction to BME
03-121 Modern Biology or 03-231 Biochemistry
03-232 Biochemistry
03-301 Physiology
BME Domain or Elective

Students are encouraged to select an interdisciplinary capstone course or independent research project for one of the BME electives.

Like the requirements for the BME double Major, the requirements for the BME Minor satisfy various categories of electives in the curriculum and should not increase the total number of units/

For non-CIT students

General Requirements: (six courses, 60 units).

42-101 Introduction to BME
A second Introductory Engineering Course
42-301 Physiology
BME Domain or Elective
BME Domain or Elective
This course cannot be a required course in your home department
This course must be offered by one of the CIT Departments
(06-xxx, 12-xxx, 18-xxx, 19-xxx, 24-xxx, 27-xxx or 42-xxx)

Advising

Each traditional engineering department within CIT has several faculty associated with the BME Department; these faculty members will be assigned as advisors for CIT students pursuing the Double Major degree and Minor programs. By department, these faculty members include:

Chemical Engineering: Profs. Todd Przybycien, James Schneider, Michael Domach, Steiner Huaun, Robert Tilton

Civil & Environmental Engineering: Profs. Omar Ghattas and Jeanne VanBriesen

Electrical & Computer Engineering: Profs. Jelena Kovacevic, José Moura, Richard Stern and Yoky Mauoka


Mechanical Engineering: Profs. Cristina Amon, James Antaki, Phil LeDuc, Qiao Lin, and Kenji Shimada

Biological Sciences: Profs. Amy Burkert; Robert Murphy

Hilda Diamond, located in Doherty Hall 2100, will also help with aspects of advising and attention to details, including student course requirements, scheduling of BME courses and working with departments to avoid conflicts. Coordination of advising with the student's traditional engineering department is essential. Note that the traditional engineering advisor must approve final schedules. Prof. Przybycien and Mrs. Diamond will serve as advisors to BME Minor program students from the SCS, MCS and H&SS colleges.

If you are a double major in Biomedical Engineering:

1. Always select your Engineering Core Courses First!

Many times it becomes very difficult to make up these courses, as they will inevitably conflict with required courses expected to be taken in subsequent years. In a few majors, BME substitutions occur for a few core courses. If you are ahead of schedule, consult with your advisor about possible options.

2. Make sure you take the BME required (core) courses as soon as possible.

Again, the likelihood of a major conflict increases if you wait, as these courses are scheduled so as to minimize conflicts in the year and semester they are most likely to be taken.

3. 42-101 and 42-301

42-101 Introduction to Biomedical Engineering should be taken, ideally, in the freshman year. If this is not possible, the fall of sophomore year is the next best choice.

Try taking 42-301 Physiology by the fall of your sophomore year, as it is bound to conflict with some other important course if you put it off. Physiology is offered only in the Fall.

4. You can double count BME and H&SS electives as general education requirements; however, some of the H&SS courses are not offered every semester.

Suggested Tracks for Undergraduate Engineers

(focused domain courses):

Biotechnology Track
(for Chemical and Civil & Environmental Engineers)

Any of the 03-xxx Domain Courses
42-334 Computational Biology
42-501 Tissue Engineering
42-511 Biomaterials
42-604 Biological Transport
42-622 Bioprocess Design
42-723 Biotechnology and Environmental Problems
42-739 Biological Processes in Environmental Systems
42-560 U.G. Research Project

Biomechanics Track
(for Mechanical and Materials Science Engineers)

42-334 Computational Biology
42-377 Rehabilitation Engineering
42-502 Cellular Biomechanics
42-511 Biomaterials
42-511 Bioprocess Design
42-652 Introduction to Biomechanics
42-560 U.G. Research Project

Medical Imaging Track
(for Electrical & Computer Engineers)

42-334 Computational Biology
42-377 Rehabilitation Engineering
42-503 Advanced Biosignal Processing
42-644 Medical Devices
42-560 U.G. Research Project

The student must satisfy the minimum course requirements established by the departments to graduate. They are as follows:

Chemical Engineering: 385 units
Civil & Environmental Engineering: 364 units
Electrical & Computer Engineering: 360 units
Materials Science & Engineering: 382 units
Mechanical Engineering: 380 units

QPA for 42-101, BME core, domain, electives, and design courses: must be 2.00 or better to graduate.

CIT has the following requirement for graduation. A student must also achieve a cumulative quality point average of 2.00 in a series of core courses, up to a maximum of 184 units, specified by the department. When more than one possibility exists for meeting a specific requirement (e.g., Breadth), the courses will be chosen as to maximize the QPA. Similarly, when a course is retaken, the better grade will be used in the computation of the minimum QPA in the above courses.
### Sample Curriculum for Biomedical Engineering

#### Chemical Engineering

**First Year**

<table>
<thead>
<tr>
<th>Semeser</th>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td><strong>Fall</strong></td>
<td>21-120, Differential and Integral Calculus</td>
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<tr>
<td></td>
<td>76-xxx, Designated Writing Course</td>
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<tr>
<td></td>
<td>99-101, Computing Skills Workshop</td>
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<tr>
<td></td>
<td>06-100, Intro. to Chemical Engineering</td>
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<tr>
<td></td>
<td>09-105, Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td><strong>Spring</strong></td>
<td>21-122, Integration, Differential Equations, &amp; Approximation</td>
<td>10</td>
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<tr>
<td></td>
<td>*42-101 Intro to Biomedical Engineering</td>
<td>12</td>
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<tr>
<td></td>
<td>33-xxx, Physics for Engineering Students I</td>
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<tr>
<td></td>
<td>xx-xxx, General Education course</td>
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<tr>
<td><strong>Second Year</strong></td>
<td>06-222, Sophomore ChemE Seminar</td>
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<tr>
<td></td>
<td>21-259, Calculus in Three Dimensions</td>
<td>9</td>
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<tr>
<td></td>
<td>06-221, Thermodynamics</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>09-206, Physical Principles of Analytical Chem.</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>OR 09-106</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15-100, Introductory/Intermediate Programming</td>
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<tr>
<td></td>
<td>xx-xxx, General Education course</td>
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<tr>
<td><strong>Third Year</strong></td>
<td>06-321, Chemical Engineering Thermodynamics</td>
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<tr>
<td></td>
<td>06-322, Junior Chemical Engineering Seminar</td>
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<tr>
<td></td>
<td>06-323, Heat and Mass Transfer</td>
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<tr>
<td></td>
<td>09-217, Organic Chemistry I</td>
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<tr>
<td></td>
<td>09-347, Advanced Physical Chemistry</td>
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<tr>
<td></td>
<td>xx-xxx, General Education course</td>
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<tr>
<td><strong>Spring</strong></td>
<td>06-361, Unit Operations of ChemE</td>
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<tr>
<td></td>
<td>06-362, Chemical Engineering Process Control</td>
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<td></td>
<td>06-363, Transport Process Laboratory</td>
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<tr>
<td></td>
<td>03-232, Biochemistry</td>
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<tr>
<td></td>
<td>xx-xxx, Elective</td>
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<tr>
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<td>xx-xxx, General Education course</td>
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<tr>
<td><strong>Fourth Year</strong></td>
<td>06-421, Chemical Process System Design</td>
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<tr>
<td></td>
<td>06-422, Chemical Reaction Engineering</td>
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<td>06-423, Unit Operations Laboratory</td>
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<td>xx-xxx, General Education course</td>
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<td><strong>Spring</strong></td>
<td>06-461, Process Design Project</td>
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<td>06-462, Economics &amp; Optimization</td>
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<td>xx-xxx, Elective</td>
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<tr>
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<td>xx-xxx, Elective</td>
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<tr>
<td></td>
<td>xx-xxx, General Education course</td>
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</table>

**You do not have to overload any semester; however, this model makes for a challenging and loaded senior yr. - 79-xxx, 80-xxx, 85-xxx, and 90-xxx may count as General Education AND BME Electives. Minimum no. units to graduate: 385.**

Please note this is a suggested schedule. *Domain courses may count as Electives; Electives cannot count as Domain.*

#### Biomedical Engineering & Chemical Engineering

**First Year**

<table>
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<tr>
<th>Semeser</th>
<th>Course</th>
<th>Units</th>
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<td>76-xxx, Same</td>
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<td>06-100, Same</td>
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<td>09-105, Same</td>
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<td><strong>Spring</strong></td>
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<td>*42-101 Intro to Biomedical Engineering (core)</td>
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<td>xx-xxx, Same</td>
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<td><strong>Second Year</strong></td>
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<td></td>
<td>21-259, Same</td>
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<td>06-221, Same</td>
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<td>09-206, Same</td>
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<tr>
<td></td>
<td>OR 09-106</td>
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<td>*42-301 Physiology (core)</td>
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<td>*42-201 BME Seminar (once a week) (core)</td>
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<tr>
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<td>06-322, Same</td>
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<td>06-323, Same</td>
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<td>09-217, Same</td>
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<td>09-347, Advanced Physical Chemistry (Domain)</td>
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<td>90-650, Intro to Health Care Management (Elective)</td>
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<tr>
<td></td>
<td>*03-232 Biochemistry (core)</td>
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<td>42-504, Biological Transport (Domain)</td>
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<td><strong>Fourth Year</strong></td>
<td>06-421, Same</td>
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<td>06-422, Same</td>
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<td>42-511, Biomaterials (Domain)</td>
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<td>xx-xxx, BME Elective &amp; General Education</td>
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<tr>
<td><strong>Spring</strong></td>
<td>06-461, Same</td>
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<td>06-462, Same</td>
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<td>42-504, Biomaterial Interfaces</td>
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<td>xx-xxx, Same</td>
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<tr>
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<td>xx-xxx, Same</td>
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## Civil & Environmental Engineering Single Major

### First Year

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<tr>
<th>Fall</th>
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<tbody>
<tr>
<td>12-100 Intro to Civil and Environmental Eng.</td>
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<tr>
<td>21-120 Differential and Integral Calculus</td>
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<tr>
<td>33-106 Physics for Engineering Students I</td>
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<tr>
<td>99-103 Computer Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Elective</td>
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<table>
<thead>
<tr>
<th>Spring</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Introduction to Engineering</td>
<td>12</td>
</tr>
<tr>
<td>Integration, Differential Equations, &amp; Approximation</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Elective</td>
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### Second Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>12-271 Intro to Computer Apps in Civil &amp; Environmental Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-251 Intro to Environmental Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-252 Environmental Engineering Lab</td>
<td>3</td>
</tr>
<tr>
<td>09-101 Intro to Experimental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-105 Modern Chemistry I</td>
<td>10</td>
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<tbody>
<tr>
<td>Statistics</td>
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<tr>
<td>Differential Equations</td>
<td>9</td>
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<tr>
<td>Intro to Computer Science</td>
<td>10</td>
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<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
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<tr>
<td>xx-xxx Elective</td>
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### Third Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>12-301 Civil &amp; Environmental Eng. Projects</td>
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<tr>
<td>12-331 Solid Mechanics</td>
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<td>12-332 Solid Mechanics Lab</td>
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<td>27-357 Materials Selection</td>
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<tr>
<td>21-259 Calculus in 3-D</td>
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<thead>
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<tbody>
<tr>
<td>Fluid Mechanics</td>
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<td>Fluid Mechanics Lab</td>
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</tr>
<tr>
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### Fourth Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>12-401 Civil &amp; Environmental Eng. Design</td>
<td>12</td>
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<tr>
<td>12-411 Engineering Economics</td>
<td>9</td>
</tr>
<tr>
<td>36-211 Probability &amp; Statistics or</td>
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</tr>
<tr>
<td>36-220 Engineering Statistics &amp; Quality Control</td>
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<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
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<table>
<thead>
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</thead>
<tbody>
<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
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<tr>
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<tr>
<td>xx-xxx Elective</td>
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## Civil & Environmental Engineering with Double Major in Biomedical Engineering

### First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>12-100 Same</td>
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<tr>
<td>21-120 Same</td>
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</tr>
<tr>
<td>33-106 Same</td>
<td>12</td>
</tr>
<tr>
<td>99-103 Same</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx Same H&amp;SS Elective</td>
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<table>
<thead>
<tr>
<th>Spring</th>
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<tbody>
<tr>
<td>*42-101 Intro to Biomedical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>21-122 Integration, Differential Equations, &amp; Approximation</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx Same</td>
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<tr>
<td>*03-121 Modern Biology</td>
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### Second Year

<table>
<thead>
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<tbody>
<tr>
<td>12-271 Same</td>
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</tr>
<tr>
<td>12-251 Same</td>
<td>3</td>
</tr>
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<td>12-252 Same</td>
<td>9</td>
</tr>
<tr>
<td>09-101 Same</td>
<td>3</td>
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<tr>
<td>09-105 Same</td>
<td>10</td>
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<tr>
<td>*42-301 Physiology</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>12-235 Same</td>
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</tr>
<tr>
<td>21-260 Same</td>
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<tr>
<td>15-127 Same</td>
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<tr>
<td>xx-xxx BME Domain</td>
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### Third Year

<table>
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<tr>
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<td>12-301 Same</td>
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<td>12-331 Same</td>
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<td>12-332 Same</td>
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<tr>
<td>27-357 Same</td>
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</tr>
<tr>
<td>*90-650 Intro to Health Care Management</td>
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<tbody>
<tr>
<td>12-355 Same</td>
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<td>12-335 Same</td>
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### Fourth Year

<table>
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<td>12-401 Same</td>
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<td>12-411 Same</td>
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<td>36-211 Same</td>
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<td>36-220 Same</td>
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<td>42-377 Rehabilitation Engineering (Domain)</td>
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</thead>
<tbody>
<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
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<td>42-644 Medical Devices (Domain)</td>
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<tr>
<td>*42-401BHE Design</td>
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As a Freshman you should take 42-101 Intro to Biomedical Engineering, and 03-121 Modern Biology. 90-650 is a BME elective AND Gen.Ed. course. Domain courses may count as fulfilling Electives, but Electives cannot count as fulfilling Domain courses. Minimum number of units required for BS Degree: 364
### Electrical & Computer Engineering

#### Single Major

**First Year**

<table>
<thead>
<tr>
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**Second Year**

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Minimum no. of units to graduate: 360 (an average of 45 units per semester)

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### Electrical & Computer Engineering and BME Double Major

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**Third Year**

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**Fourth Year**

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Minimum no. of units to graduate: 360 (an average of 45 units per semester)
### Materials Science & Engineering Single Major

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### Materials Science & Engineering and BME - Double Major (*Core Courses)

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*As a Freshman you should take 42-101 Intro to Biomedical Engineering. Biomaterials can be taken in the Spring semester of your second year since you will have taken 27-215 and be concurrently taking 09-105. **Note that the course nos. 79-XXX, 80-XXX, 85-XXX, 88-XXX, or 90-XXX courses can additionally count towards fulfilling general education AND BME electives. Domain courses can count as fulfilling Electives; but Electives cannot count as fulfilling Domain courses. Minimum no. of units to graduate: 385
# Mechanical Engineering Single Major

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### Mechanical Eng. & Biomedical Engineering Double Major

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*As a double major you need to take 24-441 ME Design in Fall and 42-401 BME Design in Spring (Sr). 42-401 BME Design replaces 24-401 Engineering Analysis for the MechE-BME Double Majors. By the end of your sophomore year, you should have taken 42-101 Intro to Biomedical Eng. and 03-232 Biochemistry. 79-XXX, 80-XXX, 85-XXX, 88-XXX, and 90-XXX courses are Gen. Ed. and BME Electives. Minimum no. of units to graduate: 380.  Domain courses may count as Electives; Electives cannot fulfill Domain courses.
FACULTY

CRISTINA AMON, Professor of Mechanical Engineering and Biomedical Engineering; Director of Institute of Complex Engineered Systems, Sc.D. 1988, Massachusetts Institute of Technology, Carnegie Mellon 1988-.

JAMES ANTAKI, Associate Professor Biomedical Engineering, Computational Biomechanics and Medical Devices; Ph.D. 1991, University of Pittsburgh, Carnegie Mellon 2003-.

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JEFFREY HOLLINGER, Professor of Biological Sciences and Biomedical Engineering, Ph.D. University of Maryland; DDS Baltimore College of Dental Surgery, Carnegie Mellon 2000-.

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PRASHANT KUMTA, Professor of Materials Science and Engineering and Biomedical Engineering, Ph.D. 1990, University of Arizona, Carnegie Mellon 1990-.

PHILIP LEDUC, Assistant Professor Molecular and Cellular Biomechanics, Biological/Medical Micro- and /Nano-technology and Biomedical Engineering, PhD Johns Hopkins 1999; Johns Hopkins University Post Doc Childrens’ Hospital, Harvard University; Carnegie Mellon 19.

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YOKY MATSUOKA, Associate Professor of Mechanical Engineering, Biomedical Engineering, Medical Robotics and Assisted Living, Ph.D. 1998, Massachusetts Institute of Technology, Carnegie Mellon 2000-.


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HENRY PIEHLER, Professor of Materials Science Engineering and Biomedical Engineering, Sc.D. 1967, Massachusetts Institute of Technology, Carnegie Mellon 1967-.

TODD PRZYBYCiesen, Professor and Head of Biomedical Engineering and Professor of Chemical Engineering, Ph.D. 1989, California Institute of Technology, Carnegie Mellon 1998-.

JAMES SCHNEIDER, Associate Professor of Chemical Engineering and Biomedical Engineering, Ph.D. 1998, University of Minnesota, Carnegie Mellon 1998-.

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LEE WEISS, Principal Research Scientist at the Robotics Institute and Research Professor of Biomedical Engineering; PhD 1984 Carnegie Mellon University, Carnegie Mellon 1984-.

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ANTHONY DIGIOIOA, Orthopedic Surgery, Director of ICAOS, West Penn Hospital, CMU 2000-.

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GARTH ERHLC, Pediatric Otolaryngologist, Dept Surgery, Allegheny General Hospital; CMU 2001-.

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DAVID VORP, Assistant Professor of Surgery, Bioengineering and Mechanical Engineering, University of Pittsburgh; Carnegie Mellon 2000-.
Chemical engineering is a broad discipline based on chemistry, mathematics, physics and biology that applies the principles of engineering science and process systems engineering to the development and commercialization of new products and processes. Engineering science provides experimental and theoretical models for predicting the behavior of fluid flow and heat transfer in materials and biological systems, as well as chemical reactions and mass transfers that take place in multi-component mixtures. Process systems engineering provides methodologies for the systematic design and analysis of processes, including their control, safety, and environmental impact. The department emphasizes the basic principles of engineering science and process systems engineering through problem solving, and it strives to broaden the experience of students by offering a significant number of electives, undergraduate research projects, an integrated masters degree, industrial internships and study abroad programs, all of which benefit from our strong industrial ties.

A career in chemical engineering offers challenging and well-compensated positions in a wide variety of growth industries. Graduates may supervise the operation of chemical plants, redesign chemical processes for pollution prevention, or be involved in the research and development of new products or processes in high technology areas. These activities require knowledge of chemical reactions and catalysis, separation technologies and energy recovery systems, all of which are thoroughly presented in our curriculum. In the petroleum industry, for example, our national need for fuels demands well-trained chemical engineers in catalysis. A significant number of chemical engineers are also hired by industries associated with colloids (fine particles), polymers (plastics and resins), and coatings (e.g., paint, integrated circuits). Opportunities exist in biotechnology, the computer industry, environmental firms, and consulting companies. Other examples include the processing of advanced polymeric systems, thin films for the semiconductor and data storage industry, and chip fabrication. A growing number of consulting companies hire chemical engineers to develop computer software for the simulation and real-time optimization of chemical processes, for predicting how toxic chemicals are dispersed and degraded in soils and in the atmosphere, and for evaluating the economic feasibility of industrial projects. The diversity of career opportunities arises from the depth and breadth of the curriculum. For instance, the pharmaceutical industry recruits chemical engineers who possess a combined expertise in process engineering and biochemical/molecular biology.

The curriculum emphasizes the fundamentals of physical, chemical, and biological phenomena, mathematical modeling, exposure to biotechnology and problem solving techniques. These provide rigorous preparation for immediate employment after graduation, or a strong basis for graduate school. The depth and breadth of coursework makes chemical engineering an excellent major for students interested in either medical or business schools. Computing is integrated throughout the curriculum, and extensive use is made of mathematical modeling and simulation software in the department’s Computational Laboratory. The Robert Rothfus Laboratory and Lubrizol Analytical Laboratory feature state-of-the-art experiments that illustrate applications in safety, environmental, product development, and computerized data acquisition and control.

Students majoring in chemical engineering learn the science and engineering that govern chemical processing systems. Fundamental principles, problem solving, systems analysis and design, development of self-confidence, and communication skills are emphasized. Students are made aware of modern tools, industrial needs and societal issues. This combination of fundamental knowledge and skills provides a firm foundation for future learning and career growth. The goal of the department is to produce students who will become leaders in their careers. Students who complete the curriculum will have attained:

- the ability to design a component or system,
- the ability to identify, formulate and solve engineering problems,
- the ability to use modern engineering tools,
- the ability to function on teams,
- an understanding of personal and professional ethics,
- an ability to communicate effectively,
- an ability to understand impact of engineering in a global/societal context,
- an appreciation and capability for life-long learning,
- a knowledge of contemporary issues facing engineers.

The department offers a number of special programs for students majoring in Chemical Engineering. In addition to the double majors or minors offered by the College of Engineering such as Biomedical Engineering and Manufacturing Management & Consulting, students may choose a minor in Colloids, Polymers, and Surfaces. Undergraduate research projects are also available in the areas of bioengineering, complex fluids engineering, environmental engineering, process systems engineering, and solid state materials. Students may participate in study abroad programs during their junior year. In addition to the University program with EPFL in Switzerland and ITESM Monterey in Mexico, the department provides its own exchange programs with the University of Aachen in Germany and Imperial College in London, Great Britain. The latter two programs are jointly organized with industrial partners, i.e., Bayer Corporation, Air Products & Chemicals, and Procter & Gamble respectively. Students may also participate in Practical Internships for Senior Chemical Engineering Students, a one-year industrial internship program offered between the Junior and Senior years. Finally, qualified students may enroll in our Master of Chemical Engineering program. This degree is typically completed in the fifth year. However, depending on the number of advanced placement courses and course load at Carnegie Mellon, this degree could be awarded during the B.S. graduation, or after one additional semester.

### Curriculum

#### First Year

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#### Second Year

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<td>xx-xxx</td>
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The following two tracks have been designed as thematic guidelines. Students are not required to follow either of these tracks. They may take courses from both tracks and they may take courses that are not listed in either track. The Process Systems Track is designed for students interested in focusing on the design and optimization of chemical processes. The Chemical Engineering Sciences Track is designed for students interested in the scientific principles underlying the fabrication and processing of synthetic and/or biological materials.

Some electives contain elements of both tracks and are therefore listed under both tracks. Undergraduate research projects that fit either track are available by arrangement with a faculty advisor. Advanced undergraduates may also take Chemical Engineering graduate courses (600+ level).

### Process Systems Track

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<td>06-606</td>
<td>Computational Methods for Large Scale Process Design and Analysis</td>
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<td>06-608</td>
<td>Safety Issues in Science and Engineering Practice</td>
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<td>06-619</td>
<td>Semiconductor Processing Technology</td>
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<tr>
<td>06-630</td>
<td>Atmospheric Chemistry Air Pollution and Global Change</td>
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<tr>
<td>06-708</td>
<td>Advanced Process Dynamics and Control</td>
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<td>06-713</td>
<td>Mathematical Techniques in Chemical Engineering</td>
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<td>06-715</td>
<td>Advanced Process Synthesis</td>
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<tr>
<td>06-717</td>
<td>Biotechnology and Environmental Processes</td>
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<tr>
<td>06-720</td>
<td>Advanced Process Systems Engineering</td>
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<tr>
<td>06-721</td>
<td>Bioprocess Design</td>
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<td>12-271</td>
<td>Introduction to Computer Applications in Civil &amp; Environmental Engineering</td>
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<td>12-411</td>
<td>Engineering Economics</td>
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<td>12-651</td>
<td>Air Quality Engineering</td>
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<td>12-655</td>
<td>Water Quality Engineering</td>
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<tr>
<td>15-111</td>
<td>Intermediate/Advanced Programming</td>
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<td>15-200</td>
<td>Advanced Programming/Practicum</td>
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<tr>
<td>21-127</td>
<td>Introduction to Modern Mathematics</td>
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<tr>
<td>15-211</td>
<td>Fundamental Data Structures and Algorithms</td>
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<td>18-370</td>
<td>Fundamentals of Control</td>
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<td>19-424</td>
<td>Energy-Environment Systems</td>
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<tr>
<td>21-127</td>
<td>Concepts of Mathematics</td>
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<td>21-292</td>
<td>Operations Research I</td>
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<td>24-451</td>
<td>Feedback Control Design</td>
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<td>27-322</td>
<td>Processing of Metal</td>
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<td>36-220</td>
<td>Engineering Statistics and Quality Control</td>
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<tr>
<td>39-405</td>
<td>Engineering Design: The Creation of Products and Processes</td>
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<td>70-371</td>
<td>Production I</td>
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<td>70-391</td>
<td>Finance</td>
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### Chemical Engineering Sciences Track

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<tr>
<td>03-231</td>
<td>Biochemistry I</td>
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<tr>
<td>03-330</td>
<td>Genetics</td>
<td>12</td>
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<tr>
<td>03-380</td>
<td>Virology</td>
<td>12</td>
</tr>
<tr>
<td>03-438</td>
<td>Physical Biochemistry</td>
<td>12</td>
</tr>
<tr>
<td>03-441</td>
<td>Molecular Biology of Prokaryotes</td>
<td>12</td>
</tr>
<tr>
<td>03-442</td>
<td>Molecular Biology of Eukaryotes</td>
<td>12</td>
</tr>
<tr>
<td>06-220</td>
<td>300, or 400 Sophomore, Junior, or Senior Research Projects (or 39-500 CIT Honors Research)</td>
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<tr>
<td>06-426</td>
<td>Experimental Colloid and Surface Science</td>
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<tr>
<td>06-466</td>
<td>Experimental Polymer Science</td>
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<tr>
<td>06-607</td>
<td>Physical Chemistry of Colloids and Surfaces</td>
<td>12</td>
</tr>
<tr>
<td>06-608</td>
<td>Safety Issues in Science and Engineering Practice</td>
<td>12</td>
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<tr>
<td>06-609/09-509</td>
<td>Physical Chemistry of Macromolecules</td>
<td>12</td>
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<tr>
<td>06-610/09-545</td>
<td>Rheology and Structure of Complex Fluids</td>
<td>12</td>
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<tr>
<td>06-619</td>
<td>Semiconductor Processing Technology</td>
<td>12</td>
</tr>
<tr>
<td>06-620</td>
<td>Global Atmospheric Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>06-640</td>
<td>Principles and Applications of Molecular Simulation</td>
<td>12</td>
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<tr>
<td>06-702</td>
<td>Advanced Reaction Kinetics</td>
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<tr>
<td>06-703</td>
<td>Advanced Fluid Dynamics</td>
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<tr>
<td>06-704</td>
<td>Advanced Heat and Mass Transfer</td>
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<tr>
<td>06-705</td>
<td>Advanced Chemical Engineering Thermodynamics</td>
<td>12</td>
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<tr>
<td>06-712</td>
<td>Colloids and Dispersions</td>
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<tr>
<td>06-713</td>
<td>Mathematical Techniques in Chemical Engineering</td>
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<tr>
<td>06-714</td>
<td>Surfaces and Adsorption</td>
<td>12</td>
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<tr>
<td>06-716</td>
<td>Electrochemical Engineering</td>
<td>12</td>
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<tr>
<td>06-717</td>
<td>Biotechnology and Environmental Processes</td>
<td>12</td>
</tr>
<tr>
<td>06-721</td>
<td>Bio Process Design</td>
<td>12</td>
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<tr>
<td>09-348</td>
<td>Inorganic Chemistry</td>
<td>12</td>
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<tr>
<td>09-510</td>
<td>Introduction to Green Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>12-651</td>
<td>Air Quality Engineering</td>
<td>12</td>
</tr>
<tr>
<td>12-655</td>
<td>Water Quality Engineering</td>
<td>12</td>
</tr>
</tbody>
</table>
Double Major in Engineering and Public Policy (EPP)

Students may pursue a double major in Chemical Engineering and EPP. This double major is very flexible, built around Electives, Social Analysis, Probability and Statistics courses, and projects. Specific course choices should be discussed with a faculty advisor or an EPP faculty representative.

Double Major in Biomedical Engineering (BME)

Students may pursue a double major in Chemical Engineering and BME. The requirements are three core courses, three depth electives, one merged (design) course, and two technical or policy-related electives. Specific course choices should be discussed with a faculty advisor or a BME faculty representative.

Minors with a B.S. in Chemical Engineering

Chemical Engineering students are eligible for any CIT Designated Minor. Those minors that are especially well suited to Chemical Engineers include Biomedical Engineering, Electronic Materials, Engineering Design, Environmental Engineering, Data Storage Systems Technology, and Automation and Control Engineering. The minor requirements may be fulfilled with electives. Other minors, such as the Manufacturing Management and Consulting minor in association with the Tepper School of Business, are also available outside of CIT. These should be discussed with a faculty advisor.

Minor in Colloids, Polymers, and Surfaces (CPS)

Historically, the CPS coursework sequence has had a long-standing popularity among chemical engineering students. A detailed description of the minor can be found in the CIT Minor section of this catalog, or ask your Chemical Engineering faculty advisor or the Director of CPS. Chemical Engineering students may use four of their electives to obtain the CPS minor. This is a sequence of closely related courses that explore the science and engineering of polymeric materials, particulates, microstructured fluids, and interfacially engineered materials. Completion of the following five courses constitutes the CPS minor:

- 06-221 Thermodynamics 9
- 06-607 Physical Chemistry of Colloids and Surfaces 9
- 06-426 Experimental Colloid and Surface Science 9
- 06-466 Experimental Polymer Science 9
- 06-609 Physical Chemistry of Macromolecules 9 (cross-listed as 09-509)

Typically 06-607 is taken in the Spring of the Junior year, while 06-609/09-509, 06-426 and 06-466 are taken during the Senior year.

International Chemical Engineering Exchange Programs

Chemical Engineering students may apply during their Sophomore year to spend their Junior year at the University of Aachen in Germany or at Imperial College in London, Great Britain. Students should register for 06-050 - Study Abroad, Fall and/or 06-051 - Study Abroad, Spring. These exchange programs provide a great opportunity for students to obtain international experience while taking courses very similar to those offered at Carnegie Mellon. Students considering either program should consult with their faculty advisors, and students considering the Aachen program in particular are advised to take at least one introductory German course before or during their sophomore year.

Practical Internships for Senior Chemical Engineering Students (PISCES)

Chemical Engineering students may apply in the fall of their Junior year for a salaried, one-year PISCES with a partner company. Admitted students begin their internships after completion of the Junior year. Following the internship, students return to complete their Senior year. There are several advantages of a one full-year internship, including the opportunity to gain a breadth of professional experience that is not generally possible in a shorter program, more opportunity to make significant contributions to the partner company, and the opportunity to complete Senior year courses in their normal sequence with no need for curriculum rearrangements. Interested students should consult with their faculty advisors.

Fifth Year Master of Chemical Engineering (MChE)

This degree offers qualified undergraduate students the opportunity to obtain a Masters degree in Chemical Engineering in less than one academic year. The goal of the program is to produce skilled engineers who will have a deeper understanding of the fundamentals of chemical engineering as well as a broader set of professional skills and exposure to other technical disciplines. The MChE degree requires the completion of at least 96 units, with a cumulative GPA of 3.0. Junior and Senior undergraduates from the department may apply to the MChE program if they have an overall GPA of 3.0. Three letters of recommendation are also required. The deadline for application is February 1 for the Fall semester and October 15 for the Spring semester. All applications should be submitted to the Graduate Admissions Committee of Chemical Engineering.

Faculty

JOHN L. ANDERSON, Adjunct Professor of Chemical Engineering—Ph.D., University of Illinois; Carnegie Mellon, 1976—.

LORENZ T. BIEGLER, Bayer Professor of Chemical Engineering—Ph.D., University of Wisconsin; Carnegie Mellon, 1981—.

MICHAEL M. DOMACH, Professor of Chemical Engineering—Ph.D., Cornell University; Carnegie Mellon, 1983—.

NEIL M. DONAHUE, Assistant Professor of Chemical Engineering and Chemistry—Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2000—.

ANDREW J. GELLMAN, Lord Professor of Chemical Engineering, Head of Department—Ph.D., University of California, Berkeley; Carnegie Mellon, 1992—.

IGNACIO E. GROSSMANN, University Dean Professor of Chemical Engineering—Ph.D., Imperial College, University of London; Carnegie Mellon, 1979—.

STEINAR HAUAN, Associate Professor of Chemical Engineering—Ph.D., Norwegian Institute of Science and Technology; Carnegie Mellon, 1999—.

ANNETTE M. JACOBSON, Principal Lecturer in Chemical Engineering—Ph.D., Carnegie Mellon, 2000—.

BYUNG J. JHON, Professor of Chemical Engineering—Ph.D., University of Chicago; Carnegie Mellon, 1980—.

EDMOND I. KO, Adjunct Professor of Chemical Engineering—Ph.D., Stanford University; Carnegie Mellon, 1980—.


SPYROS N. PANDIS, Elia Professor of Chemical Engineering and Engineering and Public Policy—Ph.D., California Institute of Technology; Carnegie Mellon, 1993—.

GARY J. POWERS, Professor of Chemical Engineering—Ph.D., University of Wisconsin; Carnegie Mellon, 1974—.

DENNIS C. PRIEVE, Gulf Professor of Chemical Engineering—Ph.D., University of Delaware; Carnegie Mellon, 1974—.

TODD M. PRZYBYCIEIN, Professor of Chemical Engineering and Head of Biomedical Engineering—Ph.D., California Institute of Technology;
JAMES W. SCHNEIDER, Associate Professor of Chemical Engineering — Ph.D., University of Minnesota; Carnegie Mellon, 1999—.

DAVID SHOLL, Associate Professor of Chemical Engineering — Ph.D., University of Colorado; Carnegie Mellon, 1998—.

PAUL J. SIDES, Professor of Chemical Engineering — Ph.D., University of California, Berkeley; Carnegie Mellon, 1981—.

ROBERT D. TILTON, Professor of Chemical Engineering — Ph.D., Stanford University; Carnegie Mellon, 1992—.

HERBERT L. TOOR, Emeritus Professor of Chemical Engineering — Ph.D., Northwestern University; Carnegie Mellon, 1953—.

LYNN M. WALKER, Associate Professor of Chemical Engineering — Ph.D., University of Delaware; Carnegie Mellon, 1997—

ARTHUR W. WESTERBERG, Emeritus, University Swearingen Professor of Chemical Engineering — Ph.D., DIC, Imperial College, University of London; Carnegie Mellon, 1976—.

LEE R. WHITE, Professor of Chemical Engineering — Ph.D., Australian National University; Carnegie Mellon, 1998—.

B. ERIK YDSTIE, Professor of Chemical Engineering — Ph.D., Imperial College, University of London; Carnegie Mellon, 1992—.
The role of civil and environmental engineers, in the broadest sense, is to apply technology to meet society’s needs. Civil engineers plan, design, and manage facilities used daily by the public and industry, such as buildings, airports, water supply and waste management systems. They work at the intersection of the built, natural and virtual environments. Today’s civil and environmental engineers are also called upon by government and industry to provide leadership on complex technical and societal issues such as demands for infrastructure improvement in our cities, remediation of hazardous waste sites, provision of safe drinking water, and incorporation of environmental safeguards in new designs. Civil and Environmental Engineering requires broad technical training and strong communicative skills because of the objects and the attendant interactions with engineers in other fields, lawyers, politicians, and the public. Carnegie Mellon’s curriculum is intended to provide this versatility for professional practice in civil and environmental engineering or as a foundation for other professional pursuits.

The Department of Civil and Environmental Engineering offers a wide spectrum of opportunities for direct entry into the engineering profession, for graduate education in engineering, or entry into various other professions. While maintaining its emphasis on the fundamental understanding of the behavior of constructed facilities through the application of the physical sciences and mathematics, the curriculum has continually evolved in directions that exploit advances in technology. The methods of engineering design are introduced in the freshman year and are emphasized throughout the curriculum in both traditional and open-ended project-oriented courses. The basic undergraduate degree program leads to a B.S. in Civil Engineering. Students with a specific interest in Environmental Engineering are advised to undertake the Minor in Environmental Engineering.

Central to the evolution of technology and its impact on engineering practice is the increased emphasis on computer-aided engineering. Several courses on computer methods are required in the curriculum, and virtually every course offered by the department requires the use of computers in applications of either design or analysis. Our curriculum emphasizes the development of scientific inquiry with the perspective of social, economic and institutional developments. For graduates who wish to enter directly the engineering profession in such specialties as structural engineering, construction, or environmental engineering, this approach to teaching allows application of the most advanced technological developments. Others who wish to pursue graduate study are prepared to engage in research on the highest level, either in traditional specialties or in emerging fields such as green design. Historically, some graduates also have found their undergraduate preparation highly suited for entry into graduate schools of business, law and medicine.

A student may choose to concentrate in one of the specialty areas in Civil Engineering, to pursue a minor in one of the CIT designated areas or to design a double major or double degree program. The specialty areas offered by the Civil and Environmental Engineering Department are described in this section. The CIT designated minor programs can be found under the Carnegie Institute of Technology section. The double-major requirements with Biomedical Engineering and with Engineering and Public Policy are described in the curriculum specified by those departments. Other double-major programs selected by recent graduates include economics, mathematics, business, architecture, history, and foreign languages. Each student should have well defined objectives in selecting courses leading to a specialty, a minor or a double major.

Educational Objectives

The objectives of the Bachelor of Science in Civil Engineering curriculum are to develop:

- Graduates who can work independently or as a productive member of a team
- Graduates who can communicate with other professionals and with society at large both in writing and in speech
- Graduates who aspire to leadership and who are prepared for a breadth of career challenges and for life long learning

The Civil Engineering curriculum is intended to allow ample opportunity for students to pursue areas of personal interest. The opportunity for self-exploration requires careful advising to gain meaningful educational experiences. We believe that design and team working experiences should occur at regular intervals in the curriculum, and that graduates should have appropriate “hands on” experience in laboratories and projects. Students are encouraged to participate in research projects and to pursue study or work abroad.

By the end of the B.S. program, students should have a variety of abilities and skills:

A. An ability to apply knowledge of mathematics (specifically, differential equations and probability and statistics) science (specifically, calculus-based physics and general chemistry) and engineering to practice and problem solving
B. An ability to design and conduct experiments as well as to analyze critically and interpret data in solid mechanics, fluid mechanics and soil mechanics
C. An ability to perform civil and environmental engineering design, and interdisciplinary design, gained through design experiences integrated throughout the curriculum
D. An ability to function on multi-disciplinary teams
E. An ability to identify, formulate and solve civil engineering problems
F. An understanding of professional and ethical responsibility
G. An ability to communicate effectively in writing and in speech
H. An understanding of the impact of engineering solutions in a global and social context
I. Recognition of the need for and an ability to engage in lifelong learning
J. Knowledge of contemporary issues relevant to engineering practice
K. An ability to use the techniques, skills and modern engineering tools necessary for civil engineering practice
L. An understanding of professional practice issues, such as: how design and construction professionals interact on a project
M. Proficiency in a minimum of four recognized major civil engineering areas

The curriculum has been designed, and is periodically evaluated and refined, to provide students instruction and experiences that lead to the development of these abilities and skills.

Curriculum

All students admitted to CIT are not required to declare a major until the end of the freshman year, and may have selected a variety of Introductory Engineering Electives and associated Restricted Technical Electives within the common foundation specified for freshmen in CIT. Regardless of this selection in the freshman year, a civil engineering major is expected to have completed, in addition to 12-100 Introduction to Civil and Environmental Engineering, the following Restricted Technical Electives by the end of the sophomore year:
09-105  Modern Chemistry I  10
09-101  Intro to Experimental Chemistry  3
15-100  Introductory/Intermediate Programming  10
21-120  Differential and Integral Calculus  10
21-122  Integration, Differential Equations & Approximations  10
33-xxx  Physics I for Engineering Students  12
33-xxx  Physics II for Engineering Students  12

Appearing below is the recommended four-year program of study for the BS in civil engineering. Advising and formulation of appropriate programs is available through the department for transfer students, students with advanced placement, or students wishing to study overseas.

### Freshman Year Fall Units

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-100</td>
<td>Introduction to Civil and Environmental Engineering</td>
<td>12</td>
</tr>
<tr>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>33-106</td>
<td>Physics for Engineering Students</td>
<td>12</td>
</tr>
<tr>
<td>99-103</td>
<td>Computer Skill Workshop</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

### Sophomore Year

#### Fall

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-251</td>
<td>Introduction to Environmental Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-252</td>
<td>Environmental Lab</td>
<td>3</td>
</tr>
<tr>
<td>12-271</td>
<td>Intro Computer Appls in Civil &amp; Environmental Engineering</td>
<td>9</td>
</tr>
<tr>
<td>09-101</td>
<td>Intro to Experimental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-105</td>
<td>Modern Chemistry I</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

### Spring

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-235</td>
<td>Statics</td>
<td>9</td>
</tr>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
<td>9</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Elective I</td>
<td>9</td>
</tr>
</tbody>
</table>

*Note: If a student takes an Introduction to Engineering course which has a co-requisite other than Physics II, the co-requisite (either 15-100 or 09-105 and 09-101) should be taken in the freshman year while Physics II will fill the respective slot in the sophomore year. Since CIT freshmen are not required to select a major, the above curriculum is based on the assumption that a potential CEE student is likely to select 12-100 as one of the two Introduction to Engineering courses in the freshman year. Otherwise, incoming sophomores should take 12-100 in the fall in lieu of Modern Chemistry or the H&SS elective.

### Junior Year

#### Fall

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-301</td>
<td>Civil and Environmental Engineering Projects</td>
<td>12</td>
</tr>
<tr>
<td>12-331</td>
<td>Solid Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>12-332</td>
<td>Solid Mechanics Lab</td>
<td>3</td>
</tr>
<tr>
<td>27-357</td>
<td>Materials Selection</td>
<td>6</td>
</tr>
<tr>
<td>12-358</td>
<td>Materials Lab</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
<td>9</td>
</tr>
</tbody>
</table>

### Spring

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-355</td>
<td>Fluid Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>12-356</td>
<td>Fluid Mechanics Lab</td>
<td>3</td>
</tr>
<tr>
<td>12-335</td>
<td>Soil Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>12-336</td>
<td>Soil Mechanics and Materials Lab</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Elective 2</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Elective 3</td>
<td>9</td>
</tr>
</tbody>
</table>

### Senior Year

#### Fall

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-401</td>
<td>Civil and Environmental Engineering Design</td>
<td>15</td>
</tr>
<tr>
<td>12-411</td>
<td>Engineering Economics</td>
<td>6</td>
</tr>
<tr>
<td>36-220</td>
<td>Prob &amp; Stat or Engr Stat and Qual Control</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Elective 4</td>
<td>9</td>
</tr>
</tbody>
</table>

### Minimum number of units required for degree: 373

#### Notes on Electives

1. One elective must be in the basic sciences, either:
   - 03-121  Modern Biology
   - 09-106  Modern Chemistry II or
   - 33-104  Experimental Physics

   Substitutions may be made only with the approval of the Department Head.

2. One elective course is restricted to any Civil Engineering course numbered 300 or above. The Civil Engineering elective is a co-requisite for 12-401.

### Specialty Areas in Civil Engineering

Students are encouraged to select a set of civil engineering and technical electives in the junior and senior years that enable them to concentrate in a specialty area if they so desire. Some available options for grouping electives into specialty areas, together with representative course selections, are indicated below.

#### Civil Infrastructure Systems and Computer-Aided Engineering

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-600</td>
<td>AutoCAD</td>
<td>9</td>
</tr>
<tr>
<td>12-605</td>
<td>Design and Construction</td>
<td>9</td>
</tr>
<tr>
<td>12-611</td>
<td>Project Management for Construction</td>
<td>9</td>
</tr>
<tr>
<td>12-631</td>
<td>Structural Design</td>
<td>9</td>
</tr>
<tr>
<td>12-636</td>
<td>Geotechnical Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-657</td>
<td>Water Resources Engineering</td>
<td>9</td>
</tr>
<tr>
<td>15-211</td>
<td>Fundamental Data Structures and Algorithms I</td>
<td>9</td>
</tr>
<tr>
<td>18-100</td>
<td>Introduction to Electrical and Computer Engineering</td>
<td>9</td>
</tr>
<tr>
<td>21-228</td>
<td>Discrete Mathematics</td>
<td>9</td>
</tr>
<tr>
<td>21-241</td>
<td>Matrix Algebra</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Environmental Engineering

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-611</td>
<td>Project Management for Construction</td>
<td>9</td>
</tr>
<tr>
<td>12-657</td>
<td>Water Resources Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-655</td>
<td>Water Quality Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-656</td>
<td>Water Quality Engineering Laboratory</td>
<td>9</td>
</tr>
<tr>
<td>12-651</td>
<td>Air Quality Engineering</td>
<td>9</td>
</tr>
<tr>
<td>06-151</td>
<td>Thermodynamics</td>
<td>9</td>
</tr>
<tr>
<td>06-152</td>
<td>Principles of Transport Processes I</td>
<td>9</td>
</tr>
<tr>
<td>06-630</td>
<td>Atmospheric Chemistry, Air Pollution and Global Change</td>
<td>9</td>
</tr>
<tr>
<td>09-510</td>
<td>Introduction to Green Chemistry</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Structures, Mechanics and Geotechnical Engineering

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-600</td>
<td>Auto CAD</td>
<td>10</td>
</tr>
<tr>
<td>12-605</td>
<td>Design and Construction</td>
<td>10</td>
</tr>
<tr>
<td>12-611</td>
<td>Project Management for Construction</td>
<td>10</td>
</tr>
<tr>
<td>12-635</td>
<td>Structural Analysis</td>
<td>12</td>
</tr>
<tr>
<td>12-631</td>
<td>Structural Design</td>
<td>12</td>
</tr>
<tr>
<td>12-636</td>
<td>Geotechnical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>21-228</td>
<td>Discrete Mathematics</td>
<td>12</td>
</tr>
<tr>
<td>21-241</td>
<td>Matrix Algebra</td>
<td>12</td>
</tr>
<tr>
<td>24-262</td>
<td>Stress Analysis</td>
<td>12</td>
</tr>
<tr>
<td>24-356</td>
<td>Engineering Vibrations</td>
<td>12</td>
</tr>
<tr>
<td>24-401</td>
<td>Engineering Analysis</td>
<td>12</td>
</tr>
</tbody>
</table>
Double Majors and Minors

Civil engineering students may pursue double majors and minors in a variety of subjects, taking advantage of the free elective courses for other requirements. The college of engineering has added designated minors to promote flexibility and diversity among engineering students. Many CEE undergraduates pursue designated minors in such areas as Engineering Design or Environmental Engineering.

Co-Operative Education Program

Students in civil engineering are encouraged to undertake professional internships during summer breaks. In addition, a formal cooperative internship program is available for either Jan-Aug or May-Dec in the junior year. Students undertaking these 8-month professional internships would ordinarily graduate after an additional semester of study. Program details are available from the Career Center or the Civil and Environmental Engineering office.

Integrated B.S./M.S. Program

Interested undergraduates may plan a course of study that leads to both the BS in Civil Engineering and the MS in Civil and Environmental Engineering. This course of study will ordinarily require ten semesters of study, although advanced placement or other study may reduce this time. Students can apply appropriate units earned as undergraduates for their MS program as long as they are beyond the 364 units required for the BS in Civil Engineering degree. In the tenth semester of study, students should register in graduate status. Interested students should consult their academic advisor or the CEE department office for information about admission to the MS program.

Faculty

AMIT ACHARYA, Assistant Professor of Civil and Environmental Engineering — Ph.D., University of Illinois at Urbana — Champaign; Carnegie Mellon, 2000—.
PETER ADAMS, Assistant Professor of Civil and Environmental Engineering — Ph.D., California Institute of Technology; Carnegie Mellon, 2001—.
BURCU AKINCI, Assistant Professor of Civil and Environmental Engineering — Ph.D., Stanford University; Carnegie Mellon, 2000—.
JACOBO BIELAK, Professor of Civil and Environmental Engineering — Ph.D., California Institute of Technology; Carnegie Mellon, 1978—.
LAWRENCE G. CARTWRIGHT, Teaching Professor of Civil and Environmental Engineering and Director of the Civil Engineering Laboratories — M.S., Carnegie Mellon University; Carnegie Mellon, 1977—.
JARED L. COHON, President and Professor of Civil and Environmental Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1997—.
CLIFF I. DAVIDSON, Professor of Civil and Environmental Engineering and Director, Environmental Institute — Ph.D., California Institute of Technology; Carnegie Mellon, 1977—.
DAVID A. DZOMBAK, Professor of Civil and Environmental Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1989—.
SUSAN FINGER, Associate Professor of Civil and Environmental Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1989—.
JAMES H. GARRETT, JR., Professor and Associate Dean of CIT, Civil and Environmental Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1990—.
OMAR N. GHATTAS, Associate Professor of Civil and Environmental Engineering — Ph.D., Duke University; Carnegie Mellon, 1989—.
CHRIS T. HENDRICKSON, Duquesne Light Company Professor and Head of Civil and Environmental Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1978—.
GREGORY LOWRY, Assistant Professor of Civil and Environmental Engineering — Ph.D., Stanford University; Carnegie Mellon, 2001—.
IRVING J. OPPENHEIM, Professor of Civil and Environmental Engineering and Architecture — Ph.D., Cambridge University; Carnegie Mellon, 1972—.

DANIEL R. REHAK, Professor of Civil and Environmental Engineering — Ph.D., University of Illinois; Carnegie Mellon, 1981—.
MITCHELL J. SMALL, Professor of Civil and Environmental Engineering and Engineering and Public Policy — Ph.D., University of Michigan; Carnegie Mellon, 1982—.
HOON SOHN, Assistant Professor of Civil and Environmental Engineering — Ph.D., Stanford University; Carnegie Mellon, 2004—.
LUCIO SOIBELMAN, Assistant Professor of Civil and Environmental Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2004—.
JEANNE VANBRIESEN, Assistant Professor of Civil and Environmental Engineering — Ph.D., Northwestern University; Carnegie Mellon, 1999—.
Department of Electrical and Computer Engineering

Pradeep K. Khosla, Head
Bruce H. Krogh, Associate Head
http://www.ece.cmu.edu/

The field of electrical and computer engineering encompasses a remarkably diverse and fertile set of technological areas, including analog and digital electronics, computer architecture, computer-aided design and manufacturing of VLSI/ULSI circuits, intelligent robotic systems, computer-based control systems, telecommunications and computer networking, computer-aided design and manufacturing of microelectromechanical systems (MEMS), electromagnetic and electromechanical systems, data storage systems, embedded systems, distributed computing, mobile computing, real-time software, digital signal processing, and optical data processing. The extraordinary advances in the field during the last fifty years have impacted nearly every aspect of human activity. These advances have resulted not only in advanced computer systems but also in consumer products such as “smart” cars, programmable dishwashers and other home appliances, cell phones and mobile computing systems, video games, home security systems, advanced medical systems for imaging, diagnosis, testing and monitoring. Systems and products such as these serve to enhance our quality of life and have also served as the basis for significant economic activity. In short, the field of electrical and computer engineering has become central to society as we know it.

The Department of Electrical and Computer Engineering at Carnegie Mellon is actively engaged in education and research at the forefront of these new technologies. Because of the diverse and broad nature of the field and the significant growth in knowledge in each of its sub areas, it is no longer possible for any single individual to know all aspects of electrical and computer engineering. Nevertheless, it is important that all electrical and computer engineers have a solid knowledge of the fundamentals with sufficient depth and breadth. Society is placing increasing demands on our graduates to try their skills in new contexts. It is also placing increasing value on engineers who can cross traditional boundaries between disciplines, and who can intelligently evaluate the broader consequences of their actions. Our curriculum is designed to produce world-class engineers who can meet these challenges.

Educational Objectives

The B.S. in Electrical and Computer Engineering is a broad and highly flexible ABET-accredited degree program structured to provide students with the smallest set of constraints consistent with a rich and comprehensive view of the profession. Students are encouraged and stimulated to explore multiple areas of theory and application. The Faculty of Electrical and Computer Engineering have established the following objectives for the B. S. in Electrical and Computer Engineering curriculum:

Fundamentals: To teach our students the fundamentals of science, mathematics, computer science, engineering, and statistics and to develop in our students the ability to formulate and analyze problems and synthesize well designed solutions based on this knowledge and their intuition.

Depth and Breadth: To provide our students with breadth and depth in disparate areas of electrical and computer engineering and the ability to apply knowledge from these areas to problem solving and system building.

Flexibility: To provide an environment that allows each student the opportunity to maximize his or her potential by providing the flexibility to pursue individual interests and academic strengths and to thereby encourage flexibility in thinking about his or her career.

Teamwork: To ensure that our students are able to work successfully in multidisciplinary teams with individuals whose expertise may span electrical and computer engineering, other engineering disciplines, and disciplines beyond engineering (such as social sciences and public policy).

Strategic Thinking: To develop in our students the ability to think in a sophisticated manner about technology and their careers and to encourage our students to always evaluate themselves and be engaged in lifelong learning.

System Builders: To develop an appreciation of the techno-socio-political environment in which engineering is practiced and to define problems and formulate solutions from a systems perspective.

Leadership: To create societal leaders and to help our students become individuals who will evaluate how and why electrical and computer engineering is practiced and to pursue careers that will help improve the profession and society.

The Department strongly believes in coupling the theoretical concepts introduced in the classroom with hands-on experience in laboratories or through projects. Design experiences emphasize contemporary problems and provide a background for developing logic and computer design skills at the professional level. Faculty in the department are involved in research that is both cutting edge and multidisciplinary, and undergraduate students with all levels of expertise (ranging from freshman to senior) are encouraged to be involved in research projects. Undergraduate research projects provide the students with the opportunity to earn academic credit while participating in the research programs of individual faculty members.

Curriculum Overview

Minimum number of units required for degree: 360 (An average of 45 units per semester)

In addition to the Carnegie Institute of Technology general education and freshman year requirements (131 units), the B.S. in Electrical and Computer Engineering requires Physics II (12 units), two math or science electives (18 units), a Probability and Statistics course (9 units), an Engineering Elective (12 units), 109 units of Electrical and Computer Engineering coursework, and 2 math co-requisites (21 units). The remaining units needed to reach the 360 required to graduate are Free Electives.

The Electrical and Computer Engineering coursework is divided into the categories of Core, Breadth, Depth, Coverage, and Capstone Design. The Core consists of 3 Electrical and Computer Engineering courses (18-100 Introduction to Electrical and Computer Engineering, 18-220 Fundamentals of Electrical Engineering, and 18-240 Fundamentals of Computer Engineering), and two math co-requisites. These courses provide the fundamental knowledge-base upon which all other electrical and computer engineering courses are built. 18-100 is generally taken during the freshman year, while the remaining courses in the Core are taken during the sophomore year. The two Fundamentals courses are split between the fall and the spring semesters (the department strongly recommends that students not take the two Fundamentals courses in the same semester). Although the Fundamentals courses (and their co-requisites) may be taken in either order, students generally first take the course in their primary area of interest. This gives added flexibility to later course selection in related areas.

Students are also required to complete a seminar course during the fall semester of the sophomore year. This course, 18-200 Emerging Trends in ECE, introduces students to the many areas within ECE and helps them decide which areas are of primary interest to them.

The courses in the ECE curriculum are grouped into five principal subject areas: Applied Physics, Signals and Systems, Circuits, Computer Hardware, and Computer Software. To satisfy the ECE Breadth requirement, at least one Breadth course must be completed from three of the five principal areas (36 units).

For the Depth requirement, at least one course (12 units) must be completed that has one of the courses used to satisfy the Breadth
requirement as a prerequisite. In other words, the student must go "two-deep" in at least one of the five principal subject areas.

The Coverage requirement is satisfied by taking at least two additional ECE curriculum courses (24 units). Students may use this requirement to further specialize in the area of their Depth course, or they may take Coverage courses to explore some of the other areas within the ECE curriculum.

The Capstone Design requirement provides students with the opportunity for some hands-on experience. Each student must complete at least one of the approved Capstone Design courses. In many cases, this course may also be used to satisfy either the Depth or Coverage requirements. The Capstone Design courses are intended to enhance the student's repertoire of professional problem-solving and engineering design skills in the context of realistic engineering situations.

In the Capstone Design courses, students work in teams to formulate the problem, propose an engineering solution or a design in the presence of technical and socioeconomic constraints, and make sound professional judgments among alternative solutions.

One additional engineering course (12 units) is required. Any technical course in CIT or any 200-level or higher course in CS (with the exception of 15-251 and 15-351) will satisfy this requirement. The capstone design course can be used to satisfy this requirement if it has not been used as a depth or coverage course.

Two additional Math/Science Electives (18 units) are required. This requirement can be satisfied with any course from the Mellon College of Science or the Department of Statistics except for: 100-level courses in Mathematics or Statistics, and courses designed for non-science or engineering majors such as 09-103, 09-104, 21-257, 23-124, 36-201, 36-202, 36-207 and 36-208. These courses may be taken at any time. Mathematics courses of particular interest to students in ECE are 21-228, Discrete Mathematics, 21-259, Calculus in Three Dimensions, and 21-260, Differential Equations.

One Probability and Statistics course is required (9 units). For students taking two probability and statistics courses, the first course will satisfy the probability and statistics requirement and the second course may be used to fulfill a Math/Science Elective requirement.

B.S. Curriculum

Minimum number of units required for degree: 360 (An average of 45 units per semester)

For detailed information and regulations of the curriculum along with the degree requirements and the most recent version of the ECE curriculum primer, please refer to the ECE World Wide Web Home Page: http://www.ece.cmu.edu/

University Requirement


CIT Requirements (see CIT section of the catalog for specifics):

CIT General Education 72 units

2 semesters of calculus 20 units

33-106 Physics for Engineering Students I 12 units

1 other introductory engineering course, generally taken during the freshman year 12 units

Specific ECE requirements:

1 Introduction to Electrical and Computer Engineering course, to be taken during the freshman year 12 units

18-100 Introduction to Electrical and Computer Engineering 12 units

1 ECE Seminar, taken during fall of the sophomore year 1 unit

18-200 Emerging Trends in ECE 1

2 ECE core courses, each with their own math co-requisites 45 units

18-220 Fundamentals of Electrical Engineering 12

18-202 Mathematical Foundations of Electrical Engineering (co-requisite to 18-220) 12

18-240 Fundamentals of Computer Engineering 12

21-127 Introduction to Modern Math (co-requisite to 18-240) 9

3 Breadth Courses 36 units (introductory-level courses, must be taken from 3 of the 5 different areas within ECE)

1 Depth Course 12 units (must have one of the Breadth courses as a prerequisite)

2 Coverage Courses 24 units (may be from any of the five areas or additional courses as indicated on the ECE Website)

1 Capstone Design Course from the following list must be taken (may be double-counted with one other requirement – Depth, Coverage, or the Engineering Elective)

1 Engineering Elective 12 units (any technical course from anywhere within CIT, or a 200-level or higher CS course except for 15-251 and 15-351)

Other ECE Requirements:

15-100/111, Introductory/Intermediate Programming, to be taken during the Freshman year 10 units

33-107, Physics for Engineering students II 12 units

2 Math/Science electives minimum of 18 units*

1 Probability and Statistics course (either 36-217, Probability Theory and Random Processes or 36-220, Engineering Statistics and Quality Control or 36-225, Introduction to Probability and Statistics I) 9 units**

Free Electives

Any graded course taken from one of the academic units on campus may be used as a free elective (no Physical Education classes, StuCo courses, or ROTC courses may be used towards free electives or any other graduation requirements)

Total: 360 units

ECE Areas

ECE courses are divided up into 5 areas: Applied Physics, Signals and Systems, Circuits, Computer Hardware, and Computer Software. The first two areas fall generally on the electrical engineering side, the last two areas fall generally on the computer engineering side, and the middle one overlaps both EE and CE.

B: Breath, D: Depth, DS: Design, CO: Coverage

Applied Physics

18-303 Engineering Electromagnetics I (B, Co) 12

18-311 Semiconductor Devices I (B, Co) 12

18-315 Introduction to Optical Communication Systems (B, Co) 12

18-316 Introduction to Data Storage Systems Technology (B, Co) 12

18-401 Electromechanics (Dp, Co) 12

18-410 Physical Sensors, Transducers and Instrumentation (Dp) 12

18-412 Semiconductor Devices II (Co, Dp) 12

18-493 Electromicroacoustics (Co) 12

18-517 Data Storage Systems Design (Dp, Ds, Co) 12

18-614 Microelectromechanical Systems (Dp, Co) 12

18-712 Optoe-Electronics for Network (Co) 12

18-713 Optical Networks (Co) 12

18-715 Physics of Applied Magnetism (Dp, Co) 12

18-716 Advanced Applied Magnetism (Co) 12

18-815 Integrated Circuit Fabrication Processes (Co) 12

18-819 Special Topics in Applied Physics (Co) 12
Signals and Systems
15-384 Robotic Manipulation (Co) 12
18-370 Fundamentals of Control (Dp, Co) 12
18-396 Signals and Systems (B, Co) 12
18-450 Digital Wireless Communications (Dp, Co) 12
18-474 Embedded Control Systems (Dp, Co) 12
18-551 Digital Communication and Signal Processing System Design (Dp, Ds, Co) 12
18-578 Mechatronic Design (Ds, Co) 12
18-751 Applied Stochastic Processes (Co) 12
18-752 Estimation, Detection and Identification (Co) 12
18-753 Information Theory and Coding (Dp, Co) 12
18-756 Circuit Switched & Packet Switching (Co) 12
18-757 Principles of Broadband Communications (Co) 12
18-758 Wireless Communications (Dp, Co) 12
18-771 Linear Systems (Co) 12
18-777 Introduction to Dynamic Systems (Dp, Co) 12
18-779 Special Topics in Systems and Control (Co) 12
18-791 Digital Signal Processing I (Dp, Co) 12
18-792 Advanced Digital Signal Processing (Co) 12
18-793 Optical Image and Radar Processing (Dp, Co) 12
18-794 Pattern Recognition Theory (Co) 12
18-796 Multimedia Communications, Coding Systems and Networking (Co) 12
18-798 Image and Video Processing (Dp, Co) 12
18-799 Special Topics in Signal Processing (Dp, Co) 12
18-859 Special Topics in Communication: Communications and Networking (Dp, Co) 12

Circuits
18-321 Analysis and Design of Analog Circuits (B, Co) 12
18-322 Analysis and Design of Digital Circuits (B, Co) 12
18-410 Physical Sensors, Transducers and Instrumentation (Dp) 12
18-523 Analog Integrated Circuit Design (Dp, Ds, Co) 12
18-525 Integrated Circuit Design Project (Dp, Ds, Co) 12
18-527 Advanced Analog Integrated Circuit Design (Ds, Co) 12
18-724 Microelectromechanical System Design (Dp, Co) 12
18-725 Digital Integrated Circuit Design (Ds, Co) 12
18-726 Circuit Simulation: Theory and Practice (Co) 12
18-764 In Between IC Design and Manufacturing (Co) 12

Computer Hardware
15-213 Introduction to Computer Systems (B, Co) 12
18-340 Digital Computation (B, Co) 12
18-345 Introduction to Telecommunication Networks (B, Co) 12
18-349 Embedded Real-Time Systems (Dp, Co) 12
18-360 Introduction to Computer-Aided Design (B, Co) 12
18-441 Verification of Computer Hardware Systems (Dp, Co) 12
18-447 Introduction to Computer Architecture (Dp, Co) 12
18-544 Network Design and Evaluation (Ds, Co) 12
18-545 Advanced Digital Design Project (Dp, Ds, Co) 12
18-549 Distributed Embedded Systems (Ds, Co) 12
18-741 Advanced Computer Architecture (Dp, Co) 12
18-742 Multiprocessor Computer Architecture (Dp, Co) 12
18-743 Energy Aware Computing (Co) 12
18-744 Hardware Systems Engineering (Dp, Ds, Co) 12
18-745 Rapid Prototyping of Computer Systems (Co, Ds) 12
18-746 Advanced Storage Systems (Dp, Co) 12
18-747 Advanced Techniques in Microprocessors (Dp, Co) 12
18-748 Dependable System Design (Dp, Co) 12
18-749 Dependable Embedded Systems (Co) 12
18-760 VLSI CAD: Logic to Layout (Dp, Co) 12
18-765 Digital System Testing and Testable Design (Dp, Co) 12
18-766 Formal Methods for System on a Chip Design (Co) 12
18-767 VSLI CAD: Software to Logic (Co) 12
18-841 Advanced Operating Systems & Distributed Systems (Co) 12
18-843 Mobile Systems Computing and Applications (Co) 12

Computer Software
15-211 Fundamental Data Structures and Algorithms (B, Co) 12
15-212 Principles of Programming (Dp, Co) 12
15-312 Programming Language Design and Programming (Co) 9
15-381 Artificial Intelligence: Representation and Problem Solving (Co) 9
15-385 Artificial Intelligence: Computer Vision (Co) 9
15-410 Operating System Design & Implementation (Co) 12
15-411 Compiler Design (Co) 12
15-415 Database Applications (Co) 12
15-441 Computer Networks (Co) 12
15-451 Algorithm Design & Analysis (Co) 9
15-453 Formal Languages and Automata (Co) 9
15-462 Computer Graphics I (Co) 12
15-681 Machine Learning (Co) 12
18-349 Embedded Real-Time Systems (Dp, Co) 12
18-549 Distributed Embedded Systems (Ds, Co) 12
18-730 Introduction to Computer Security (Dp, Co) 12
18-749 Dependable Embedded Systems (Co) 12
18-839 Special Topics in Network and Software Security (Dp, Co) 12
18-845 Internet Services (Co) 12
18-849 Special Topics in Computer Networking (Co) 12

Capstone Design Courses
18-517 Data Storage Systems Design 12
18-523 Analog Integrated Circuit Design 12
18-525 Integrated Circuit Design Project 12
18-544 Network Design and Evaluation 12
18-545 Advanced Digital Design Project 12
18-549 Distributed Embedded Systems 12
18-551 Digital Communication and Signal Processing System Design 12
18-571 Mechatronic Design 12
18-723 Advanced Analog Integrated Circuit Design 12
18-725 Digital Integrated Circuit Design 12
18-744 Hardware Systems Engineering 12
18-745 Rapid Prototyping of Computer Systems 12
39-500 CIT Honors Research Project (if advised and certified by an ECE faculty member) 12

*The math/science requirement can be satisfied with any course from The Mellon College of Science or The Department of Statistics except for: 100-level courses in Mathematics or Statistics, and courses designed for non-science or engineering majors, such as 09-103, 09-104, 21-257, 33-124, 36-201, 36-202, 36-207 and 36-208. Although shown in the Fall of the Junior and Senior years, these courses may be taken at any time. Mathematics courses of particular interest to students in ECE are:
21-228 Discrete Mathematics
21-259 Calculus in Three Dimensions
21-260 Differential Equations

** 36-217 (a prerequisite for 18-345, Introduction to Telecommunications Networks and 18-450, Digital Wireless Communications) is recommended for students interested in communications, control, networks, and signal processing. 36-220 is appropriate for students interested in quality control, manufacturing, and statistical methods. The two-course sequence 36-217 and 36-220 (or 36-225 and 36-226) will be of interest for Business Administration double majors.

The following table shows a possible roadmap through our broad and flexible curriculum:

<table>
<thead>
<tr>
<th>Freshman Year</th>
<th>Fall</th>
<th>Spring</th>
<th>Sophomore Year</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Electrical &amp; Computer Engineering (12)</td>
<td>Introductory Engineering Elective (12)</td>
<td>Emerging Trends in ECE (1)</td>
<td>ECE Core Course (12)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLSI CAD: Logic to Layout (Dp, Co)</td>
<td>Advanced Topics in Computer Hardware and Networking (Co)</td>
<td>Calculus (10)</td>
<td>Calculus (10)</td>
<td>Mathematical Foundations of EE/Concepts of Mathematics (12/9)</td>
<td></td>
</tr>
<tr>
<td>Writing/Expression Course(9)</td>
<td>General Education Course (9)</td>
<td>Writing/Expression Course(9)</td>
<td>General Education Course (9)</td>
<td>Writing/Expression Course(9)</td>
<td></td>
</tr>
<tr>
<td>Computer Skills Workshop (3)</td>
<td>General Education Course (9)</td>
<td>Computer Skills Workshop (3)</td>
<td>General Education Course (9)</td>
<td>Computer Skills Workshop (3)</td>
<td></td>
</tr>
</tbody>
</table>

Total Units: 44/46/43/48/51
The ECE Co-Op is a unique 8-month contiguous extended internship experience in which ECE students with a minimum QPA of 3.0 may opt to participate. Students typically engage in this option in the spring semester of their junior year, from January through August. A May through December option is also available. Students who engage in this program typically graduate in 4.5 academic years (but still eight semesters).

Notes on the Curriculum

Policy on ECE Coverage Courses with Fewer than 12 Units
The basic curriculum requirements for Breadth, Depth, and Coverage are stated in terms of courses rather than units. The nominal total of 72 units for these categories is determined by assuming that each course is 12 units. In the event that courses with fewer than 12 units are used to satisfy some or all of these requirements, additional courses from the ECE coverage lists must be taken until the total units in ECE courses beyond the core meets or exceeds 72 units. Any ECE coverage course is acceptable, and any excess units may be counted as free elective credit.

QPA Requirement and Overload Policy
An overload is defined as any schedule with more than 54 units in one semester. A student will only be permitted to overload by 12 units if he or she achieved a QPA of at least 3.5 out of 4.0 in the previous semester, or if his or her overall QPA is at least 3.5.

Pass/Fail policy
No course taken as Pass/Fail may be used in any way toward graduation (including Free Elective credit).

Other Graduation Requirements
CIT has the following requirement for graduation. "Students must complete the requirements for their specified degrees with a cumulative quality point average of 2.00 or higher for all courses taken after the freshman year. In addition, a student is expected to achieve a cumulative quality point average of 2.00 in a series of core departmental courses." In ECE, this means that the student must complete 18-100, ECE Core, Breadth, Depth, Coverage, and Design courses with a minimum QPA of 2.0 to graduate.

When more than one possibility exists for meeting a specific requirement (e.g., Breadth), the courses used for calculating the ECE QPA will be chosen so as to maximize the QPA. Similarly, when a course is retaken, the better grade will be used in the computation of the minimum QPA in the above courses.

Other Opportunities in ECE

ECE Cooperative Education Program
The ECE Co-Op is a unique 8-month contiguous extended internship experience in which ECE students with a minimum QPA of 3.0 may opt to participate. Students typically engage in this option in the spring semester of their junior year, from January through August. A May through December option is also available. Students who engage in this program typically graduate in 4.5 academic years (but still eight semesters).

Eligible students interested in participating should apply to the ECE Undergraduate Office for the program at the close of their sophomore year. Students are required to submit a formal application consisting of a transcript, a resume, and a one-page statement of purpose including an academic plan. Students then work with the Career Center to find a Co-Op position. Once a Co-Op position is found, a Co-Op job description is required from the employer, to be approved by the ECE Undergraduate Office.

While on the Co-Op assignment, the students are participating in a recognized CIT educational program, retaining their full-time student status, akin to our students who study abroad in established exchange programs (such as EPFL) for one or two semesters.

Upon returning to Carnegie Mellon, the students are required to submit for approval the following two documents to the ECE Undergraduate Office: a three to five page technical report of the Co-Op work, and a one page assessment and evaluation of the Co-Op experience.

Students may obtain more detailed information through the department, the Career Center in the University Center, or online at http://www.ece.cmu.edu/undergrad/

Integrated M.S./B.S. Degrees Program
Qualifying undergraduates also have the opportunity to receive an M.S. Degree in ECE by taking an additional 96 units (nominally eight 12 unit courses) of coursework at Carnegie Mellon. The degrees may be awarded simultaneously or sequentially depending on the progress and preference of the student. The primary purpose of the Integrated Masters/Bachelors (IMB) Degree Program is to provide students with superior breadth and depth of technical material, which will better prepare them for careers in industry. The Integrated Masters/Bachelors Degree Program normally requires an additional year of coursework beyond the B.S. Degree Requirements. Students interested in pursuing the Integrated M.S./B.S. Degrees are encouraged to begin taking some of the required graduate courses before their last year. In the face of the ever increasing technological complexity of the workplace, the additional year of advanced undergraduate and graduate classes required for the Integrated M.S./B.S. Degrees substantially enhances a student’s readiness to contribute in an industrial position.

M.S. Degree Requirements

Total units required for M.S.: 96

The Integrated Masters/Bachelors Degrees Program is available to all undergraduates who maintain a cumulative QPA of at least 3.0, including the Freshman Year. Students must also maintain a QPA of 3.0 in courses used to satisfy the requirements of the M.S. degree. The following are the requirements for the M.S. Degree. These are in addition to the requirements for the B.S. Degree. Note that no course can be counted as satisfying more than one of the requirements listed below and no course used to satisfy the B.S. Degree requirements can be used to satisfy the M.S. requirements listed below.

1. A minimum of 96 units must be completed for the M.S., in addition to the 360 units required for the B.S.

2. Of the 96 units, the College of Engineering requires that a minimum of 60 units must be at the ECE graduate level (600-level and above), including both course and project units.

3. At least 48 units of the 60 required ECE units must be ECE graduate-level courses (600-level and above). The remaining 12 units may either be an additional ECE graduate course, or it may be 12 units of project units.

4. 36 units additional units (may be from any academic unit of the University).
   - A minimum of 24 of the 36 units must be at the 500-level and above
   - No more than 12 units of undergraduate (400 level and below) coursework may count toward the 96-unit requirement
• No more than 15 units of project/research (18-980) may be counted toward the 96-unit requirement. Of this 15 units, no more than 12 of them may be used towards the 60 units of 600-level and above requirement.

Notes

• No course with a grade lower than C will be counted toward the Masters Degree requirements for the Integrated M.S./B.S. Degree (those over and above the requirements for the B.S. Degree). Students become eligible to declare their intention to participate during the spring semester of the junior year, or the semester in which they accumulate 270 or more units, whichever is earlier.

• Up to 15 units of 39-500, CIT Honors Project, can be used towards the 96-unit requirement. Of this 15 units, no more than 13 units can then be used to count towards the 96-unit requirement. The student must have graduate standing in order to conduct graduate research. The graduate project must contain substantial design and/or research experience. Graduate projects must be proposed (one-page abstract describing the project), supported by an ECE Faculty advisor, and submitted for approval to the ECE Undergraduate Office.

• Any student going beyond 8 semesters to complete both the B.S. and M.S. degree requirements may maintain undergraduate standing. However, they will be required to take graduate standing for at least the last semester in which they are enrolled. This means that all B.S. degree requirements and any requirements for second majors or minors must be met prior to this last semester.

Faculty

ANASTASSIA AILAMAKI, Assistant Professor of Computer Science and Electrical and Computer Engineering — Ph.D., University of Wisconsin-Madison; Carnegie Mellon, 2001—.

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LAWRENCE T. PILEGGI, Tanoto Professor of Electrical and Computer Engineering; Director, Center for Silicon System Implementation— Ph.D., Carnegie Mellon University; Carnegie Mellon 1996—.
MARKUS PUSCHEL, Research Scientist — Ph.D., University of Karlsruhe; Carnegie Mellon, 1999—.
RAGUNATHAN RAJKUMAR, Professor of Electrical and Computer Engineering; Director, Real-Time and Multimedia Laboratory — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1992—.
MIKE REITER, Professor of Electrical and Computer Engineering and Computer Science; Associate Director, CyLab — Ph.D., Cornell University; Carnegie Mellon, 2001—.
ROB A. RUTENBAR, Stephen J. Jatras Professor of Electrical and Computer Engineering and Computer Science; Director, MARCO Focus Center for Circuit and System Solutions — Ph.D., University of Michigan; Carnegie Mellon, 1984—.
MAHADEV SATYANARAYANAN, Carnegie Professor of Computer Science and Electrical and Computer Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1983—.
TUVIYAH E. SCHLESINGER, Professor of Electrical and Computer Engineering; Director, Data Storage Systems Center — Ph.D., California Institute of Technology; Carnegie Mellon, 1985—.
SRINI SESHAH, Associate Professor of Electrical and Computer Engineering — Ph.D., University of California, Berkeley; Carnegie Mellon 2000—.
DANIEL P. SIEWIOREK, Buhl University Professor of Electrical and Computer Engineering and Computer Science; Director, Human Computer Interaction Institute — Ph.D., Stanford University; Carnegie Mellon, 1972—.
MARVIN A. SIRBU, Professor of Engineering and Public Policy, Graduate School of Industrial Administration and Electrical and Computer Engineering — Sc.D., Massachusetts Institute of Technology; Carnegie Mellon, 1985—.
METIN SITTI, Assistant Professor of Mechanical Engineering and Electrical and Computer Engineering — Ph.D., University of Toledo; Carnegie Mellon, 2002—.
ASIM SMALAGIC, Research Professor — Ph.D., University of Sarajevo and University of Edinburgh; Carnegie Mellon, 1992—.
DAWN SONG, Assistant Professor of Electrical and Computer Engineering — Ph.D. University of California, Berkeley; Carnegie Mellon, 2002—.
DANIEL D. STANCL, Professor of Electrical and Computer Engineering; Director, Center for Wireless and Broadband Networking — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1986—.
PETER STEENKISTE, Professor of Electrical and Computer Engineering and Computer Science — Ph.D., Stanford University; Carnegie Mellon, 1987—.
RICHARD M. STERN, JR., Professor of Electrical and Computer Engineering, Computer Science, and Biomedical Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1977—.
ANDRZEJ J. STROJWAS, Keithley Professor of Electrical and Computer
Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1983—.

THOMAS SULLIVAN, Lecturer, Electrical and Computer Engineering —
Ph.D., Carnegie Mellon University; Carnegie Mellon, 1996—.

SAROSH N. TALUKDAR, Professor of Electrical and Computer
Engineering — Ph.D., Purdue University; Carnegie Mellon, 1974—.

ALFRED A. THIELE, Distinguished Scholar — Ph.D., Massachusetts
Institute of Technology; Carnegie Mellon, 1981—.

DONALD E. THOMAS, JR., Professor of Electrical and Computer
Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1977—.

OZAN TONGUZ, Professor of Electrical and Computer Engineering —
Ph.D., Rutgers University; Carnegie Mellon, 2000—.

ELIAS TOWE, Grobstein Memorial Professor of Electrical and Computer
Engineering and Materials Science and Engineering — Ph.D.,
Massachusetts Institute of Technology; Carnegie Mellon, 2001—.

CHENXI WANG, Research Scientist — Ph.D. University of Virginia;
Carnegie Mellon, 2001—.

ROBERT WHITE, University Professor Emeritus of Electrical and
Computer Engineering and Engineering and Public Policy — Ph.D.,
Stanford University; Carnegie Mellon, 1993—.

PATRICK YUE, Assistant Professor of Electrical and Computer
Engineering — Ph.D., Stanford University; Carnegie Mellon, 2003—.

HUI ZHANG, Associate Professor of Computer Science and Electrical
and Computer Engineering — Ph.D., University of California, Berkeley;
Carnegie Mellon 1995—.

JIAN-GANG ZHU, ABB Professor of Electrical and Computer
Engineering; Professor of Materials Science and Engineering and
Physics — Ph.D., University of California, San Diego; Carnegie Mellon, 1997—.
Department of Engineering and Public Policy

M. Granger Morgan, Head
Mark Kleier, Assistant Department Head
Office: Baker Hall 129

Mission Statement
The Department of Engineering and Public Policy (EPP) is a unique engineering department, whose overall objective is to enhance undergraduate engineering education with the perspectives and skills that enable the engineer to understand and work at the interface between technology and society. Society is largely responsible for setting the goals and framing the problems that engineers work on. However, technologies designed by engineers profoundly change the societies in which they operate. Technology has enabled a healthier, richer and more productive society. At the same time, technology has contributed to the creation of many of the more serious problems our society faces.

Technology can help us build a happier, freer, and more fulfilling life, while maintaining risks and undesirable impacts at acceptable levels. But that does not happen automatically. It takes careful hard work by people who understand both technology and the society in which they live. In order to do their jobs responsibly and well in today's world, engineers must develop an understanding of the interface between technology and society and a command of the skills necessary to work at that interface. The undergraduate degree programs of the Department of Engineering and Public Policy (EPP) have been designed to allow engineering students at Carnegie Mellon University to add this important dimension to their traditional engineering education. EPP double major graduates, for the most part, will enter traditional engineering careers... and in doing so will carry with them a set of insights and skills that will help them to better deal with issues in technology and policy, and better exercise their ethical and social obligations as practicing professionals.

Educational Outcomes: Double Major Knowledge and Skills Development

Through required courses, carefully selected technical and non-technical electives, and project activities, double major students in Engineering and Public Policy develop the knowledge and skills needed to understand and address the broader social context of technology during the course of their future careers as practicing engineers. Specifically they develop:

- An understanding of ideas and analytical tools in economics, decision science, and other social sciences through several required courses and a group of "social analysis electives;"
- A knowledge of probability and statistics beyond that acquired by many engineering single majors;
- An understanding of how technical and social issues interact and affect each other through a set of required "EPP technical electives" (these courses are also available to other CIT students who wish to broaden their technical education);
- An appreciation of, and ability to deal with, ethical issues posed by technology and technical systems though case studies and discussion in the EPP Sophomore Seminar. Additionally, students may choose EPP technical and social analysis electives that cover ethics in disciplinary, philosophical, societal, and technical contexts.
- Hands on experience in integrating their technical and social analytical skills by addressing current, open-ended technology and public policy problems in two group project courses. These courses also require students to work in interdisciplinary groups, and they enhance communications skills through group processes and formal presentations.
- An understanding of how decision-makers in governments and other institutions can effectively use technical and scientific information when devising or evaluating public policy.

Double Major Objectives: Advantages in Career Paths
By design, most graduates from Engineering and Public Policy pursue traditional technical career paths. However, the double major provides students with additional insights and abilities including:

- An understanding that engineering is not practiced in isolation. Technical products and systems are shaped, conditioned and evaluated by society while at the same time technology shapes the social world.
- An ability to understand, and seek advanced assistance in addressing, problems in areas such as health, safety, environmental and economic regulation, and impacts of technological innovation.
- An appreciation of the difference between the effects and attributes of engineering at the "unit" level and engineering for mass consumption or for large technological systems.
- An awareness of tools and methods to approach complex decision problems that engineers often must face, including issues beyond the design of products and processes.
- An awareness of possible future career paths more diverse than those traditionally associated with engineering or other technical careers.
- A "head start" in addressing and integrating both "hard" and "soft" engineering issues, in teams composed of many disciplines.

Overview
The department offers double-major B.S. degree programs with each of the five traditional engineering departments in the engineering college (e.g., B.S. in chemical engineering/engineering and public policy), as well as with the School of Computer Science. These joint degree programs, which have been offered since 1971, are now chosen by about 10 percent of all undergraduate engineering students at Carnegie Mellon. Typically, they only require the unit equivalent of less than one added course. The engineering double-major programs lead to fully accredited engineering degrees that prepare students for traditional engineering careers. EPP double-major engineers are not educated to be a different kind of engineer. Rather their education is intended to enable them to be better, more socially responsible engineers in the traditional engineering fields. The department also offers a minor in Technology and Policy for non-engineering majors.

All of the undergraduate double major programs in EPP combine the strong foundation in mathematics and physical sciences, and the development of engineering skills in the specific engineering field, with a rigorous preparation in the analysis of social and political problems. The curricula include subject matter which is not part of traditional engineering or social science curricula, but which contains elements of each. This is accomplished by Engineering and Public Policy technical elective courses, social analysis courses, and through participation by each student in at least two interdisciplinary problem-solving projects. Problem areas for these projects are chosen from local, state, and national situations and include such topics as industrial automation and robotics, environmental control, telecommunication and computer technologies, product safety, and energy systems. Engineering and Public Policy students take courses in engineering and science offered by the Carnegie Institute of Technology and the Mellon College of Science, and the social science, humanities, and industrial administration courses offered in the College of Humanities and Social Sciences and GSIA's under-graduate business program. There is also significant interaction between EPP students and the Environmental Institute, the H. John Heinz III School of Public Policy and Management, and the Department of Social and Decision
Many who begin in conventional engineering careers later migrate to the social responsiveness of their work, and the work of their colleagues. The majority of the double-major graduates in Engineering and Public Policy should see their advisor early to plan for these.

The majority of the double-major graduates in Engineering and Public Policy pursue conventional engineering careers, using the additional dimension in their background to improve the quality, sensitivity, and social responsiveness of their work, and the work of their colleagues. Many who begin in conventional engineering careers later migrate into positions with responsibilities which make special use of their EPP education. A number of prominent technical careers with local, state, or national government or with policy research and consulting firms. Some choose to continue their formal education, doing graduate work in an engineering discipline, in the social sciences, law, or in an interdisciplinary program.

### Current faculty advisors of the program are the following:

- For Chemical Engineering/Engineering and Public Policy majors: Jon Peha, Marvin A. Sirbu, Mark Kieler, Marija Ilic, Adrian Perrig, Mitchell J. Small, Scott Matthews, Peter Adams
- For Computer Science/EPP majors: Mark Kieler, Jon Peha, Marvin A. Sirbu, Mark Kieler, Marija Ilic, Adrian Perrig
- For Electrical and Computer Engineering/EPP majors: Jon Peha, Marvin A. Sirbu, Mark Kieler, Marija Ilic, Adrian Perrig
- For Mechanical Engineering/EPP majors: Edward S. Rubin, Allen Robinson
- For Materials Science and Engineering/ EPP majors: Mark Kieler
- For EPP-Heinz School Accelerated Masters program students: Mark Kieler

Designated Minors are possible with an EPP double major. Students should see their advisor early to plan for these. Students can also obtain general academic advice and guidance from Mark Kieler, the undergraduate assistant department head of EPP.

Credit-unit overloads of between one and six units are also involved. To ease these overloads, some students occasionally elect a minimum of summer work. Course and credit-unit requirements for the single-major and double-major degrees are listed on the next page.

### Double-Major Curricula

**Bachelor of Science in an Engineering Specialty and Engineering and Public Policy, or Computer Science and Engineering and Public Policy**

The EPP double-major curricula allow the student the option of a number of non-traditional career paths, and at the same time preserve the option of a traditional technical career. Following the sample curricula below, the student simultaneously satisfies all requirements for the undergraduate degree in a traditional engineering department or computer science, and all requirements for the undergraduate degree in Engineering and Public Policy. With early planning, some of the designated minors are also possible without overload.

This degree program has the attractive feature of allowing technical students to keep a number of options open after they graduate. Students graduating with a double-major degree have found a range of job possibilities, from traditional engineering jobs in industrial organizations to assignments in consulting firms and positions in local and national government. Students have also entered graduate schools of engineering, business, urban management, and law.

Specific degree requirements for the double major program vary with department. However, with the exception of a three-unit seminar course, the double-major program requires the same number of courses for completion as the corresponding single-major departmental degree programs. However, as the curricula on the following pages illustrate, there are substantial differences between elective course requirements for the double-major and single-major students.

### Note on EPP double major requirements

This note is intended to clarify the major substitutions that occur in the single major curriculum when it is fashioned into an EPP double major curriculum.

**Freshman Electives:** An EPP major is not required to take the introduction to EPP course although taking it may be a way to find out the kind of questions and issues studied in EPP. All EPP students are required to take 19-102 EPP Sophomore Seminar in the fall of their sophomore year. In order to avoid overloads later in the curriculum, students wishing to pursue the EPP double major should complete the freshman and sophomore electives required by the student’s other traditional technical department. These requirements are listed in the Undergraduate Catalog for the various departments.

For CIT students, the introductory engineering course in the major and a second introductory course must be completed. Students wishing to pursue EPP are also advised to complete the humanistic studies and Writing/Expression requirements listed in the section on General Education program for CIT Students. However, as explained below, the other two distribution requirements - cognition and institutions, depth sequence and other general education elective categories are replaced by the policy components of the double major curriculum as reflected in the social analysis electives described later. All EPP students are required to take 73-100 Principles of Economics and should complete this as early as possible.

A MSE/EPP double major may choose the Industrial Internship Option (IIO) which is a MSE program in cooperative education. Just as in the MSE single major IIO option, the MSE/EPP (IIO) option provides the students with an opportunity to supplement the academic program with relevant work experience in metallurgy and materials science as well as in the public policy area.

Under the IIO option the student enhances classroom learning by alternating one-semester work periods in industry with on-campus semesters, beginning in the summer following the sophomore year. Interested students should read the relevant parts of the MSE section carefully.

The student graduates with a bachelor’s degree in MSE and EPP in four-and- one-third years. The internship option curriculum differs from the standard curriculum in the last three academic semesters, as indicated in the MSE section.
EPP Core courses

The EPP double major curriculum consists of two sets of core courses: one set for the disciplinary major (ChE, CEE, CS, ECE, MEG, MSE) and the second set for the interdisciplinary EPP major. The student is referred to the relevant sections of this catalog for the core courses in the disciplinary major. The EPP core contains the sophomore seminar, two EPP project courses, two semesters of a probability and statistics sequence, an introductory economics and a decision science course. The EPP core consists of the following courses:

- 19-102 EPP Sophomore Seminar
- 19-451 EPP Project I
- 19-452 EPP Project II
- 73-100 Principles of Economics
- 88-xxx/19-xxx Decision Analysis (see below)
- 36-xxx Probability and Statistics (2 courses, see below)
- xx-xxx 4 EPP Technical Electives
- xx-xxx 4 EPP Social Analysis Electives

These requirements are described in more detail below.

The above EPP Core Courses in general replace technical and general education requirements, seminars, and free electives of the single major. The one exception is the first EPP Project that replaces 24-401: Engineering Analysis in the MEG /EPP curriculum. In all other cases, the two EPP Projects substitute for technical or free electives.

Technical Course Requirements

Probability and Statistics Sequence

In today's world, knowledge of probability and statistics are critical in understanding how technological systems operate. The EPP double major requires that students take a 2 course sequence in probability and statistics. If the student's primary major has a statistics requirement as well, that course may count towards meeting one of the two course requirement. The courses should be selected from the following list:

- 36-217 Probability Theory and Random Processes
- 36-220 Engineering Statistics and Quality Control
- 36-310 Fundamentals of Statistical Modeling

All students generally take 36-220 and then one other statistics course.

- ChE/EPP majors take 36-220 in place of a technical elective and the second course in place of a free elective.
- CEE/EPP majors have 36-220 in their single major curriculum, and take the second course as a free elective.
- CS/EPP majors should take 36-217 as part of their single major curriculum, and take the second course as a free elective.
- ECE/EPP majors must take 36-220 or 36-217 in their single major curriculum, and take the second course as a free elective. Note that 36-217 is the preferred option for students planning to take the communications course.
- MEG /EPP majors take 36-220 in place of a technical elective and the second course in place of a free elective.
- MSE/EPP majors take 36-220 as part of their single major curriculum and the second course in place of a technical elective.

EPP Technical Electives

EPP technical electives are generally a subset of the courses taught in the engineering school (CIT), college of science (MCS), or the School of Computer Science (SCS). These electives are either disciplinary courses that provide background knowledge or skills necessary for problem solving in the technology/policy area; or, courses that have a multidisciplinary approach to problems with substantial technological and societal components. A more detailed listing of EPP technical electives is given later in this section. Note that the catalog listing is not exhaustive, and that the offering of courses changes all the time. Prior to the beginning of registration process each semester, a list of EPP Technical Electives is distributed by the department. Classes can then be selected from this list.

All double majors must complete four EPP technical electives with the following special cases:

- ChE /EPP students count the following ChE core courses as 2 EPP technical electives and hence take only two more EPP technical electives:
  - 06-421 Chemical Process Systems Design (12 units)
  - 06-461 Process Design Project (6 units)
  - 06-462 Economics and Optimization (6 units)

- CEE/EPP students count two CEE core mini courses, 12-411 Engineering Economics, and 27-357, Introduction to Materials Selection, as one EPP Technical Elective. CE/EPP students take only three more EPP Technical Electives.

- MEG /EPP students count a special version of a MEG core course, 24-442 Engineering Design for EPP, as an EPP technical elective. MEG/EPP students take only three more EPP technical electives.

If you are pursuing a designated minor as well, the EPP technical electives must be chosen from among the courses for the designated minor, and which are also EPP technical electives to prevent unnecessary overloading.

Social Analysis Requirements

Decision Analysis and Economics Requirements

For analysis of technical and policy problems in the department, it is important to understand how decisions are made and how economic conditions affect alternatives. Students are required to complete the following economics course:

- 73-100 Principles of Economics

Students should complete 73-100 as early as possible, preferably during their freshman year. Students are also required to complete one decision analysis course from the following list:

- 88-223 Decision Analysis and Decision Support Systems
- 88-302 Behavioral Decision Making
- 19-426 Environmental Decision Making

If 88-223 and 88-302 have a statistics course prerequisite.

Social Analysis Electives

Social Analysis electives are a subset of courses taught in the College of Humanities and Social Sciences (H&SS), the H. John Heinz III School of Public Policy and Management and GSIA's undergraduate business department. Some examples of these courses are provided later in this section. Students selecting Social Analysis electives should always refer to the department's current list, which is revised prior to registration for each semester. The Social Analysis requirements provide an effective "depth sequence" for EPP students. Hence they are not required to complete the CIT depth sequences. However, they must complete the Writing and Cultural Analysis requirements.
Special Feature: Interdisciplinary Problem-Solving Projects

One of the most interesting and unique features of the Department of Engineering and Public Policy is the problem-solving project courses which are designed to provide a student with real-world experiences. Each student participates in two technology/policy projects (generally, one each in the junior and senior years) which deal with research and development of recommendations for solving actual and critical problems currently affecting society. The students, faculty, and graduate student managers for the project are drawn from EPP, the Heinz School, and H&SS, and hence bring different areas of expertise to the structuring and solution of the problem.

The topics for EPP projects are drawn from diverse areas such as environmental systems and resources, public transportation, urban engineering problems, energy and fuel utilization, the interaction of law and technology, strategic materials and vulnerability of supply, technical issues in national security, and problems in automation, robotics and communication technology.

Although a different topic is chosen for each project, every project has the same basic characteristics:

1. The problem selected for study is associated with a public policy problem and is constrained by technology, politics, and economics.
2. A client is defined to focus the framework within which the project is worked. Often, the client agency or institution interacts closely with the students in the project.
3. A set of external experts acts as a client for the project and composes a review panel which critiques class efforts during the semester.
4. Class organization is aimed at putting together a workable set of alternatives to the problem. Typically, groups of four to eight students investigate specified aspects of the problem; group efforts are coordinated by student managers and faculty advisors; and objectives and personnel are reassigned during the semester. Three formal oral reports are given before the review panel during the semester; a written report is also submitted at the end of the semester.
5. Problem areas for the projects are abstracted from local, state and national situations. Examples of topics and clients of projects undertaken by EPP students are listed below.

- "An Assessment of Civil Sector Uses of Digital Data Encryption" (1980) - Public;
- "Effects of Windshear in Aviation" (1989) — Public
- "Household Batteries: Is There a Need for Change in Regulation and Disposal?" (1989) — Public;
- "Magnetic Levitation Transportation: The Pittsburgh Frontier" (1990) — Public;
- "Safety with Fuel Efficiency: Alternatives to CAFE" (1991) — Public;
- "Design Issues in Waste Avoidance" (1991) - Pennsylvania Department of Environmental Resources;
- "Aral Sea Regional Ecological Crisis" (1992) - Senator Albert Gore of Tennessee;
- "Airbags: Help or Harm?" (1997) — public;
- "Food Irradiation" (1998) — public;
- "Transition to a Hydrogen-Based Energy System: The Next Ten Years" (2000) — public;
- "Voting Systems Transitions: What are the Options for Pennsylvania?" (2001) — public;

Each academic year at graduation, the best undergraduate project from the previous year is awarded the Stephen O. Lee Undergraduate Policy Project Award. All student participants are recognized.

Fifth Year M.S. program in Engineering and Public Policy

Juniors affiliated with the department may apply for the fifth year masters program that will lead to the additional degree of Master of Science in Engineering and Public Policy. Interested students must have a minimum 3.0 GPA and should contact their advisor for details on the application process.

Following are the additional requirements for the MS degree. Note that no course taken may count for both a BS in CIT and the MS degree (students minoring in Technology and Policy from a non-CIT department should consult with their home college about double counting issues). Note that successful completion of the MS degree requires 96 units of coursework and research.

Requirements for Fifth year M.S. in Engineering and Public Policy

<table>
<thead>
<tr>
<th>I. Type A [Technical] Courses</th>
<th>30 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-704 Estimation Methods</td>
<td>12 units</td>
</tr>
<tr>
<td>xx-xxx Technical Elective 1 (400-level or higher)</td>
<td>9 units</td>
</tr>
<tr>
<td>xx-xxx Technical Elective 2 (400-level or higher)</td>
<td>9 units</td>
</tr>
<tr>
<td>II. Type B [Social Analysis] Courses</td>
<td>24 units</td>
</tr>
<tr>
<td>90-908 Microeconomics</td>
<td>12 units</td>
</tr>
<tr>
<td>xx-xxx Social Analysis (Graduate Level)</td>
<td>12 units</td>
</tr>
<tr>
<td>III. Type C [EPP Core] Courses</td>
<td>36 units*</td>
</tr>
<tr>
<td>19-701 Theory and Practice of Policy Analysis</td>
<td>12 units**</td>
</tr>
<tr>
<td>19-702 Quantitative Methods for Policy Analysis</td>
<td></td>
</tr>
<tr>
<td>Or any two of the following 6 unit courses:</td>
<td></td>
</tr>
<tr>
<td>19-703 Survey Design and Analysis</td>
<td></td>
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<tr>
<td>19-704 Applied Data Analysis</td>
<td></td>
</tr>
<tr>
<td>19-705 Workshop in Applied Policy Analysis</td>
<td>12 units**</td>
</tr>
<tr>
<td>19-752 EPP Project Management</td>
<td>12 units</td>
</tr>
<tr>
<td>IV. Project Research</td>
<td>18 units</td>
</tr>
</tbody>
</table>

Total units required for degree: 96 units

* 12 units of these courses will be taken (and counted) as an under-graduate Technical Elective, and will not count toward the 96 unit MS degree.

** The primary concern for scheduling and completing this integrated program is completing the 2-year sequence of core EPP graduate courses (19-701 in addition to 19-702, or 2 courses from 19-703, 19-704, or 19-705). These courses are individually taught every other academic year. The student should ensure that they schedule the courses offered in their senior year, followed by the remainder in their fifth year.

Students may elect to begin the Project Research component after their fourth year.

Minor in Technology and Policy

The department also offers a minor in Technology and Policy to non-CIT majors. This minor allows non-technical students to sample the EPP requirements and develop exposure and awareness to issues at the interface of science, technology, and society. Details of this program are provided in the discussion of CIT minors...
Bachelor of Science in Engineering and Public Policy and Master of Science in Public Management and Policy

Highly motivated and talented students can earn the EPP double major bachelor’s degree, and a master’s degree in the H. John Heinz School of Public Policy and Management in a five-year course of study. Students interested in the combined degree program should enroll in a standard double-major program in an engineering specialty and EPP. During the third year of study, the student applies to the Heinz School for admission to the master’s program; an academic record of B average or better is normally a prerequisite for admittance.

The five-year course of study is possible because of specific course load overlaps between the EPP and Heinz School programs: (1) some social analysis requirements in EPP, usually four semester courses, can be satisfied with Heinz School common core courses in economics, and social science; (2) at least one project course is common and applicable to both curriculums; (3) at least one additional EPP technical elective, engineering option or project course will be accepted for Heinz School credit following the usual request to the master’s committee.

[Comment on (2): A second physical/technical systems course would count automatically for all program cores except financial analysis.]

Students desiring this option should seek faculty advice and counsel in their freshman or sophomore year so that a curriculum satisfying all the degree requirements can be ensured. Contact Mark Kieler (Assistant Head, EPP) for more information. For general information on Heinz 3-1-1 programs please contact the Heinz school or refer to their website.
# Chemical Engineering

## Single Major

### Sophomore Year

<table>
<thead>
<tr>
<th>Term</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>21-259 Calculus in Three-Dimensions</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>06-221 Thermodynamics</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>06-222 Sophomore Chemical Engineering Seminar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>09-106 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>15-100/ Introductory Intermediate Programming /</td>
<td></td>
</tr>
<tr>
<td></td>
<td>33-xxx Physics for Engineering Students II</td>
<td>10-12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx General Education Course</td>
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</table>

### Spring

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-261 Fluid Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>06-262 Mathematical Methods of Chemical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>09-221 Lab 1: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>33-107/ Physics for Engineering Students II</td>
<td>12-10</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
</tbody>
</table>

Total for Sophomore Year: 47-50

### Junior Year

<table>
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<tr>
<th>Term</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>06-321 Chemical Engineering Thermodynamics</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>06-323 Heat and Mass Transfer</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>06-322 Junior Chemical Engineering Seminar</td>
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</tr>
<tr>
<td></td>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>09-347 Advanced Physical Chemistry</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
</tbody>
</table>

### Spring

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-361 Unit Operations of Chemical Engineering</td>
<td>9</td>
</tr>
<tr>
<td>06-362 Chemical Engineering Process Control</td>
<td>9</td>
</tr>
<tr>
<td>06-363 Transport Processes Laboratory</td>
<td>6</td>
</tr>
<tr>
<td>03-232 Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
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Total for Junior Year: 54-52

### Senior Year

<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>06-421 Chemical Process Systems Design</td>
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<td>06-422 Chemical Reaction Engineering</td>
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Minimum number of units required for degree: 385

---

# Chemical Engineering/ Engineering and Public Policy

## Double Major

### Sophomore Year

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<tr>
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### Spring

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Total for Sophomore Year: 50-52

### Junior Year

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Total for Junior Year: 48

### Senior Year

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### Spring

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<td>36-310 Fundamentals of Statistical Modeling</td>
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Minimum number of units required for degree: 391

One of these must be taken from the following list:

- 88-302 Behavioral Decision Making
- 88-223 Decision Analysis and Decision Support Systems
- 19-426 Environmental Decision Making

*
# Civil and Environmental Engineering

## Single Major

**Sophomore Year**

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<thead>
<tr>
<th>Course Code</th>
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<th>Units</th>
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<tbody>
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<td>Introduction to Environmental Engineering</td>
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</tr>
<tr>
<td>12-252</td>
<td>Environmental Engineering Lab</td>
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<tr>
<td>12-271</td>
<td>Intro Computer Apps in Civil &amp; Environmental Engr</td>
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<tr>
<td>09-101</td>
<td>Intro to Experimental Chemistry</td>
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<tr>
<td>09-105</td>
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<th>Course Title</th>
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<td>12-252</td>
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<tr>
<td>73-100</td>
<td>Principles of Economics</td>
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**Junior Year**

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<td>12-301</td>
<td>Civil and Environmental Engineering Projects</td>
<td>15</td>
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<tr>
<td>12-331</td>
<td>Solid Mechanics</td>
<td>9</td>
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<tr>
<td>12-332</td>
<td>Solid Mechanics Lab</td>
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<tr>
<td>27-357</td>
<td>Materials Selection</td>
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<td>12-335</td>
<td>Soil Mechanics</td>
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**Senior Year**

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<td>12-411</td>
<td>Engineering Economics</td>
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<td>36-211/220</td>
<td>Prob &amp; Stat or Engr Stat and Qual Control</td>
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**Spring**

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Minimum number of units required for degree: 373

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## Civil and Environmental Engineering/Engineering and Public Policy

### Double Major

**Sophomore Year**

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<td>09-105</td>
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<td>73-100</td>
<td>Principles of Economics</td>
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**Spring**

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**Junior Year**

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<tbody>
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**Senior Year**

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<td>Engineering Statistics and Quality Control</td>
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Minimum number of units required for degree: 382

* One of these must be taken from the following list:

- 88-302 Behavioral Decision Making
- 88-223 Decision Analysis and Decision Support Systems
- 19-426 Environmental Decision Making
### Computer Science

#### Single Major

**Sophomore Year**

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<td>15-212 Principles of Programming</td>
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<td>36-217 Probability Theory and Random Processes</td>
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<tr>
<td>xx-xxx Minor Requirement / Free Elective</td>
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**Spring**

| 15-213 Introduction to Computer Systems   | 12    |
| xx-xxx Matrix Algebra                     | 9     |
| xx-xxx Engineering / Science Course       | 9     |
| xx-xxx Humanities and Arts Elective       | 9     |
|                                           | 48    |

**Junior Year**

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**Spring**

| 15-xxx Computer Science Elective          | 9     |
| xx-xxx Computer Science Elective          | 9     |
| xx-xxx Minor Requirement / Free Elective  | 9     |
| xx-xxx Humanities and Arts Elective       | 9     |
|                                           | 36    |

**Senior Year**

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<th>Units</th>
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<tr>
<td>15-xxx Computer Science Elective</td>
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<td>xx-xxx Minor Requirement / Free Elective</td>
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<td>xx-xxx Humanities and Arts Elective</td>
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**Spring**

| 15-xxx Computer Science Elective          | 9     |
| xx-xxx Minor Requirement / Free Elective  | 9     |
| xx-xxx Minor Requirement / Free Elective  | 9     |
| xx-xxx Humanities and Arts Elective       | 9     |
|                                           | 36    |

**Minimum units required for degree: 360**

### Computer Science/Engineering and Public Policy

#### Double Major

**Sophomore Year**

<table>
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<tbody>
<tr>
<td>15-113 Same</td>
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<td>15-212 Same</td>
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<td>36-217 Same</td>
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<tr>
<td>xx-xxx Same</td>
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<tr>
<td>73-100 Principles of Economics</td>
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**Spring**

| 15-213 Same                              | 12    |
| 15-xxx Same                             | 9     |
| 24-241 Same                             | 9     |
| xx-xxx Same                             | 9     |
| xx-xxx EPP Social Analysis Elective*     | 9     |
| xx-xxx EPP Technical Elective           | 9     |
|                                           | 48    |

**Junior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
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</tbody>
</table>

**Spring**

| 15-xxx Same                             | 9     |
| 15-xxx Same                             | 9     |
| 19-451 EPP Project                     | 12    |
| xx-xxx EPP Social Analysis Elective*     | 9     |
| xx-xxx EPP Technical Elective           | 9     |
|                                           | 39    |

**Senior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-xxx Same</td>
<td>9</td>
</tr>
<tr>
<td>19-452 EPP Project</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx EPP Social Analysis Elective*</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx EPP Technical Elective</td>
<td>9</td>
</tr>
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**Spring**

| 15-xxx Same                             | 9     |
| 36-220 Engr Stats and Quality Control   | 9     |
| xx-xxx EPP Technical Elective           | 9     |
| xx-xxx EPP Social Analysis Elective*     | 9     |
|                                           | 36    |

**Minimum units required for degree: 369**

* One Social Analysis Elective must be a Decision Analysis course from the following list:

- 88-223 Decision Analysis and Decision Support Systems
- 88-302 Behavioral Decision Making
- 19-426 Environmental Decision Making

* 73-100, Principles of Economics, satisfies the BSCS category 2 breadth requirement and is also required for the CS/EPP double major.
### Electrical and Computer Engineering

#### Single Major

**Sophomore Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>18-200 Emerging Trends in Electrical and Computer Engineering</td>
<td>1</td>
</tr>
<tr>
<td>18-2x0 ECE Core Course</td>
<td>12</td>
</tr>
<tr>
<td>18-202 Mathematical Foundations of Electrical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>33-107 Physics for Engineering Students II</td>
<td>12</td>
</tr>
<tr>
<td><strong>x</strong>-<strong>xx</strong> General Education Course</td>
<td>9</td>
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</tbody>
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**Spring**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>18-2x0 ECE Core Course</td>
<td>12</td>
</tr>
<tr>
<td>21-127 Introduction to Modern Mathematics</td>
<td>9</td>
</tr>
<tr>
<td><strong>x</strong>-<strong>xx</strong> General Education Course</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> ECE Breadth Course 2</td>
<td>12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> ECE Breadth Course 3</td>
<td>12</td>
</tr>
<tr>
<td>36-217 Probability and Statistics</td>
<td>9</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> General Education Course</td>
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**Spring**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> ECE Depth Course</td>
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</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> ECE Coverage Course 1</td>
<td>12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Engineering Elective</td>
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<td><strong>xx</strong>-<strong>xxx</strong> General Education Course</td>
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</table>

#### Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Capstone Design (e.g., ECE Coverage Course 2)</td>
<td>12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Math/Science Elective 2</td>
<td>9</td>
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<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Free Elective</td>
<td>9/12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Free Elective</td>
<td>6</td>
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<tr>
<td><strong>xx</strong>-<strong>xxx</strong> General Education Course</td>
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**Spring**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Free Elective</td>
<td>12</td>
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<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Free Elective</td>
<td>12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> General Education Course</td>
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Minimum number of units required for degree: 360

### Electrical and Computer Engineering/Engineering and Public Policy

#### Double Major

**Sophomore Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-200 Same</td>
<td>12</td>
</tr>
<tr>
<td>18-2x0 Same</td>
<td>12</td>
</tr>
<tr>
<td>18-202 Same</td>
<td>12</td>
</tr>
<tr>
<td>33-107 Same</td>
<td>12</td>
</tr>
<tr>
<td>73-100 Principles of Economics</td>
<td>9</td>
</tr>
<tr>
<td>19-102 EPP Sophomore Seminar</td>
<td>3</td>
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</tbody>
</table>

**Spring**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>18-2x0 Same</td>
<td>12</td>
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<tr>
<td>18-205 Same</td>
<td>12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Same</td>
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</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> EPP Social Analysis Elective*</td>
<td>9</td>
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</tbody>
</table>

#### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Same</td>
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</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Same</td>
<td>12</td>
</tr>
<tr>
<td>36-217/220 Same</td>
<td>9</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Same</td>
<td>9</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> EPP Social Analysis Elective*</td>
<td>9</td>
</tr>
</tbody>
</table>

**Spring**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Same</td>
<td>12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Same</td>
<td>12</td>
</tr>
<tr>
<td>19-451 EPP Project</td>
<td>12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> EPP Social Analysis Elective*</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> Same</td>
<td>12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> EPP Technical Elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> EPP Technical Elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> EPP Social Analysis Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

**Spring**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> EPP Technical Elective</td>
<td>12</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> EPP Technical Elective</td>
<td>12</td>
</tr>
<tr>
<td>36-217/220 Second Statistics Course</td>
<td>9</td>
</tr>
<tr>
<td><strong>xx</strong>-<strong>xxx</strong> EPP Social Analysis Elective</td>
<td>9</td>
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</table>

Minimum number of units required for degree: 363

* One of these must be taken from the following list:

- 88-302 Behavioral Decision Making
- 88-223 Decision Analysis and Decision Support Systems
- 19-426 Environmental Decision Making
Materials Science and Engineering

Single Major

Sophomore Year

Fall   Units
21-259 Calculus in Three Dimensions 9
21-126 Introduction to Mathematical Software 3
33-107 Physics for Engineering Students II 12
27-299 MSE Undergraduate Seminar I 1
27-215 Thermodynamics of Materials 12
27-201 Perfect Crystals 6+3
27-202 Defects in Materials 6+3

Spring

21-260 Differential Equations 9
09-105 Modern Chemistry I 10
09-101 Introduction to Experimental Chemistry 3
27-216 Transport in Materials 9+3
27-217 Phase Relations and Diagrams 9+3
xx-xxx H&SS Elective 9

Junior Year

Fall   Units
33-225 Quantum Physics and Structure of Matter 9
or 09-117 Organic Chemistry 9
or 03-121 Modern Biology 9
27-399 MSE Undergraduate Seminar II 1
27-301 Microstructure and Properties I 6+3
27-367 Selection and Performance of Materials 6
xx-xxx Free Elective 9
xx-xxx H&SS Elective 9

Spring

36-220 Engineering Statistics and Quality Control 9
xx-xxx H&SS Elective 9

Senior Year

Fall   Units
27-401 MSE Capstone Course [1] 6
27-402 MSE Capstone Course [2] 6
27-499 MSE Undergraduate Seminar III 1
xx-xxx H&SS Elective 9
xx-xxx H&SS Elective 9

Spring

27-xxx MSE Restricted Elective [7] 6
27-xxx MSE Restricted Elective [8] 6
xx-xxx H&SS Elective 9

Minimum number of units required for degree: 382

Materials Science and Engineering/Engineering and Public Policy

Double Major revised 11-03

Sophomore Year

Fall   Units
21-259 Same 9
21-126 Same 3
33-107 Same 12
27-299 MSE Undergraduate Seminar I 1
27-215 (Seminar requirement is met by 19-102) 12
27-201 Same 6+3
27-202 Same 6+3
19-102 EPP Sophomore Seminar 3

Spring

21-260 Same 9
09-105 Same 10
09-101 Same 3
27-216 Same 9+3
27-217 Same 9+3
73-100 Principles of Economics 9

Junior Year

Fall   Units
33-225 Same 9
or 09-117 Same 9
or 03-121 Same 9
27-xxx Same 6
27-301 Microstructure and Properties I 6+3
27-367 Selection and Performance of Materials 6
xx-xxx EPP Social Analysis Elective* 9
xx-xxx EPP Social Analysis Elective* 9
xx-xxx Free Elective 9
xx-xxx EPP Technical Elective 9
19-451 EPP Project 12
xx-xxx EPP Social Analysis Elective* 9

Spring

36-220 Same 9
27-xxx Same 6
27-xxx Same 6
xx-xxx EPP Technical Elective 9
19-451 EPP Project 12
xx-xxx EPP Social Analysis Elective* 9
xx-xxx EPP Technical Elective 9

Senior Year

Fall   Units
27-401 Same 6
27-402 Same 6
(Seminar requirement is met by 19-102) 6
27-xxx Same 6
27-xxx Same 6
xx-xxx EPP Technical Elective 9
19-452 EPP Project 12
xx-xxx EPP Social Analysis Elective* 9
xx-xxx EPP Social Analysis Elective* 9

Spring

27-xxx Same 6
27-xxx Same 6
(EPP double majors take 36 vs 48 units of MSE restricted electives) 6
36-310 Fundamentals of Statistical Modeling 9
xx-xxx EPP Social Analysis Elective* 9
xx-xxx EPP Social Analysis Elective* 9
xx-xxx EPP Technical Elective 9

Minimum number of units required for degree: 385

* One of these must be taken from the following list:
  88-302 Behavioral Decision Making
  88-223 Decision Analysis and Decision Support Systems
  19-426 Environmental Decision Making
# Mechanical Engineering

**Single Major**

**Sophomore Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>24-221 Thermodynamics I</td>
<td>10</td>
</tr>
<tr>
<td>24-261 Statics</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx Restricted Technical Elective*</td>
<td>10-13</td>
</tr>
<tr>
<td>xx-xxx General Education Course**</td>
<td>9</td>
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</tbody>
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**Spring**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-260 Differential Equations</td>
<td>9</td>
</tr>
<tr>
<td>24-231 Fluid Mechanics</td>
<td>10</td>
</tr>
<tr>
<td>24-262 Stress Analysis</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx Restricted Technical Elective</td>
<td>10-13</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
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**Junior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>24-302 Mechanical Engineering Seminar I</td>
<td>1</td>
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<tr>
<td>24-311 Numerical Methods</td>
<td>9</td>
</tr>
<tr>
<td>24-322 Heat Transfer</td>
<td>10</td>
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<tr>
<td>24-351 Dynamics</td>
<td>12</td>
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<tr>
<td>24-xxx Mechanical Engineering Technical Elective</td>
<td>9-12</td>
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<tr>
<td>xx-xxx General Education Course</td>
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<table>
<thead>
<tr>
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<th>Units</th>
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</thead>
<tbody>
<tr>
<td>24-371 Electromechanical Systems</td>
<td>10</td>
</tr>
<tr>
<td>24-303 Mechanical Engineering Seminar II</td>
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</tr>
<tr>
<td>24-321 Thermal-Fluids Engineering</td>
<td>12</td>
</tr>
<tr>
<td>24-352 Dynamic Systems and Control</td>
<td>12</td>
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<tr>
<td>xx-xxx General Education Course</td>
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**Senior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>24-401 Engineering Analysis</td>
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<td>or</td>
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<td>24-441 Engineering Design</td>
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<tr>
<td>xx-xxx Elective</td>
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<td>xx-xxx Elective</td>
<td>9</td>
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<tr>
<td>xx-xxx General Education Course</td>
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<table>
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<th>Units</th>
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<tbody>
<tr>
<td>24-441 Engineering Design</td>
<td>12</td>
</tr>
<tr>
<td>or</td>
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<tr>
<td>24-401 Engineering Analysis</td>
<td>12</td>
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<tr>
<td>24-xxx Mechanical Engineering Technical Elective</td>
<td>9-12</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
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<tr>
<td>xx-xxx Elective</td>
<td>9</td>
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<tr>
<td>xx-xxx General Education Course</td>
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</tbody>
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**Minimum number of units required for degree: 380**

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# Mechanical Engineering/Engineering and Public Policy

**Double Major**

**Sophomore Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>21-259 Same</td>
<td>9</td>
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<tr>
<td>24-221 Same</td>
<td>10</td>
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<tr>
<td>24-261 Same</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx Same</td>
<td>10-13</td>
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<tr>
<td>73-100 Principles of Economics</td>
<td>9</td>
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<tr>
<td>19-102 EPP Sophomore Seminar</td>
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<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>21-260 Same</td>
<td>9</td>
</tr>
<tr>
<td>24-231 Same</td>
<td>10</td>
</tr>
<tr>
<td>24-262 Same</td>
<td>12</td>
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<tr>
<td>xx-xxx Same</td>
<td>10-13</td>
</tr>
<tr>
<td>xx-xxx EPP Social Analysis Elective</td>
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**Junior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>24-311 Same</td>
<td>9</td>
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<tr>
<td>24-322 Same</td>
<td>10</td>
</tr>
<tr>
<td>24-351 Same</td>
<td>12</td>
</tr>
<tr>
<td>36-220 Engineering Statistics and Quality Control</td>
<td>9</td>
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<tr>
<td>xx-xxx EPP Social Analysis Elective*</td>
<td>9</td>
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</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
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<tbody>
<tr>
<td>24-371 Same</td>
<td>10</td>
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<tr>
<td>(Seminar requirement is met by 19-102)</td>
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<tr>
<td>24-321 Same</td>
<td>12</td>
</tr>
<tr>
<td>24-352 Same</td>
<td>12</td>
</tr>
<tr>
<td>19-451 EPP Project I</td>
<td>12</td>
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**Senior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-442 EPP Engineering Design EPP</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx EPP Technical Elective</td>
<td>9</td>
</tr>
<tr>
<td>19-452 EPP Project (replaces single major 24-401 requirement)</td>
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</tr>
<tr>
<td>xx-xxx EPP Technical Elective</td>
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</tr>
<tr>
<td>xx-xxx EPP Social Analysis Elective*</td>
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<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-310 Fundamentals of Statistical Modeling</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx EPP Technical Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx EPP Social Analysis Elective*</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx EPP Social Analysis Elective</td>
<td>9</td>
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</tbody>
</table>

**Minimum number of units required for degree: 384**

* One of these must be taken from the following list:
  - 88-302 Behavioral Decision Making
  - 88-223 Decision Analysis and Decision Support Systems
  - 19-426 Environmental Decision Making
Engineering and Public Policy
Undergraduate / Graduate Level Courses

Many courses taught by the department (19-XXX courses) are offered to undergraduate and graduate students. These "dual level" courses are offered in two formats:

- Some courses are taught under both an undergraduate and graduate number. An example is 19-402 / 19-712 Telecommunications Technology, Policy and Management. In these types of courses, students who sign up under the 700-level (graduate) course number may be expected to perform the same coursework at a higher level, and / or complete additional coursework, compared to 19-4XX students. Undergraduates who choose to take the course under the graduate number will be also expected to work at the higher expectation / coursework level.

- Other courses are taught under a 600 level number. An example is 19-650 Climate and Energy: Science and Public Policy. These courses may be taken by undergraduates as a senior level course, or by graduate students as a graduate level course. As with dual number courses, graduate level students, or undergraduates taking the course for graduate credit, may be required to perform coursework at a higher level and / or complete additional coursework. Undergraduates who are taking a 600 level course for graduate credit should identify this fact to both the course instructor and to their EPP department advisor.

Students who have questions about the requirements of a specific EPP 400 / 700, or 600 level course, should contact the course instructor. Other departments may have different policies regarding courses offered under both an undergraduate and graduate number, and courses offered under numbers other than the 100, 200, 300, 400, or 700 levels. Students who wish to take these courses should check with those departments for their specific policies.

Engineering and Public Policy Electives

Engineering and Public Policy technical elective courses are taught in CIT, MCS, or SCS. EPP technical electives generally belong to two categories: courses which synthesize engineering analysis and social analysis perspectives and apply them to problems with substantial societal and technological components; or, courses that teach methods or background vital to classes of important problems at the technology-society interface.

Specific areas of interest in which courses are taught are energy, resources, and the environment; risk assessment; forensic engineering; urban engineering; telecommunications, advanced information systems, and robotics. Courses may be elected in any of these areas or concentrated in one area. Each student elects four of these courses.

A categorical listing of representative EPP technical electives is provided below. There are more than 130 EPP Technical Electives available in various semesters. Also, course offerings are subject to change, and may have prerequisites. Students should always consult the EPP advising packet for the semester for which they are enrolling. The course listing in the current semester advising packet always has precedent over the following list.

Energy, Resources and the Environment

19-424/ Energy and the Environment
24-424
12-651 Air Quality Engineering
12-655 Water Quality Engineering
19-707 The Business of Brownfields

Information and Telecommunication Technologies

19-402/ Telecommunications Policy Analysis 18-482
15-381 Artificial Intelligence: Representation and Problem Solving
15-385 Artificial Intelligence: Computer Vision 15-827 Security and Cryptography
19-601 Information Warfare

Other

03-121 Modern Biology
03-360 The Biology of the Brain
15-540 Rapid Design and Prototyping of Computer Systems
19-448/748 Science, Technology and Ethics
18-443/ Civilian and Military Applications of Space
19-430
15-391 Computer Science and the Community
21-292 Operations Research
39-405 Engineering Design: The Creation of Products and Processes
39-600 Integrated Product Development

Social Analysis Electives

In addition to traditional engineering skills, double majors in the Engineering and Public Policy Department are expected to acquire social science skills that complement their engineering skills and prepare them to address the complicated problems which confront engineers in both the public and private sector. Listed below are areas of social analysis deemed relevant to double majors’ career objectives and some of the courses currently available in each area.

Courses may be elected in any of these areas, or concentrated in one or two specific areas. Faculty advisors can help students in choosing areas best suited to individual needs. Each student elects four courses in addition to 73-100 and the decision science course (88-223, 88-302, or 19-426). The 4 Social Analysis Electives replace the CIT depth sequence requirement. Students may also count one foreign language course (82-XXX) as a Social Analysis Elective.

The following is a representative sample: Over 300 Social Analysis Electives are offered in various semesters. Also, course offerings are subject to change. Students should always consult the EPP advising packet for the semester for which they are enrolling. The current semester advising packet list always has precedent over the course listing below.

Economics

Economics skills are aimed at the understanding of the free economy, and the development and use of analytical tools for handling complex economic variables. All economics courses qualify as social analysis electives. Examples are:

73-100 Principles of Economics (required)
73-250 Intermediate Microeconomics
73-248 Environmental Economics
73-340 Labor Economics
73-469 Economics of E Commerce

Interpersonal Processes and Organizations

Skills in interpersonal processes involve an awareness of the development of relationships, the obligations of relationships, processes of bargaining, coalition formation, and power and dependence. Examples are:

85-221 Principles of Child Development
85-241 Social Psychology
70-311 Organizational Behavior
88-260 Organizations
88-302 Behavioral Decision Making

Ethics

As technology and society become more closely intertwined, it becomes imperative that engineers whose products serve society, be aware of ethical problems that may arise in their work. Courses in ethics taught by the Department of Philosophy address issues of ethics in different spheres.

80-230 Ethical Theory
80-241 Ethical Judgments in Professional Life
80-244 Management, Environment, and Ethics
80-245 Medical Ethics
80-340 Environmental Ethics
Political Analysis
Political analysis includes knowledge of the structure of American government, especially legislative, executive, budgetary, regulatory and electoral processes.
70-364 Business Law
88-104 Decision Processes in American Political Institutions
88-324 Electoral Processes
88-358 Policy Making Institutions
88-441 Formal Models of Political Economies

Urban Analysis
Urban analysis provides a better understanding of phenomena such as urbanism and urbanization, urban economic base and growth, metropolitanization and suburbanization, urban ecology and social differentiation, location behavior and the distribution of activities, and transportation development in the evolution of land use.
79-226 Cultural Memory in the Urban Space
79-235 The City in History
79-243 A History of Urban American Life
79-244 Pittsburgh and the Transformation of Modern Urban America
79-353 Culture Class and Survival in Urban America
90-743 Urban and Regional Economic development

Technology and Society
This area deals with the interaction of technology and society from a historical and humanistic perspective. Among the questions considered are the role of technology in the industrial revolution, the impact of technology on the city and the relationship of government policy to technological development.
79-212 History of Modern Science
79-230 Technology in American Society
79-384 Medicine and Society
88-343 Economics of Technological Change
88-345 The Rise of Industrial Research and Development

International Peace and Security
National and international problems dealing with security and strategy and their political and historical perspectives are examined in these courses.
79-231 American Foreign Policy 1945-Present
79-232 Vietnam: America’s Last War
79-350 Theories in International Relations
79-351 The Cold War in Documents and Film
79-352 Arab-Israeli Condition: War and Peace

Policy Analysis
This area deals with the analyses and assessments which form the basis of policies and decisions as well as the methodologies of policy making which are used to transform a model into a workable policy.
80-321 Causation and Social Policy
80-346 Value Fact and Policy
88-220 Policy Analysis I
88-223 Decision Analysis and Decision Support Systems
88-331 Political Feasibility and Policy Analysis

Role of Computers in Institutions
This area deals with the institutional, interpersonal, and policy aspects of the increasing role of computers in our society.
88-344 Organizational Intelligence in the Information Age
90-802 Information Security: Comparison of U.S. and European Policies
90-813 Cybercrime
91-832 Legal Issues in Information Technology
95-730 Electronic Commerce

Students are urged to elect as a social analysis elective one technical writing course, such as 76-270 Writing for the Professions or 76-379 Technical Communications for Engineers.
LESTER B. LAVE, University Professor; James H. Higgins Professor of Economics; Professor of Engineering and Public Policy; Director, Green Design Institute; Co-Director, Carnegie Mellon Electricity Industry Center — Ph.D., Harvard University; Carnegie Mellon 1963—.

H. SCOTT MATTHEWS, Assistant Professor of Civil and Environmental Engineering/Engineering and Public Policy; Research Director, Green Design Institute — Ph.D., Carnegie Mellon University; Carnegie Mellon 1999—.

FRANCIS C. McMICHAEL, Walter J. Blenko, Sr. Professor of Environmental Engineering; Professor of Civil and Environmental Engineering/Engineering and Public Policy, Emeritus — Ph.D., California Institute of Technology; Carnegie Mellon 1967—.

BENOÎT MOREL, Senior Lecturer of Engineering and Public Policy/Physics — Ph.D., University of Geneva; Carnegie Mellon 1987—.

M. GRANGER MORGAN, University and Lord Chair Professor of Engineering; Head of the Department of Engineering and Public Policy; Professor of Engineering and Public Policy/Electrical and Computer Engineering/The H. John Heinz III School of Public Policy and Management; Co-Director, Carnegie Mellon Electricity Industry Center — Ph.D., University of California, San Diego; Carnegie Mellon 1974—.

INDIRA NAIR, Vice Provost for Education; Professor of Engineering and Public Policy — Ph.D., Northwestern University; Carnegie Mellon 1978—.

SPYROS N. PANDIS, Research Professor of Chemical Engineering/Engineering and Public Policy — Ph.D., California Institute of Technology; Carnegie Mellon 1993—.

JON M. PEHA, Professor of Engineering and Public Policy/Electrical and Computer Engineering — Ph.D., Stanford University; Carnegie Mellon 1991—.

ADRIAN PERRIG, Assistant Professor of Electrical and Computer Engineering/Engineering and Public Policy — Ph.D., Carnegie Mellon University; Carnegie Mellon 2002—.

HENRY R. PIEHLER, Professor of Materials Science and Engineering/Engineering and Public Policy/Biomedical Engineering, Emeritus — Sc.D., MIT; Carnegie Mellon 1967—.

ALLEN ROBINSON, Associate Professor of Mechanical Engineering/Engineering and Public Policy — Ph.D., University of California, Berkeley; Carnegie Mellon 1998—.

EDWARD S. RUBIN, The Alumni Professor of Environmental Engineering and Science; Professor of Engineering and Public Policy/Mechanical Engineering; Director, Center for Energy and Environmental Studies — Ph.D., Stanford University; Carnegie Mellon 1969—.

MARVIN A. SIRBU, Professor of Engineering and Public Policy/Industrial Administration/Electrical and Computer Engineering — Sc.D., MIT; Carnegie Mellon 1985—.

MITCHELL J. SMALL, The H. John Heinz III Professor of Environmental Engineering; Professor and Associate Department Head for Graduate Affairs of Engineering and Public Policy; Professor of Civil and Environmental Engineering — Ph.D., University of Michigan; Carnegie Mellon 1982—.

JOEL A. TARR, Richard S. Caliguiri Professor of Urban and Environmental History and Policy; Professor of History/Engineering and Public Policy/The H. John Heinz III School of Public Policy and Management— Ph.D., Northwestern University; Carnegie Mellon 1967—.

RAHUL TONGIA, Research Engineer of Engineering and Public Policy; Systems Scientist of Computer Science — Ph.D., Carnegie Mellon University; Carnegie Mellon 1998—.

HERBERT L. TOOR, University Professor of Chemical Engineering/Engineering and Public Policy, Emeritus — Ph.D., Northwestern University; Carnegie Mellon, 1953—.

FRANCISCO VELOSO, Assistant Professor of Engineering and Public Policy— Ph.D., MIT; Carnegie Mellon 2002—.

ROBERT M. WHITE, University Professor of Electrical and Computer Engineering/Engineering and Public Policy, Emeritus — Ph.D., Stanford University; Carnegie Mellon, 1993—.
Materials Science and Engineering

Alan W. Cramb, Head Office: Wean Hall 3327

Essentially every technology depends on materials development and innovation. Novel technologies are often initiated based on materials innovations, while conventional technologies rely on materials development to either reduce production costs or respond to mandates of the marketplace. The overarching paradigm of materials science and engineering is to exploit the connection between processing, microstructure and the properties of a material in order to choose a material that will fit the performance criteria for a given application. Thus, in Materials Science and Engineering, one must develop: (1) an understanding of current materials and their applications; (2) an ability to further improve current materials; and, (3) an ability to understand the potential applications of new materials, as they are developed. In addition to this product specific knowledge, a Materials Engineer must understand the implications of Materials processing routes on the environment and energy resources and must be involved in life cycle analysis to ensure that the material can be properly produced, used and recycled in a sustainable manner.

Materials Science & Engineering is therefore the discipline that applies the tools of basic and applied science to the processing, manufacture and application of materials, and the tools and understanding of the production routes on the environment and energy resources and must be involved in life cycle analysis to ensure that the material can be properly produced, used and recycled in a sustainable manner.

Materials Science and Engineering is the overarching term describing the study and understanding one type of material are often well suited for others. Thus a common set of tools and understanding has been developed that applies to the complete spectrum of materials types, including ceramics, polymers, metals, semiconductors and composites, etc.

The paradigm of materials science is that one must understand the internal or surface structure of materials in order to predict and engineer their properties: this is addressed in the core courses on "Microstructure & Properties" and "Selection & Performance" of materials. There is also a capstone design experience in the final year that is aimed at integration of knowledge and team skill development. The elective program allows the attainment of excellence in a student’s chosen specialty, whether it is ceramics, semiconductors, metals, composites, magnetic or optical materials, biomaterials or polymers. The option of concentration in the one or more of the areas of electronic materials*, engineering design*, biomedical engineering*, environmental engineering*, manufacturing engineering*, mechanical behavior of materials*, biomedical and health engineering**, and engineering and public policy**, is available. (**) Designated Minor, (***) Double Major). In addition, a number of elective tracks have been developed to aid the student in choosing various courses of specialization in the electives. (http://neon.mems.cmu.edu/MSE/tracksh2l)

Based on the broad range of destinations for graduates of the MSE program, our curriculum is designed to provide a strong foundation in fundamental knowledge and skills. This provides an excellent basis for the substantial fraction of our graduates who go on to graduate school. For the equally substantial fraction of our graduates who find employment in industry, the program provides the foundation on which a graduate can build his/her domain specific knowledge. For those individuals who move on to other areas, the MSE curriculum provides a modern liberal education, i.e. one that inculcates a thoughtful, problem-solving approach to professional life. It is thus the goal of our education to provide a general education in Materials Science and Engineering that will enable our graduates to easily switch between materials industries as their career develops or to go to any of the leading institutions of graduate education in Materials and be successful.

Educational Objectives

All ABET accredited academic programs publish long term program objectives, along with statements that describe what students are expected to do know or be able to do by the time of graduation from the program. The faculty of the Department of Materials Science and Engineering, in consultation with students, alumni and other interested parties, has identified the following overarching objective for its program:

(1) To provide a world class educational environment where our students are assured of an undergraduate education in Materials that is current, innovative and an appropriate starting point for a career. Establishing and maintaining a world class educational environment combines developing core competency in the fundamental issues in materials science and engineering with the development of problem solving skills, an ability to work responsibly and ethically within a diverse team, and an appreciation for the necessity for lifelong learning. Regardless of the student’s final career choice, our graduates aspire to leadership positions in their chosen profession. This is accomplished through the second program objective:

(2) To ensure that our curriculum is dynamic, flexible and responsive to the needs of our undergraduates, so that our students are able to tailor their academic program to reflect their specific career objectives.

A dynamic curriculum takes advantage of the historical Carnegie Mellon University interdisciplinary approach to problem solving. It is responsive to the students’ aims in identifying Tracks for technical elective course options, and in minor and dual degree programs. These offer the potential for developing a depth of knowledge in a chosen area of Materials Science and/or coupling Materials competency with another discipline. The flexibility in tailoring the curriculum can often be amplified by research and/or internship opportunities.

The MSE Department recognizes that there are two major career paths of an undergraduate who is educated in Materials at CMU: (a) continued education at a top graduate school in Materials Science and Engineering or a related discipline, or (b) employment as a Materials Engineer or related field in industry. Our curriculum offers an education that fosters an appreciation for both and makes it possible for students to move between the two with ease if they so choose. The final two objectives address these two career paths:

(3) To teach a curriculum that prepares our graduates to be successful in a top graduate school in Materials Science and Engineering or another appropriate discipline, and,
(4) To teach a curriculum that prepares our students to find a suitable position and be successful as a materials engineer or as an engineer in a related field.

Based on these objectives our program is focused to allow a student to be successful regardless of their future career choice.

The Department of Materials Science and Engineering has accepted the following definitions for the educational outcomes of the department that will allow our students to be successful in any career choice and achieve the long term objectives of our department.

**Outcome Definitions for MSE**

**MSE Outcome A:**
An ability to apply a knowledge of mathematics, physics, chemistry, materials and statistics to identify, formulate and solve the problems encountered in the production or application of a material.

**MSE Outcome B:**
An ability to apply core concepts in materials science (structure, properties, processing and performance) to identify, formulate and solve contemporary materials engineering problems.

**MSE Outcome C:**
An ability to communicate effectively.

**MSE Outcome D:**
An ability to design and conduct experiments and to analyze and interpret the data derived from these experiments with an emphasis on relating properties and processing to structure and on relating structure and properties to materials performance.

**MSE Outcome E:**
An ability to select materials to meet relevant performance criteria during the design of engineered systems and components.

**MSE Outcome F:**
An ability to function responsibly and ethically in a professional, multidisciplinary environment as an individual or as a member of a team.

**MSE Outcome G:**
An ability to employ the techniques, skills and tools of modern materials engineering practice.

**MSE Outcome H:**
A recognition of the need for lifelong scholarship as the field of materials is continually evolving as new knowledge and materials are developed.

**MSE Outcome I:**
A Knowledge of contemporary issues in the application of materials.

**MSE Outcome J:**
The broad education necessary to understand the impact of materials engineering solutions in a global and societal context.

**Industrial Intern Program**
An industrial internship option (IIIO - cooperative educational program) within the department offers an MSE student an opportunity to obtain valuable experience and insight from alternating periods in industry and on campus (beginning the spring after the sophomore year). The combination of learning while participating in an industrial environment with academic course work creates strongly motivated students and a personalized learning situation. Graduation with a B.S. degree occurs four and one-third calendar years after entering the university. Exceptionally able students may be admitted to a program leading to both the B.S. and M.S. degrees in five years. Students in the IIIO program should consult with their faculty advisors before electing to participate in any of the designated minor programs.

Following the standard or industrial internship programs the graduate of the Department of Materials Science and Engineering is well prepared for leadership in our highly technological society which continues to demand more and more from the materials used in engineered systems. Many of our graduates elect to continue their education to the Master’s and Doctoral Level in order to satisfy their need for advanced education in the discipline.

**Standard Program**

**Freshman Year**

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Minimum number of units required for degree: 382

* The Materials in Engineering course 27-100 may also be taken in the spring semester, and must be taken before the end of the sophomore year (the H&SS Elective in the Sophomore Spring may be moved to later in the program to accommodate the 27-100 course).

** These courses must be taken before the end of the sophomore year, but need not be taken in the same order or semester as listed above.

*** The 8 MSE Restricted Electives are listed above as 6 unit courses. The student must complete at least 48 units of MSE Restricted Electives, and may combine 6 and 9 unit courses to reach or exceed this total.

Notes on the Curriculum

Quality Point Average

In addition to the College requirement of a minimum cumulative quality point average of 2.00 for all courses taken beyond the freshman year, the Department requires a quality point average of 2.00 or higher in courses taken in the MSE department. Students may repeat a course to achieve the QPA requirement. Only the higher grade will be used for this departmental calculation.

MSE Restricted Electives

The MSE Restricted Electives are listed below. Each student in the Standard or Industrial Internship program must take at least 48 units from this list. In double major programs at least 36 units are required. The total number of units may be reached through any combination of the courses below.

27-302 Microstructure and Properties II
27-322 Processing of Metals
27-323 Powder Processing of Materials
27-402 MSE Capstone Course II
27-421 Processing Design
27-432 Electrical, Magnetic and Optical Properties of Materials
27-442 Deformation Processing
27-454 Supervised Reading
27-510 Introduction to Biomaterials I
27-511 Introduction to Biomaterials II
27-512 Diffraction Methods in Materials Science
27-530 Advanced Physical Metallurgy
27-533 Principles of Growth and Processing of Semiconductors
27-542 Processing and Properties of Thin Films
27-551 Properties of Ceramics and Glasses
27-555 Materials Project I
27-556 Materials Project II
27-560 Physical Chemistry of Metallurgical Reactions
27-566 Special Topics
27-582 Phase Transformations in Solids
27-591 Mechanical Behavior of Materials
27-592 Solidification Processing
27-594 Electrochemical Processes in Materials
06-466 Experimental Polymer Science
06-609 Physical Chemistry of Macromolecules
06-619 Semiconductor Processing Technology
06-466 Experimental Polymer Science
12-605 Design and Construction
12-411 Engineering Economics
12-611 Project Management Construction
12-631 Structural Design
18-311 Semiconductor Devices I
18-412 Semiconductor Devices II
24-262 Stress Analysis
24-341 Manufacturing Sciences
24-361 Intermediate Stress Analysis
24-401 Engineering Analysis
33-341 Thermal Physics I
33-448 Introduction to Solid State Physics
42-644 Medical Devices

Industrial Internship Option (Cooperative Education Program)

The industrial internship option (IIO) unique to the Department offers the student in Materials Science and Engineering an opportunity to supplement the regular academic program with valuable practical experience through alternating periods in industry and on campus, beginning in the Spring of the sophomore year. Interested students should apply for this option during the first semester of the sophomore year and are expected to follow the program, including four industry periods, to completion.

Standard Program

Sophomore Program

Fall
Standard Program for the Fall semester; co-op interviews in Fall

Spring
Industry 1

Summer

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Junior Year

Fall
Industry 2

Spring

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Summer
Industry 3

Senior Year

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Summer
Industry 4

[1] MSE Restricted Electives

Industry Periods

Standard Program for the Fall semester; co-op interviews in Fall
Fifth Year

Fall
27-499 MSE Undergraduate Seminar (session 3) 1
27-xxx MSE Restricted Elective [7] 6
27-xxx MSE Restricted Elective [8] 6
27-401 MSE Capstone Course 12

Minimum number of units required for degree: 382

* The 8 MSE Restricted Electives are listed above as 6 unit courses. The student must complete at least 48 units of MSE Restricted Electives, and may combine 6 and 9 unit courses to reach or exceed this total.

** See remark after Standard Program.

Integrated B.S./M.S. Program

Undergraduates have the opportunity to receive simultaneously or sequentially awarded B.S. and M.S. degrees in MSE by taking an additional 96 units of coursework at Carnegie Mellon. The primary purpose of the Integrated Masters/ Bachelor Degree Program is to provide students with superior breadth and depth in technical material, which will better prepare them for careers in industry. The Integrated Masters/Bachelor Degree Program normally requires an additional academic year of coursework beyond the B.S. Degree Requirements. However, students interested in pursuing the Integrated M.S./B.S. Degrees are encouraged to begin taking some of the required graduate courses before their last year.

Degree Requirements

The following are the additional requirements for the Integrated M.S./B.S. Degrees over and above the requirements for the B.S. Degree. Note that no course can be counted as satisfying more than one of the requirements listed below and no course used to satisfy the B.S. Degree requirements can be used to satisfy any other requirements such as a double major or minor.

1. Course Option (96 units)
   27-780 Thermodynamics
   27-788 Defects in Materials
   27-766 Diffusion in Materials
   27-779 Bonding in Crystalline Materials
   • plus 60 units of 500 or 700 level Materials Science and Engineering courses.

2. Research Option (30 units, Summer 4-th year)
   27-780 Thermodynamics
   27-779 Bonding in Crystalline Materials
   27-766 Diffusion in Materials
   27-779 Bonding in Crystalline Materials
   • plus 30 units of 500 or 700 level Materials Science and Engineering courses.
   • plus 30 units of 27-756 Masters project (usually taken in the summer of the fourth year).

The Integrated B.S./M.S. Degree Program is available to all undergraduates who maintain a cumulative GPA of 3.0 or better, including the freshman year. Students must also maintain a GPA of 3.0 in courses used to satisfy the requirements of the M.S. degree. No course with a grade lower than C will be counted toward the Master's Degree requirements (those over and above the requirements for the B.S. Degree).

Students (with a cumulative GPA of 3.0 or higher) become eligible to apply to the program during the spring semester of their junior year, or the semester in which they accumulate 280 or more units, whichever is earlier. Interested students should apply to the Department Head of Materials Science and Engineering prior to February 15 of their junior year.

As with all M.S. Degrees in the Department of Materials Science and Engineering, students must pass the master's comprehensive examination which should be taken near the end of the Spring semester of the fourth year. Although some specific graduate courses are required above, substitutions are permitted within the freedom of the normal requirements for the M.S. degree (see graduate curriculum information for further details). Students interested in a program with a strong research orientation are encouraged to elect 27-402 MSE Capstone Course II as part of their undergraduate program.

Faculty

V.S. ARUNACHALAM, Distinguished Service Professor of Materials Science and Engineering, Engineering and Public Policy and Robotics — Ph.D. Wales (England); Carnegie Mellon, 1995—.

KATAYUN BARMAK, Professor of Materials Science and Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon 1999—.

MICHAEL BOCKSTALLER, Assistant Professor of Materials Science and Engineering — Ph.D., Max-Planck Institute for Polymer Research; Carnegie Mellon 2005—.

ALAN W. CRAMB, POSCO Professor and Head of Materials Science and Engineering — Ph.D., University of Pennsylvania; Carnegie Mellon, 1986—.

ROBERT F. DAVIS, Bertucci Professor of Materials Science and Engineering — Ph.D., University of California, Berkeley; Carnegie Mellon, 2004—.

ROBERT HEARD, Lecturer and Coordinator, Industrial Internship Option, Ph.D., University of Toronto; Carnegie Mellon, 2003—.

PRASHANT KUMTA, Professor of Materials Science and Engineering — Ph.D., University of Arizona; Carnegie Mellon; 1990—.

DAVID E. LAUGHLIN, ALCOA Professor of Materials Science and Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1974—.

MICHAEL E. MCHENRY, Professor of Materials Science and Engineering — Ph.D. Massachusetts Institute of Technology; Carnegie Mellon 1989—.

HENRY R. PIEHLER, Professor of Materials Science and Engineering, and Public Policy — D.Sc., Massachusetts Institute of Technology; Carnegie Mellon, 1967—.

LISA M. PORTER, Associate Professor of Materials Science and Engineering — Ph.D., North Carolina State; Carnegie Mellon, 1997—.

GREGORY S. ROHRER, Mullins Professor of Materials Science and Engineering Ph.D., University of Pennsylvania; Carnegie Mellon, 1990—.

ANTHONY D. ROLLETT, Professor of Materials Science and Engineering — Ph.D., Drexel University; Carnegie Mellon, 1995—.

PAUL A. SALVADOR, Associate Professor of Materials Science and Engineering — Ph.D., Northwestern University; Carnegie Mellon, 1999—.

SRIDHAR SEETHARAMAN, Associate Professor of Materials Science and Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2000—.

MAREK SKOWRONSKI, Professor of Materials Science and Engineering — Ph.D., Warsaw University; Carnegie Mellon, 1988—.

ELIAS TOWE, Grobstein Professor of Materials Science and Engineering and Electrical and Computer Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2001—.
Emeritus Faculty

HUBERT I. AARONSON, Robert Franklin Mehl Professor Emeritus of Materials Science and Engineering —Ph.D., Carnegie Mellon University; Carnegie Mellon, 1979—.

THADDEUS B. MASSALSKI, Professor Emeritus of Physics, Materials Science and Engineering —Ph.D., D.Sc., University of Birmingham, England; D.Sc. (h), University of Warsaw, Poland; Carnegie Mellon, 1959—.

HAROLD W. PAXTON, University Professor and U.S. Steel Professor Emeritus of Materials Science and Engineering —Ph.D. University of Birmingham, England; Carnegie Mellon, 1986—.

PAUL WYNBLATT, Professor Emeritus of Materials Science and Engineering — Ph.D., University of California at Berkeley; Carnegie Mellon, 1981—.

Affiliated Faculty

AMIT ACHARYA, Associate Professor, Civil and Environmental Engineering— Ph.D. University of Illinois, Urbana-Champaign; Carnegie Mellon 2000—.

JAMES BAIN, Associate Professor, Electrical and Computer Engineering— Ph.D. Stanford University; Carnegie Mellon 1993—.

PHIL CAMPBELL, Senior Research Scientist, Institute for Complex Engineered Systems— Ph.D., The Pennsylvania State University; Carnegie Mellon 2000—.

JACK BEUTH, Professor, Mechanical Engineering — Ph.D., Harvard University; Carnegie Mellon, 1992—.

RANDALL FEENSTRA, Professor, Physics— Ph.D., California Institute of Technology; Carnegie Mellon, 1995—.

STEPHEN GAROFF, Professor, Physics – Ph.D., Harvard University; Carnegie Mellon, 1988 —.

ANDREW GELLMAN, Lord Professor, Chemical Engineering— Ph.D., University of California, Berkeley; Carnegie Mellon 1992—.

DAVID W. GREVE, Professor, Electrical and Computer Engineering— Ph.D., Lehigh University; Carnegie Mellon, 1982—.

DAVID KINDERLEHRER, Professor, Mathematical Sciences – Ph.D., Carnegie Mellon, 1990 —.

DAVID LAMBETH, Professor, Electrical and Computer Engineering and Materials Science and Engineering—Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1989—.

O. BURAK OZDOGANLAR, Assistant Professor of Mechanical Engineering — Ph.D., University of Michigan; Carnegie Mellon, 2004—.

ROBERT SEKERKA, University Professor, Physics, Mathematics and Materials Science—Ph.D., Harvard; Carnegie Mellon , 1969—.

CHARLES SFEIR, Assistant Professor, University of Pittsburgh, School of Dental Medicine— Ph.D., Northwestern University; Carnegie Mellon, 2003—.

DAVID SHOLL, Associate Professor, Chemical Engineering— Ph.D., University of Colorado; Carnegie Mellon, 1998—.

ROBERT SUTER, Professor, Physics— Ph.D., Clark University; Carnegie Mellon, 1981—.

LYNN WALKER, Associate Professor, Chemical Engineering— Ph.D., University of Delaware; Carnegie Mellon, 1997—.

LEE WEISS, Principal Research Scientist, ICES— Ph.D., Carnegie Mellon University; Carnegie Mellon, 1983—.

JIAN-GANG ZHU, Professor, Electrical and Computer Engineering— Ph.D. University of California at San Diego, Carnegie Mellon, 1997—.
The profession of mechanical engineering, second largest among engineering disciplines, involves the design, analysis, and manufacturing of machines. Central to the profession is the importance of innovation and creativity in technology and products. The Department's curriculum is structured to provide students with the analytical tools, technical skills, engineering insights, and practical problem solving abilities that are necessary to convert a concept into a reliable, cost-effective, and safe device.

Mechanical engineers are employed by small start-ups, multinational corporations, government agencies, national laboratories, consulting firms, and universities. They can work in the areas of research, design, manufacturing, sales, quality assurance, or management. Mechanical engineers work in teams that design jet engines; automobiles; aircraft and spacecraft; microfluidic mechanical and pressure sensors; heating, ventilation, and air conditioning systems; power generation systems; biomedical and biomechanical devices such as artificial hip implants; and such integrated mechanical and electronic (mechatronic) systems as robots. The Department of Mechanical Engineering at Carnegie Mellon University is respected for the many significant advances in these technologies and others that have been made by its alumni and faculty.

The Department's curriculum provides students with a solid foundation upon which they can build to meet the challenges associated with their individual career paths, and to adapt to the rapidly changing technologies faced by today's engineers. Early in their education, Carnegie Mellon students develop a strong scientific foundation by taking courses in mathematics, physics, computer programming, and chemistry. In addition, all students are exposed at the Freshman level to two engineering disciplines through introductory courses taught by each department in the engineering college. The Department's Freshman–level course is project-based, and it orients the students to the various disciplines of mechanical engineering through lecture, laboratories, and hands-on learning. In the Sophomore and Junior years, students take core engineering courses in solid and fluid mechanics, thermodynamics, heat transfer, dynamics, systems and controls, and numerical methods.

While the program is demanding, the Department's curriculum is also flexible and enables students to (i) begin taking elective courses during the Junior year; (ii) develop a specialization within mechanical engineering; (iii) develop a technical emphasis within another engineering or science department; or (iv) pursue studies in any other Carnegie Mellon department, such as foreign languages, economics, or design. This liberal approach to engineering education recognizes the broader role that mechanical engineers play in society, as leaders in business, government, and law. During the Senior year, students take electives and capstone courses in engineering analysis and design with projects that often result in prototype hardware for new products. Students work in teams, on projects of their choosing, and are exposed to the design process from conceptualization to production. Recent examples include low-squeal disk brakes, high efficiency engines, neck gear to minimize spinal cord injury in sports, a stabilizer support arm for movie cameras, and equipment to improve the mobility of disabled persons. Effective writing, speaking and presentation skills, and engineering ethics are also emphasized as important attributes of successful leaders.

Throughout the undergraduate program, beginning in the Freshman year, students use the latest computer-based design and analysis methods in their courses and project work. An undergraduate computing laboratory is available for design work, structural and thermal/fluid finite element analyses, and dynamic system simulations. Students work with industry-standard computer aided design tools to develop engineering drawings, and to visualize the performance of those parts through computer simulation before they are fabricated. After the design is optimized, the computer model can be downloaded to a multi-axis computer-controlled milling machine, from which the part is manufactured. Other resources within the Undergraduate Design and Manufacturing Laboratory include MIG welding, injection molding, and a full student shop equipped with lathes, drill presses, milling machines, band saws, and other hand and power tools. In coursework and projects, students work with state-of-the-art technologies and laboratory equipment, including spectrum analyzers, digital oscilloscopes, multi-waveform generators, and sensors which measure acceleration, strain, pressure, temperature, and force. Through such experiences, the Department emphasizes the modern industrial practice of seamlessly integrating computer-based design, analysis, characterization, and manufacturing.

Through electives and special degree programs, mechanical engineering students are able to pursue their personal interests both inside and outside the Department. Advanced courses in mechanical engineering are available in such areas as energy conversion, control, vibration, dynamics, manufacturing, robotics, internal combustion engines, mechatronics, fluid and solid mechanics, aerodynamics, and engineering design. Mechanical engineering students can also take a wide variety of technical and non-technical electives from other departments in order to develop a double major, minor, or concentration through an individualized program of study that is developed in collaboration with a faculty advisor. Exceptional students can participate in a Departmental senior honors program through a design or research project. Students often find that solving unstructured open-ended problems in project-based courses or in their honors thesis provides the ultimate educational experience.

The Department also offers an Accelerated Graduate Program, with access restricted to Carnegie Mellon undergraduates. In this program, students can take graduate courses during the Senior year in order to receive academic credit towards the Master's degree. After being admitted to the program, students can complete the coursework-based M.S. degree with only an additional summer and one semester of study beyond the traditional B.S. program.

In addition to teaching, the Department's faculty are actively involved in research sponsored by industry, consortia, and government agencies. Results of the research often serve as specific examples, case studies, and projects in undergraduate courses. Frequent seminars are sponsored by the Department, and they keep both students and faculty aware of recent advances in mechanical engineering and its related fields. Speakers of national and international reputation are invited to give these lectures. Seminars are open to all students within the Department, and they can provide students with a broad perspective on the mechanical engineering profession.

Additional information about the program is available through the Department's web page located at www.me.cmu.edu. The Department's Undergraduate Student Handbook includes further description of the Department's resources and policies. The handbook is distributed to all students in the Department each Fall, and is also available on-line at the Department's main web site. Additional copies can be requested in SH 426.

**Educational Objectives**

The mission of the mechanical engineering undergraduate program at CMU is to make positive, substantive, and lasting contributions to the lives of our students and to society. This mission is articulated by two program objectives:

1. The quality of life of our students will be improved through their study of mechanical engineering at CMU, and enriched by opportunities such as interdisciplinary research and a flexible curriculum that facilitates individualized programs of study. The educational and extracurricular experiences at CMU will enable our alumni to practice engineering or to pursue alternative professional paths successfully and, more broadly, to conduct their lives ably and with a sense of personal satisfaction.
2. The efforts and initiatives of our students after graduation, in either technical or non-technical areas, will improve the lives of others. The department’s contribution to society will be magnified by having instilled problem-solving skills, a sense of professional responsibility, and leadership potential in our alumni.

Overview of the Curriculum

The Department’s program fully meets the requirements of an accredited curriculum in mechanical engineering as certified by the Accreditation Board for Engineering and Technology (ABET).

Curriculum

The following template for the four-year B.S. program depicts the standard and recommended course sequences. In order to ensure that prerequisites are satisfied, and to prevent scheduling conflicts, students should discuss any significant deviation from this exemplar with their faculty advisor.

Freshman Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>24-101 Fundamentals of Mechanical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>33-106 Physics for Engineering Students I</td>
<td>12</td>
</tr>
<tr>
<td>99-101 Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx Writing/Expression Course</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>44</strong></td>
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</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-122 Integration, Differential Equations, and Approximations</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx Second Introductory Engineering Course</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx Restricted Technical Elective</td>
<td>10-13</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
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</tr>
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<td><strong>Total</strong></td>
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Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>24-221 Thermodynamics I</td>
<td>10</td>
</tr>
<tr>
<td>24-261 Statics</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx Restricted Technical Elective</td>
<td>10-13</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>48-51</strong></td>
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</table>

Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>21-260 Differential Equations</td>
<td>9</td>
</tr>
<tr>
<td>24-231 Fluid Mechanics</td>
<td>10</td>
</tr>
<tr>
<td>24-262 Stress Analysis</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx Restricted Technical Elective</td>
<td>10-13</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
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<tr>
<td><strong>Total</strong></td>
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</tr>
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Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>24-302 Mechanical Engineering Seminar I</td>
<td>1</td>
</tr>
<tr>
<td>24-311 Numerical Methods</td>
<td>9</td>
</tr>
<tr>
<td>24-322 Heat Transfer</td>
<td>10</td>
</tr>
<tr>
<td>24-351 Dynamics</td>
<td>12</td>
</tr>
<tr>
<td>24-401 Mechanical Engineering Technical Elective</td>
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</tr>
<tr>
<td>xx-xxx General Education Course</td>
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<td><strong>Total</strong></td>
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Spring

<table>
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<th>Course</th>
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<tbody>
<tr>
<td>24-371 Electromechanical Systems</td>
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</tr>
<tr>
<td>24-303 Mechanical Engineering Seminar II</td>
<td>1</td>
</tr>
<tr>
<td>24-321 Thermal-Fluids Engineering</td>
<td>12</td>
</tr>
<tr>
<td>24-352 Dynamic Systems and Control</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
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</tr>
</tbody>
</table>

Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-401 Engineering Analysis</td>
<td>12</td>
</tr>
<tr>
<td>or</td>
<td>9</td>
</tr>
<tr>
<td>24-441 Engineering Design</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>48</strong></td>
</tr>
</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-441 Engineering Design</td>
<td>12</td>
</tr>
<tr>
<td>24-xxx Mechanical Engineering Technical Elective</td>
<td>9-12</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>51</strong></td>
</tr>
</tbody>
</table>

Notes on the Curriculum

1. A minimum of 380 units is required for completion of the B.S. degree.

2. In the Freshman year, 24-101 Fundamentals of Mechanical Engineering can be taken in either the Fall or Spring semesters. A second introductory engineering course is taken in the other semester of the Freshman year.

For those students who did not complete 24-101 Fundamentals of Mechanical Engineering during the Freshman year, this course should be taken during the Fall semester of the Sophomore year in place of the General Education Course. In this event, the replaced General Education Course should be taken during the Junior or Senior years. The additional introductory engineering course can be used to fulfill one of the Elective requirements as described below.

3. By the end of the Sophomore year, a mechanical engineering student should have completed the following mathematics, computer science, and introductory engineering courses:

   - 21-120 Differential and Integral Calculus
   - 21-122 Integration, Differential Equations and Approximation
   - 21-259 Calculus in Three Dimensions
   - 21-260 Differential Equations
   - 33-xxx Physics I for Engineering Students
   - 33-xxx Physics II for Engineering Students
   - 09-105 Modern Chemistry I
   - 15-100 Introductory/Intermediate Programming
   - 15-111 Intermediate/Advanced Programming
   - 24-101 Introduction to Mechanical Engineering
   - xx-xxx Second Introductory Engineering Course

Mechanical engineering undergraduates must satisfy a Science Laboratory requirement to graduate. Normally the Science Laboratory requirement is satisfied by passing 09-101 Introduction Experimental Chemistry (3 units). Students can also satisfy the Science Laboratory requirement by passing one of the following courses:

   - a. 03-124 Modern Biology Laboratory (9 units)
   - b. 33-100 Basic Experimental Physics (6 units)
   - c. 33-104 Experimental Physics (9 units)
   - d. 33-453 Intermediate Optics (12 units)

   These courses may have prerequisites and tight enrollment limits that students should consider in their planning.

4. In the Junior year, the Mechanical Engineering Technical Elective can alternatively be taken in the Spring semester. In this case, students should complete two General Education Courses in the Fall semester of the Junior year, and take no General Education Course in the Spring semester.
5. the Junior year, the communications requirement can be satisfied by completing at least one of the following options:
   24-302 ME Seminar I (1 unit) and 24-303 ME Seminar II (1 unit)
   76-379 Technical Communications for Engineers (9 units)
   70-340 Business Communications (9 units)

6. In the Senior year, students enroll in either 24-401 Engineering Analysis or 24-441 Engineering Design during the Fall semester. The other course is taken during the Spring semester of the Senior year.

**Restricted Technical Electives**

By the end of the Sophomore year, students should have completed each of the following courses, which are listed as "Restricted Technical Electives" in the exemplary curriculum. Students have some flexibility in the sequencing of these courses during the Freshman and Sophomore years:

- 33-107 Physics for Engineering Students II
- 09-101 Introduction to Experimental Chemistry
- 09-105 Modern Chemistry I
- 15-100 Introductory/Intermediate Programming
- 15-111 Intermediate/Advanced Programming

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-107</td>
<td>12</td>
</tr>
<tr>
<td>09-101</td>
<td>3</td>
</tr>
<tr>
<td>09-105</td>
<td>10</td>
</tr>
<tr>
<td>15-100</td>
<td>10</td>
</tr>
<tr>
<td>15-111</td>
<td>10</td>
</tr>
</tbody>
</table>

**Mechanical Engineering Technical Electives**

Students are required to take at least two electives offered by the Department. These elective courses are listed as "Mechanical Engineering Technical Electives" in the exemplary curriculum. The courses below are grouped according to their discipline within mechanical engineering, and students can select courses from the same discipline or from different ones. Students must take at least two of the following courses for a minimum of 18 units to fulfill the Mechanical Engineering Technical Elective requirement:

**Design and Manufacturing**

- 24-201 Engineering Graphics
- 24-341 Manufacturing Sciences
- 24-443 Design for Manufacture

**Mechanical Systems**

- 24-353 Intermediate Dynamics
- 24-354 General Robotics
- 24-355 Kinematics and Dynamics of Mechanisms
- 24-356 Engineering Vibrations
- 24-361 Intermediate Stress Analysis
- 24-451 Feedback Control Systems

**Thermal-Fluid Systems**

- 24-323 Thermodynamics II
- 24-331 Viscous Flow
- 24-332 Potential Flow and Aerodynamics
- 24-333 Gas Dynamics
- 24-421 Internal Combustion Engines
- 24-422 Thermal Systems Analysis
- 24-423 Direct Energy Conversion
- 24-424 Energy and the Environment
- 24-425 Combustion and Air Pollution Control

**Special Topics**

- 24-380-386 Special Topics in Mechanical Engineering

These courses are offered regularly according to the Department’s teaching schedule. However, the offering of a particular course in a given semester cannot be guaranteed.

24-391/392 Mechanical Engineering Project, 24-491/492 Departmental Research Honors, and 39-xxx series courses can not be used to satisfy the Mechanical Engineering Technical Elective requirement. However, those courses can be taken in the remaining five Elective slots.

Undergraduate students can also take certain graduate courses which are offered by the Department in order to satisfy the Mechanical Engineering Technical Elective requirement, provided that the appropriate prerequisites have been met and the student has secured the approval of a faculty advisor and the course’s instructor. Graduate courses offered by the Department are listed in the “Course Descriptions” section of this catalog.

**Electives**

Students are required to complete five courses which are listed as “Electives” in the exemplary curriculum. These electives can be technical or non-technical courses. Only one such elective can be taken in the areas of Physical Education (69-xxx) or ROTC (30-xxx, 31-xxx, and 32-xxx).

Elective courses can be taken in the Mechanical Engineering Department, in other departments within the College of Engineering, or in any other department of the University. This feature of the curriculum is intended to provide students with sufficient flexibility to allow specialization in a wide variety of fields, and to facilitate minor and double major curricula.

**Constructing a Program of Study**

A total of seven electives (two Mechanical Engineering Technical Electives and five Electives) are available to students. These courses should be selected through consultation with a faculty advisor, and reflect long-term planning on the part of the student. For instance, the electives can be allocated in order to meet the requirements of minor, double major, or double degree programs. The Department's Undergraduate Student Handbook provides additional information on course and elective selection. Options available to students for structuring their programs of study include the following:

**Specialization Within Mechanical Engineering**

Students can develop deeper focus within mechanical engineering by using the Elective slots to take additional courses offered by the Department beyond the two required Mechanical Engineering Technical Electives. These courses can be chosen from the list of Mechanical Engineering Technical Electives, or from the list of the Department’s graduate courses.

**Research and Independent Study Projects**

Students can pursue independent study within the Department on a design or research project under the supervision and coordination of a faculty advisor. Interested students are encouraged to contact faculty members and identify potential project areas of mutual interest. Mechanical engineering projects generally involve open-ended problem solving with laboratory, analytical, field, design, or computational work.

Students complete projects and research by taking either or both of the following courses within the Elective slots:

- 24-391/392 Mechanical Engineering Project
- 24-491/492 Departmental Research Honors

These courses do not qualify as Mechanical Engineering Technical Electives. There is no additional quality point average (QPA) requirement for students who choose to enroll in 24-391/392 Mechanical Engineering Project. Qualified students can pursue 24-491/492 Departmental Research Honors and receive such recognition at commencement. In order to graduate with research honors, a student must have attained a QPA of 3.2 or higher at graduation, have completed 18 units of 24-491/492 Departmental Research Honors in which grades of B or better were attained, and have submitted an approved thesis to the faculty advisor.

A student who completes all requirements for CIT Honors Research will also graduate with Departmental Research Honors if a written thesis describing the work completed under 18 units of 39-500 CIT Honors Research is submitted and approved by a faculty advisor before graduation. Such research projects must be conducted under the supervision of a mechanical engineering faculty member.

**Student-Structured Interdisciplinary Studies**

Using the Elective slots, students can take courses outside the Mechanical Engineering Department in technical or non-technical areas. For instance, depending on a student’s particular career interests, courses can be taken in such departments as Design, Biomedical Engineering, or Materials Science and Engineering, or through the College of Engineering’s interdisciplinary 39-xxx series. Often, Elective courses are selected around a common theme that can span several departments, and are chosen so as to form a student-structured area of concentration. Such programs of study can be constructed in an informal manner by the student and a faculty advisor, or they can be part of a minor or double major program.
Minors and Double Majors

The College of Engineering offers a series of designated minors in different areas of engineering specialization. The Elective, and Mechanical Engineering Technical Elective slots can be used to complete the requirements of these minors. Although students can generally complete a designated minor without increasing the number of units required for graduation, early planning is important.

Double major programs within the College of Engineering are also available. Students in the Department can earn double majors in (1) Mechanical Engineering, and Engineering and Public Policy, and (ii) Mechanical Engineering, and Biomedical and Health Engineering.

In addition, many departments in the University offer minor and double major degree programs. The Elective slots available to mechanical engineering students can be used to advantage in completing the requirements for a minor or double major, but early schedule planning is important. Interested students should contact the main office in the department of interest and inquire as to those requirements.

Advising

Students are assigned a faculty advisor after selecting the mechanical engineering major. Students should meet with their advisors in order to plan courses for each semester, and also to make longer range plans such as summer internships, research opportunities, employment prospects and graduate school.

The Department’s website (www.me.cmu.edu) archives the Mechanical Engineering Undergraduate Handbook, lists of points of contact, curriculum flow charts and other valuable resources.

Students are also welcome to visit the Undergraduate Coordinator in Scaife 426 for information on graduation requirements, curriculum questions and other undergraduate issues.

As a regular part of monitoring progress toward completion of the degree, students should compare their transcripts with the department’s degree requirements. Academic Audit - The HUB Website www.cmu.edu/hub.

Accelerated Graduate Program

An accelerated program is available to Carnegie Mellon undergraduate students who also wish to complete a coursework Master’s degree in mechanical engineering. Exceptional students can apply for admission to the program at the end of the first semester of the Senior year and must meet the requirements for admission to the Department’s graduate program. Financial aid in the form of Teaching or Research Assistantships is not offered to students in the Accelerated Graduate Program.

In this program, students must complete at least 24 units of graduate coursework by the end of the Senior year. An average GPA of 3.0 or better must be attained in those courses, and they can not be used to satisfy the requirements of the baccalaureate degree. During the summer immediately after the Senior year, students complete up to 24 units of 24–793 Supervised Reading and 24–794 Master of Science Project. During the following Fall semester, students then complete all remaining coursework. A total of 96 units is required for completion of the coursework Master’s degree. Students who wish to pursue the Accelerated Graduate Program should contact a faculty advisor or inquire in the Department’s main office for further information.

Quality Point Average Requirements

In addition to the College of Engineering’s requirement of a cumulative quality point average (QPA) of 2.00 or higher for all courses taken after the Freshman year, the Mechanical Engineering Department requires that students attain a quality point average of 2.00 or higher for all required Mechanical Engineering courses.

Pursuant to university rules, students can repeat a course in which a grade below C was attained in order to achieve the QPA requirement. The highest grade so obtained will be used to calculate the quality point average for all required Mechanical Engineering courses.

Faculty

ADNAN AKAY, Lord Professor of Engineering; Head, Department of Mechanical Engineering — Ph.D., North Carolina State University; Carnegie Mellon, 1992—.

SHELLEY ANNA, Assistant Professor of Mechanical Engineering — Ph.D., Harvard University; Carnegie Mellon, 2003 —.

CRISTINA HORTENSIA AMON, Lane Distinguished Professor of Mechanical Engineering — Sc.D., Massachusetts Institute of Technology; Carnegie Mellon, 1988—.

DAVID H. ARCHER, Adjunct Professor of Mechanical Engineering — Ph.D., University of Delaware; Carnegie Mellon University, 1991—.

MEHDI ASHEGHI, Assistant Professor of Mechanical Engineering — Ph.D., Stanford University; Carnegie Mellon University, 2000—.

JACK LEE BEUTH, Professor of Mechanical Engineering — Ph.D., Harvard University; Carnegie Mellon, 1992—.

JONATHAN CAGAN, Professor of Mechanical Engineering — Ph.D., University of California, Berkeley; Carnegie Mellon, 1990—.

NORMAN CHIGIER, Professor of Mechanical Engineering — Sc.D., University of Cambridge; Carnegie Mellon, 1981—.

HOWIE CHOSET, Associate Professor of Mechanical Engineering — Ph.D., California Institute of Technology; Carnegie Mellon, 1996—.

JERRY HOWARD GRIFFIN, William J. Brown Professor of Mechanical Engineering — Ph.D., California Institute of Technology; Carnegie Mellon, 1980—.

C. FRED HIGGS III, Assistant Professor of Mechanical Engineering — Ph.D., Rensselaer Polytechnic Institute; Carnegie Mellon University, 2003—.

PHILIP R. LeDUC, Assistant Professor of Mechanical Engineering — Ph.D., The Johns Hopkins University; Carnegie Mellon, 2002—.

QIAO LIN, Assistant Professor of Mechanical Engineering — Ph.D., California Institute of Technology; Carnegie Mellon, 2000—.

YOKY MATSUOKA, Assistant Professor of Mechanical Engineering and Robotics — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2001—.

WILLIAM CHARLES MESSNER, Professor of Mechanical Engineering — Ph.D., University of California, Berkeley; Carnegie Mellon, 1993—.

JOHN FLETCHER OSTERLE, Theodore Ahrens Professor of Mechanical Engineering, Emeritus — D.Sc., Carnegie Mellon University; Carnegie Mellon, 1946—.

O. BURAK OZDOGANLAR, Assistant Professor of Mechanical Engineering — Ph.D., University of Michigan; Carnegie Mellon, 2004—.

YOED RABIN, Associate Professor of Mechanical Engineering — D.Sc., Technion-Israel Institute of Technology; Carnegie Mellon University, 2000—.

ALLEN L. ROBINSON, Assistant Professor of Mechanical Engineering, and Engineering and Public Policy — Ph.D., University of California, Berkeley; Carnegie Mellon, 1998—.

WILFRED THOMAS ROULEAU, Professor of Mechanical Engineering, Emeritus — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1954—.

EDWARD STEPHEN RUBIN, Professor of Mechanical Engineering and Engineering and Public Policy — Ph.D., Stanford University; Carnegie Mellon, 1969—.

KENJI SHIMADA, Associate Professor of Mechanical Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1996—.

METIN SITTI, Assistant Professor of Mechanical Engineering — Ph.D., University of Tokyo; Carnegie Mellon, 2002—.

PAUL SETH STEIF, Professor of Mechanical Engineering — Ph.D., Harvard University; Carnegie Mellon, 1983—.

JOHN WILLIAM WESNER, Adjunct Teaching Professor of Mechanical Engineering — Ph.D., Carnegie Mellon University;
Carnegie Mellon, 2000—.

JONATHAN ADAM WICKERT, Professor of Mechanical Engineering — Ph.D., University of California, Berkeley; Carnegie Mellon, 1990—.

JOHN WILLIAM WISS, Adjunct Professor of Mechanical Engineering — M.Mech.E., Rensselaer Polytechnic Institute; Carnegie Mellon, 1982—.

SHI-CHUNE YAO, Professor of Mechanical Engineering — Ph.D., University of California, Berkeley; Carnegie Mellon, 1977—.
The College of Fine Arts

Minors Offered by the College of Fine Arts

School of Architecture

School of Art

School of Design

School of Drama

School of Music
The College of Fine Arts

Martin Prekop, Dean
Office: The College of Fine Arts 100 Barbara Anderson, Associate Dean
Office: Purnell Center for the Arts 332 Luis Rico Gutierrez, Associate Dean

The College of Fine Arts at Carnegie Mellon University was founded in 1905 as the first comprehensive arts learning institution in the United States. For 98 years it has educated outstanding artists, architects, designers, theater artists and musicians who have made important contributions to culture in the United States and the world. The alumni of the College of Fine Arts have shaped the television, stage and film worlds; are collected in numerous international museums; have composed, performed in and conducting major symphony orchestras, choruses and opera companies; have built notable buildings, designed building systems and architectural imaging systems; created significant innovations in graphic and industrial design; and are professors and deans in major arts institutions.

The College of Fine Arts concentrates on the education of professionals in the arts in the broader context of Carnegie Mellon University. Beyond their education in their chosen field, through required and elective course work, students are involved with other disciplines within the College of Fine Arts and within the other colleges of Carnegie Mellon University. Further, the College’s location in the Oakland District of Pittsburgh with its broad cultural resources (The Carnegie Museum of Art, the Carnegie Museum of Natural History, The Carnegie Library, the University of Pittsburgh, The Hillman Library, the Frick Fine Arts Building, Phipps Botanical Conservatory, and the public television station WQED) places the College of Fine Arts at the center of a premier cultural environment.

The College of Fine Arts has a 9:1 student faculty ratio which provides a rigorous learning environment. It is a highly spirited federation of schools (Architecture, Art, Design, Drama and Music) made up of students and faculty who have an intense need to create and excel. Interacting among the schools, the University and the wider community are research centers such as the Studio for Creative Inquiry, the Center for Building Performance and Diagnostics and the Center for Arts in Society. The educational and artistic life of the College is interwoven with a dense calendar of theater performances, concerts, exhibitions, film and media presentations and lectures by visiting artists, practicio-ners and scholars.

The College of Fine Arts offers a wide range of professionally oriented majors and minors in each of its schools. In addition, the College offers the Bachelor of Humanities and Arts (BHA, jointly with The College of Humanities and Social Sciences), the Bachelor of Science and Arts (BSA, jointly with the Mellon College of Science) and the Bachelor of Arts Management (BAM, jointly with the Heinz School of Public Policy and Management). These are presented only briefly below, but a complete listing of the graduation requirements for these programs may be found in the school descriptions later in this section and elsewhere in this volume.

Architecture Office: CFA 201

The School of Architecture offers a five-year NAAB accredited Bachelor of Architecture undergraduate degree for students who seek careers in architectural practice. Beyond standard preparation in architectural design, history and representation, its curriculum stresses the centrality of scientific knowledge and technical know-how in the preparation of future practicing professionals. A significant body of core university course work in mathematics, physical sciences, social sciences, writing and history is prerequisite to sequences in design, building science/technology, and architectural history. Other degrees offered by the School are a M.S. and a Ph.D. in the areas of Building Performance and Diagnostics and Computer Aided Design. We also offer a joint Masters degree with the Heinz School in Public Policy and Management. Three additional Masters Degrees will begin in Fall 2002: Masters of Urban Design, Masters of Science in Sustainable Design and Masters of Science in Architecture Engineering and Construction Management.

Art Office: CFA 300

The primary mission of the School of Art is to develop in the individual student the skills, knowledge, and commitment required to work as an artist in society. The four-year undergraduate program leads to a Bachelor of Fine Arts degree in Art. Concentrations within the art major are offered in three areas: 1) Painting, Drawing, and Printmaking; 2) Electronic and Time-Based Work; and 3) Sculpture, Installation, and Site Work. A Master of Fine Arts degree in Art is also offered.

Design Office: MM 110

The School of Design seeks to combine a sound education in the liberal arts with professional study that leads to careers in many fields of design. It offers the following degrees: B.F.A. in Communication Design; B.F.A. in Industrial Design; Master of Design in Interaction Design (with specializations in Human-Computer Interaction Design and Human-Machine Interaction Design); and Master of Design in Communication Planning and Information Design (a joint degree with the Department of English).

Drama Office: PCA 220

The School of Drama offers a highly focused, world-class theatre education with thorough preparation for today’s entertainment industries. The undergraduate programs lead to BFA degrees in Drama, with focuses in acting, music theatre, directing, design, production technology and management; MFA programs are offered in scene, costume and lighting design, directing, dramatic writing and production technology and management.

Music Office: CFA 105

The School of Music has as its goal the preparation of musicians for careers in performance, composition, conducting and teaching. The program provides the opportunity to study with experienced artists in a conservatory environment, combining the educational with the intensely professional. Undergraduate degrees are offered in Music Composition and Music Performance with minors in Accompanying, Conducting, Jazz Performance, Music Education, and Music Technology available. The Master of Music is offered in Composition, Performance, Conducting and Music Education.

Bachelor of Humanities and Arts (BHA)
Bachelor of Science and Arts (BSA)
Intercollege Degree Programs

Particia Maurides, Director
Margaret Morrison College 107
www.cmu.edu/interdisciplinary

The Bachelor of Humanities and Arts (BHA) is a four-year intercollege degree-granting program designed for students interested in blending studies in the College of Fine Arts and the College of Humanities and Social Sciences. It combines a General Education requirement (75 units), a concentration of courses in the College of Fine Arts (108 units, in one or more schools), a concentration of courses in the College of Humanities and Social Sciences (54 units), and free electives (114 units). Please refer to Intercollege Programs in this catalog, page 76.

The Bachelor of Science and Arts (BSA) is a four-year intercollege degree-granting program designed for students interested in combining studies in the College of Fine Arts and the Mellon College of Science. It combines General Core requirements (108 units) a concentration of courses in the College of Fine Arts (108 units, in one or more schools), a concentration of courses in the Mellon College of Science (120-134 units), and free electives (30-44 units). Please refer to Intercollege Programs in this catalog on page 86.

For the BHA and BSA Programs, there is no acting or musical theatre option in the School of Drama, and there is no voice performance option in the School of Music.
The Master of Arts Management Program
1104 Hamburg Hall

The search for both increased support and larger audiences has intensified over the last decade and now, more than ever, arts organizations seek skilled managers. To meet this need, the College of Fine Arts and the Heinz School jointly developed the Master of Arts Management (MAM) Program to provide strong leadership in theater companies, dance companies, orchestras, opera companies, and visual arts organizations. The Master of Arts Management Program provides undergraduate students the opportunity to complete the Bachelor of Fine Arts and Master of Arts Management degrees within a period of five years. MAM Program alumni can be found managing music and arts service organizations; marketing orchestras, theaters and dance companies; fund-raising for museums, opera companies, ballet companies and public television stations; and managing the finances of university arts departments and private businesses working in the arts and entertainment industry.

Student Organizations
Professional and honorary societies for students in the College of Fine Arts are the American Institute of Architects, Tau Sigma (honorary for students in architecture), Alpha Rho Chi (architectural award for leadership), the Student Design Forum (SDF), American Institute of Graphic Arts (AIGA), Industrial Designers Society of America (IDSA), University of Pittsburgh Industrial Design Association (UPIDA), Phi Mu Alpha Sinfonia (music fraternity for men), Sigma Alpha Iota (music sorority for women), Pi Kappa Lambda (honorary for students in music) and the Music Educators’ National Conference.

Academic Standards
Grading Practices
Grades given to record academic performance in the College of Fine Arts are detailed on p. 48. All courses taught by the schools in the College of Fine Arts follow the standard letter grade system of the university. Responsibility for the grade given the student rests entirely with the instructor and the school concerned. A permanent grade may not be raised by taking a second examination. Students who wish to repeat a course already passed must obtain approval from the Dean of the College. At the time of approval, the Dean will decide in the light of circumstances whether the new grade or the old grade will be the official grade used as the computing factor for honors. Both grades, however, will appear on the official transcript.

Academic Actions
The decision to impose academic action is first initiated at the conclusion of each semester by the School faculty most involved in the student's primary area of study and then presented at the end of the semester to the Academic Actions sub-committee of the College Council for confirmation.

A student who is not making satisfactory progress toward meeting professional standards or toward completing graduation requirements in a School may have any of the academic actions listed below imposed by that School even though the student has received “passing” grades.

The academic actions listed below do not follow a particular sequence; any of the actions may be appropriately imposed at any time upon recommendation of the School faculty concerned and confirmation by the College Council.

Warning: For failure to maintain professional standards in a required course, or insufficient evidence of serious application to the professional standard of the School; or an overall quality point average below a satisfactory level. Warning action is intended to notify the student of unsatisfactory performance, and to suggest that the student take steps to determine and correct the cause of the difficulty.

Probation: For failure to pass any professional course as outlined by the faculty of the School; or failure to meet the professional standards of the School although no failing grades are given; or failure to earn the minimum quality point average required to continue in the School. A student on probation may be required to achieve a specified quality point average. The student must improve scholastic standing to an acceptable level in order to be removed from Probation. A student not doing so may be Suspended or Dropped at the end of the semester.

Final Probation: For significantly poor performance, or for continued failure to meet the professional standards of the School. The student must improve scholastic standing to an acceptable level in order to be removed from Final Probation. A student not doing so may be Suspended or Dropped at the end of the semester. This action may be taken without previous academic action.

School Suspension: For poor performance, or for personal problems that create an impediment to professional achievement in the School. A student is suspended from the School, but not the University, when it is deemed in the best interest of the student to allow continuation of study outside of the School during the period of the suspension. The student is not permitted to take courses in the School for a period to be determined by this faculty action, but will be re-admitted at the end of the period of School Suspension specified by the faculty after the condition of the School Suspension is satisfied.

University Suspension: For exceptionally poor performance, or for personal problems that create an impediment to any academic achievement. The student is required to withdraw from the University for a period to be determined by faculty action. Re-admission is subject to conditions specified in each case by the School faculty concerned. An application for Withdrawal/Leave of Absence form is enclosed with the letter notifying a student of this academic action. A student who has been suspended from the University is not eligible for employment by the University during the period of the suspension.

Drop from the School: A student is Dropped from the School when it is clear that the student’s progress in professional training is insufficient to warrant continuing in the current professional field of study in this College. This action is taken in the case of a student who has been lacking in some essential requirement in the chosen professional field, but whose general scholastic ability, habits and character justify an opportunity in some other field of education. This action terminates the student’s enrollment in the current School, but is not intended to prejudice admission to another Department, School, College of the University, or to another institution.

This academic action allows the student three choices:
- Transfer to another Carnegie Mellon University Department or School. A student must contact that Department or School of choice to discuss possible transfer.
- Request for Transitional status in the College of Fine Arts for one semester (see below: Transitional Students). A student must make an appointment with the Associate Dean of the College of Fine Arts to discuss this option.
- Withdraw from Carnegie Mellon University. An application for Withdrawal/Leave of Absence form is enclosed with the letter notifying a student of this academic action.

Drop from the College: A student is Dropped from the College when it is clear that the student shows no indication of being able to reach an acceptable level of performance or maintain steady progress toward completing graduation requirements. This action terminates the student’s enrollment in the College of Fine Arts, but is not intended to prejudice admission to another College of the University, or to another institution.

This academic action allows the student two choices:
- Transfer to another Carnegie Mellon University College. A student must contact that College of choice to discuss possible transfer.
- Withdraw from Carnegie Mellon University. An application for Withdrawal/Leave of Absence form is enclosed with the letter notifying a student of this academic action.

A student who has been suspended from the University or has withdrawn is required to leave the campus, including dormitories and fraternity houses, within a maximum of two days after the action and to remain off campus for the duration of the time specified. This action includes exclusion from point-taking for study at the University for the duration of the period of the action.

Graduation Requirements
Because of the special nature of work in the College of Fine Arts, the first year in all schools should be considered probationary, a period in which a student and faculty can evaluate professional promise in terms of the college’s standards. Graduation from the College of Fine Arts follows the general university guidelines. As part of a student’s qualification for an undergraduate degree, the equivalent of two terms of full-time work must be pursued under the direction of faculty members in the college during the period immediately prior to the
degree award. Courses completed at other institutions will not be acceptable as terminal credit for a degree. Exceptions to this stipulation can be recommended by a school faculty in unusual cases, but the concurrence of the College Council is necessary before final approval of an exception can be given.

Other graduation requirements in the College of Fine Arts are described in the curriculum of each school. Further questions about specific course requirements and the total number of units required should be directed to the respective school advisers.

**Other Regulations Affecting Student Status**

**Schedule Changes**

Courses may be added or dropped within the times stated in the college calendar. No courses may be added or dropped after the stated deadline dates except with the approval of the student’s School Head and the Dean of the College. (See page 29 for Add/Drop procedures.)

**Withdrawal/Leave of Absence**

Please refer to the Student Leave Policy on page 50.

**Transitional Students**

The designation Transitional Student has been instituted by the Dean of the College of Fine Arts to assist students who have been judged unlikely to make satisfactory progress in their chosen professional field, or who on their own initiative, have changed their mind about their originally chosen field of study. Being a Transitional Student gives them an opportunity to maintain a relationship with the College of Fine Arts while re-orienting career plans and goals. It also gives them time to enhance their admissibility to another school in the college, another college in the university, or another institution. Ordinarily a student will be permitted to register as a Transitional Student for no more than one semester.

Transitional status is made available to students upon the advice of their advisers or upon their own request. A student must make an appointment with the Associate Dean of the College of Fine Arts to discuss this option.

**Transfer Students**

Undergraduate students seeking transfer within or to any school of the College of Fine Arts must file an application with the School and proceed with the established transfer application procedure, audition, portfolio review or ASAT requirements. Admission may dictate freshman status regardless of the student’s prior college experience.

**Materials**

The college does not furnish students with any drawing materials, make-up materials, textbooks, or other expendable equipment except those in courses in which materials fees are charged to cover specific costs.

**Retention of Student’s Work**

The college reserves the right to retain indefinitely any student work the faculty may select. All work not retained by the faculty must be claimed at the time specified on the bulletin boards of the schools concerned. The college assumes no liability for student materials in its custody.
Minors Offered by the College of Fine Arts

The College of Fine Arts offers minors in Architecture, Art, Design, Drama, and Music to students from other colleges at Carnegie Mellon University. These minors allow students at Carnegie Mellon to take courses and develop a direction for electives in any of the five schools in CFA. Students in the College of Fine Arts may also earn minors outside of their major within other schools in the College. They may also study any of the minors offered by the other colleges to the University at large, thus taking advantage of the broad educational opportunities available at Carnegie Mellon University.

Minors Offered by the College of Fine Arts:

Architecture
Architectural History (available also to B. Arch candidates)
Architectural Representation and Visualization
Architectural Technology
Art
Building Science (available only to B. Arch candidates)
Communication
Drama
History of the Arts
Industrial Design
Jazz Performance
Music Performance
Music Composition
Music Technology
Music Theory
Photography, Film, and Digital Imaging

Guidelines for students are: 1) except where so designated, CFA students are not eligible to earn a minor in their own school; students from outside CFA may earn a minor in any school in CFA; 2) faculty advisers in the student’s home school (in consultation with the academic officer of the other unit involved) will advise students as to the structuring of the courses in each minor; 3) a minor is not to be considered an overload; rather, through the assistance of faculty advisors it should be integrated into a student’s overall units required for graduation; 4) the advisors will also monitor the student’s development in these minors and keep records in their files which indicate the fulfillment of the course requirements in the minors, as well as in the majors in the student’s own school. Courses listed as possible for the minors may be available, but not all courses are offered every semester. Students should consult with their advisors.

Students interested in earning a minor in any of the CFA schools should contact: Architecture: Judith Kamps; Art: Doris Schwartz; Design: Melissa Cicozi; Drama: Catherine Morrow; Music: Lewis Strouse.

Minor in Architecture

This sequence is for candidates who intend to develop intellectual links to the architectural profession. The scope of courses offered includes a full spectrum of professional issues in architecture.

Prerequisite Courses 9 units
79-104 Introduction to World History 9

Required Courses 27 units
48-125 Computer Modeling 2 6
48-240 Architecture History 1: Survey of World Architecture & Urbanism 9

Elective Courses (Choose three)** 27 units
48-120 Computer Modeling 1 9
48-130 Introduction to Architectural Drawing 6
48-135 Architectural Drawing 9
48-230 Perspective 9

Minimum units: 54

Minor in Architectural History

(available also to B. Arch Candidates)

This sequence is intended for candidates interested in the discipline of history as it relates to the architectural profession. Participation in professional courses is intended to assist the student’s awareness of the scope of the profession and place historical questions within this perspective.

Prerequisite Courses 9 units
79-104 Introduction to World History 9

Elective Courses 45 units
48-340 Modern Architecture and Theory, 1900-1945 9
48-341 History of Architectural Theory 9
48-343 American Built Environment Since 1860 9
48-440 American Built Environment to 1860 9
48-441 Frank Lloyd Wright 9
48-445 The City in History 9
48-447 History and Preservation 9

Minimum units: 54

Minor in Architectural Representation and Visualization

This sequence is for candidates who intend to develop particular skills in architectural representation.

Required Courses 33 units
48-120 Computer Modeling 1 9
48-130 Introduction to Architectural Drawing 6
48-230 Perspective 9

Elective Courses 21 units
48-125 Computer Modeling 2 6
48-560 Computer Modeling 3 9
48-725 Building Economics 9
48-745 Geometric Modeling (Prereq. 48-711, 48-750) 6
48-747 Shape Grammars (Prereq. 48-711, 48-750) 6

Minimum units: 54

Minor in Architectural Technology

This sequence is for candidates who intend to develop intellectual links to the technical aspects of the profession. It is not available to B. Arch Candidates.

Prerequisite Courses 22 units
21-115 Differential Calculus 5
21-116 Integral Calculus 5
33-106 Physics for Engineering Students 1 12
Minor in Building Science

(Available only to B. Arch Candidates)

This sequence is intended for candidates seeking in depth knowledge in several areas of architectural science and for those interested in gaining advance placement into the Graduate M.S. Program offered by the School of Architecture in Building Performance and Computer Aided Design.

**Required Courses**  
9 units

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-711</td>
<td>Research Models and Methods</td>
<td>9</td>
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</tbody>
</table>

**Elective Courses**  
45 units

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Units</th>
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</thead>
<tbody>
<tr>
<td>48-721</td>
<td>Building Controls &amp; Diagnostics</td>
<td>12</td>
</tr>
<tr>
<td>48-723</td>
<td>Advanced Building Systems</td>
<td>9</td>
</tr>
<tr>
<td>48-742</td>
<td>Design Databases</td>
<td>6</td>
</tr>
<tr>
<td>48-745</td>
<td>Geometric Modelling</td>
<td>6</td>
</tr>
<tr>
<td>48-747</td>
<td>Shape Grammars</td>
<td>6</td>
</tr>
<tr>
<td>48-743</td>
<td>Symbolic Modelling</td>
<td>12</td>
</tr>
<tr>
<td>48-746</td>
<td>Interface for Design</td>
<td>6</td>
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<tr>
<td>48-725</td>
<td>Building Economics</td>
<td>9</td>
</tr>
<tr>
<td>48-729</td>
<td>Special Topics in BPD</td>
<td>9</td>
</tr>
<tr>
<td>48-749</td>
<td>Special Topics in CAD</td>
<td>9</td>
</tr>
<tr>
<td>48-750</td>
<td>Strategic Use of CAD</td>
<td>9</td>
</tr>
<tr>
<td>48-756</td>
<td>Object-Oriented Application Development in CAD</td>
<td>12</td>
</tr>
</tbody>
</table>

**Minimum units required:** 54

**Minor in Art**

Concept Studio (choose one)  
10 units

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-101</td>
<td>Concept Studio I: The Human Being (fall)</td>
<td>10</td>
</tr>
<tr>
<td>60-102</td>
<td>Concept Studio II: Time and Space (spring)</td>
<td>10</td>
</tr>
<tr>
<td>60-201</td>
<td>Concept Studio III: Systems and Processes (fall)</td>
<td>10</td>
</tr>
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</table>

Media Studios (choose two)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>60-110</td>
<td>Electronic Media Studio I: Computer Art (fall)</td>
<td>10</td>
</tr>
<tr>
<td>60-210</td>
<td>Electronic Media Studio II: Video art (fall and spring)</td>
<td>10</td>
</tr>
<tr>
<td>60-130</td>
<td>Three Dimensional Media Studio I (spring)</td>
<td>10</td>
</tr>
<tr>
<td>60-230</td>
<td>Three-Dimensional Media Studio II (fall)</td>
<td>10</td>
</tr>
<tr>
<td>60-150</td>
<td>Two-Dimensional Media Studio I: Drawing (fall)</td>
<td>10</td>
</tr>
<tr>
<td>60-151</td>
<td>Two-Dimensional Media Studio II: Drawing (spring)</td>
<td>10</td>
</tr>
<tr>
<td>60-250</td>
<td>Two-Dimensional Media Studio III: Painting (fall and spring)</td>
<td>10</td>
</tr>
<tr>
<td>60-251</td>
<td>Two-Dimensional Media Studio IV: Printmaking (spring)</td>
<td>10</td>
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</table>

Advanced Media (choose two)  
20 units

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>60-4xx</td>
<td>Advanced ETB: Electives</td>
<td>10</td>
</tr>
<tr>
<td>60-4xx</td>
<td>Advanced SIS: Electives</td>
<td>10</td>
</tr>
<tr>
<td>60-4xx</td>
<td>Advanced PDP: Electives</td>
<td>10</td>
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Art History/Theory  
9 units

<table>
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<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-105</td>
<td>Pre-Industrial Visual Cultures 1789 (spring)</td>
<td>9</td>
</tr>
<tr>
<td>60-205</td>
<td>Modern Visual Cultures 1789-1945 (fall)</td>
<td>9</td>
</tr>
<tr>
<td>60-206</td>
<td>Contemporary Visual Cultures 1945 to the Present</td>
<td>9</td>
</tr>
<tr>
<td>60-3xx</td>
<td>Art History/Theory Electives</td>
<td>9</td>
</tr>
</tbody>
</table>

**Minimum units:** 59

**Minor in the History of Arts**

This minor of six or more courses as designated below, will offer students a grouping of Arts History courses that can provide a broad survey in the arts or a highly specialized field. For College of Fine Arts students, all courses meeting the requirements of the Minor in the History in the Arts must be taken outside of their major School, with the exception of the School of Architecture. Interested students should contact the Office of the Dean in 107 Margaret Morrison Carnegie Hall.

**Elective Courses**  
54 units

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-210</td>
<td>Statics (Prereq. 21-115, 21-116, 33-106)</td>
<td>9</td>
</tr>
<tr>
<td>48-215</td>
<td>Materials and Assemblies</td>
<td>15</td>
</tr>
<tr>
<td>48-217</td>
<td>Structures (Prereq. 48-210 or 12-207)</td>
<td>9</td>
</tr>
<tr>
<td>48-315</td>
<td>Environment 1: Climate &amp; Energy</td>
<td>9</td>
</tr>
<tr>
<td>48-410</td>
<td>Environment 2: Space Sound Light</td>
<td>9</td>
</tr>
<tr>
<td>48-412</td>
<td>Environment 3: Mechanical Systems</td>
<td>9</td>
</tr>
<tr>
<td>48-415</td>
<td>Advanced Building Systems</td>
<td>9</td>
</tr>
<tr>
<td>48-56x, 57x,</td>
<td>Designated Dept. Technical Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

**Introduction Level Courses:**  
27 units

(choose three, CFA students pick 3 outside of major)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-240</td>
<td>Architectural History I: Historical Survey of World</td>
<td>9</td>
</tr>
<tr>
<td>48-394</td>
<td>Architecture &amp; Urbanism</td>
<td>9</td>
</tr>
<tr>
<td>51-271</td>
<td>Design History I: Fall Only</td>
<td>9</td>
</tr>
<tr>
<td>54-239</td>
<td>History of Architecture and Decor</td>
<td>6</td>
</tr>
<tr>
<td>54-245</td>
<td>History of Clothing: Fall</td>
<td>6</td>
</tr>
<tr>
<td>54-246</td>
<td>History of Clothing: Spring</td>
<td>6</td>
</tr>
<tr>
<td>54-281</td>
<td>History of Drama: Fall</td>
<td>6</td>
</tr>
<tr>
<td>54-282</td>
<td>History of Drama I: Spring</td>
<td>6</td>
</tr>
<tr>
<td>57-173</td>
<td>Survey of Western Music History</td>
<td>9</td>
</tr>
<tr>
<td>60-105</td>
<td>Pre-Industrial Culture to 1789</td>
<td>9</td>
</tr>
<tr>
<td>60-205</td>
<td>Modern Visual Cultures 1789-1945 to the Present</td>
<td>9</td>
</tr>
<tr>
<td>62-148</td>
<td>Art &amp; Culture</td>
<td>9</td>
</tr>
</tbody>
</table>

**Advanced Courses**  
27 units

(choose at least three, CFA students pick 3 outside of major)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-340</td>
<td>Modern Architecture: Fall Only</td>
<td>9</td>
</tr>
<tr>
<td>48-341</td>
<td>History of Theory: Spring Only</td>
<td>9</td>
</tr>
<tr>
<td>48-343</td>
<td>The American Built Environment Since 1860: Spring Only</td>
<td>9</td>
</tr>
<tr>
<td>48-344</td>
<td>Architecture of Henry Hornbostel: Fall Only</td>
<td>9</td>
</tr>
<tr>
<td>48-348</td>
<td>Architecture of Central &amp; South America</td>
<td>9</td>
</tr>
<tr>
<td>48-440</td>
<td>The American Built Environment to 1860: Fall Only</td>
<td>9</td>
</tr>
<tr>
<td>48-441</td>
<td>Frank Lloyd Wright: Spring Only</td>
<td>9</td>
</tr>
<tr>
<td>48-447</td>
<td>History and Preservation: Spring Only</td>
<td>9</td>
</tr>
<tr>
<td>48-448</td>
<td>1920’s &amp; 1930’s: Multidisciplinary Perspectives on the Arts</td>
<td>9</td>
</tr>
<tr>
<td>48-449</td>
<td>Islamic Architecture</td>
<td>9</td>
</tr>
<tr>
<td>51-272</td>
<td>Design History II: Spring Only</td>
<td>9</td>
</tr>
<tr>
<td>51-378</td>
<td>History of the Book and Printing</td>
<td>9</td>
</tr>
<tr>
<td>54-381</td>
<td>History of Drama: Fall - 3 units</td>
<td>9</td>
</tr>
<tr>
<td>54-382</td>
<td>History of Drama II: 3 units</td>
<td>9</td>
</tr>
<tr>
<td>57-202</td>
<td>Opera History: Spring Only</td>
<td>9</td>
</tr>
<tr>
<td>57-205</td>
<td>20th Century Music History</td>
<td>9</td>
</tr>
<tr>
<td>60-350-98</td>
<td>Art History / Theory Special Topics (Instructor Permission Only)</td>
<td>9</td>
</tr>
<tr>
<td>62-360</td>
<td>Photographers: Photography since WWII</td>
<td>9</td>
</tr>
<tr>
<td>62-371</td>
<td>Photography, The First 100 years</td>
<td>9</td>
</tr>
<tr>
<td>79-324</td>
<td>Modernism and Painting, 1890-1945</td>
<td>9</td>
</tr>
<tr>
<td>79-325</td>
<td>Art and Religion</td>
<td>9</td>
</tr>
<tr>
<td>79-355</td>
<td>The American Skyscraper: It's History and Development</td>
<td>9</td>
</tr>
<tr>
<td>79-364</td>
<td>Art, Anthropology and Empire</td>
<td>9</td>
</tr>
<tr>
<td>79-395</td>
<td>The Arts in Pittsburgh</td>
<td>9</td>
</tr>
<tr>
<td>79-396</td>
<td>Music and Society in the 19th/20th Century Europe and the US</td>
<td>9</td>
</tr>
</tbody>
</table>

**Minimum units required:** 54

**Minor in Communication Design**

This program gives an overview of basic visual communication skills and the concerns of the communication design professions. Entry into the program and course registration is contingent upon your ability to demonstrate an acceptable level of design skills and aptitude through a portfolio review. Students must receive approval and course counseling for a Minor in Communication Design from the Communication Design Faculty Advisor before beginning the sequence of required courses. Through this advising system, a curriculum sequence will be chosen to meet your specific needs and fit within Design's current course capacities. Applications are reviewed each February.

**Required Courses**  
18 units

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>51-261</td>
<td>Communication Design Fundamentals (fall)</td>
<td>9</td>
</tr>
<tr>
<td>51-271</td>
<td>Design History I (fall)</td>
<td>9</td>
</tr>
</tbody>
</table>

**Elective Courses**  
36 units

Elective courses are to be chosen from those listed in the current course catalog. This program description is based on the latest information at the time of publication. Interested students should contact the School of Design regarding any changes in the program and the availability of courses.

**Minimum units required:** 54
Minor in Industrial Design

This program gives an overview of basic design skills and concerns of the product design profession. It is intended to enable students from Engineering, Humanities and Social Science, Management and other colleges to interact effectively with professional Product Designers. Entry into the program and course registration is contingent upon your ability to demonstrate an acceptable level of design skills and aptitude through a portfolio review. Students must receive approval and course counseling for a Minor in Industrial Design from the Industrial Design Faculty Advisor before beginning the sequence of required courses. Through this advising system, a curriculum sequence will be chosen to meet your specific needs and fit within Design’s current course capacities. Applications are reviewed each February.

Required Courses: 18 units
- 51-263 Industrial Design Fundamentals (fall) 9
- 51-271 Design History I (fall) 9

Elective Courses: 36 units
Elective courses are to be chosen from those listed in the current course catalog. This program description is based on the latest information at the time of publication. Interested students should contact the School of Design regarding any changes in the program and the availability of the courses.

Minimum units required: 54

Minor in Drama

The Drama minor provides students with an opportunity to participate in a preliminary professional exposure to the theatre arts. Courses may involve acting, dance, text analysis, directing, playwriting, design and a series of related history of theatre and drama courses.

Students must also become involved with Drama productions by signing up for Production Preparation. Production Preparation III is optional but encouraged. These courses specifically involve evening crew work on various Drama productions, both main stage and studio theatre.

Admission Requirements

1. Students must apply to enter the program in the office of the Drama Advisor, Catherine Morrow (PCA 223).
2. The student must successfully pass one Drama course prior to being considered for minor status.

Required Courses: 30 units
- 51-163/4* Introduction to Production 12
- 51-177/8* Text to Stage 12
- 51-281/2 History of Drama 6

Elective Courses: 30 units
- 51-113/4* Ballet Elective (Beginning & Advanced) 12
- 51-134 Directing for Non-Majors 6
- 51-187/8 Introduction to Playwriting 6
- 51-189/90 Advanced Playwriting 9
- 51-191/2 Acting for Non-Majors 9
- 51-239/40 History of Architecture and Décor 6
- 51-245/6* History of Clothing 6
- 51-259 or 262 Production II (Crew) 9
- 51-251/2* Introduction to Lighting Design 6
- 51-309/10 Theatre Lab 4
- 51-381/2 History of Drama (Minis) 3 units each
- 51-481/2 History of Drama (Minis) 3 units each
- 51-475 Theatre Management 6

The following courses are available by audition and the agreement of the instructor:
- 51-123/4* Dance I 6
- 51-223/4* Dance II 6

Minimum units required: 60

Minor in Jazz Performance

This sequence is for candidates who are majors from any discipline in the university who have substantial potential as demonstrated by an acceptable audition and would like to improve their jazz performance skills.

Admission Requirements

1. The student must apply to enter the program in the office of the advisor for music minors (CFA 160A).
2. The student must perform an acceptable audition. For the audition, the student should perform two contrasting pieces and demonstrate the potential for the development of improvisatory skills.

Prerequisite Courses: 12 units
- 57-090 Basic Theory Skills 0
- 57-092 Basic Solfege Skills 0
- 57-152 Harmony I 6
- 57-181 Solfege I 6

Required Jazz Courses: 24 units
- 57-xxxx Jazz Ensemble or Jazz Vocal Ensemble 3
- 57-xxxx Jazz Ensemble or Jazz Vocal Ensemble 3
- 57-319 Jazz Piano 3
- 57-320 Jazz Piano 3
- 57-328 Jazz Chamber Music 3
- 57-328 Jazz Chamber Music 3
- 57-450 Jazz Ear Training 3
- 57-453 Jazz Improvisation 3

Required Studio Courses: 24 units
This requirement must be fulfilled by taking Minor Studio for 4 semesters.

Elective Courses (choose 1): 6 units
- 57-451 Jazz Arranging 6
- 57-452 Jazz Composition 6
- 57-454 Jazz Transcription and Analysis 6
- 57-457 Jazz History I 6
- 57-458 Jazz History II 6

Minimum units required: 54

Minor in Music Performance or Music (Composition)

This sequence is for candidates who are majors from any discipline in the university other than music who have professional potential as demonstrated by an acceptable audition and would like to improve their performance or composition skills, but who have chosen to pursue a major other than music.

Admission Requirements

1. The student must apply to enter the program in the office of the advisor for music minors (CFA 160A).
2. The student must perform an acceptable audition. Requirements for the audition can be found in the Admission section of the Undergraduate Catalog.

Prerequisite Courses: 0-3 units
Basic Theory Skills and/or Basic Solfege Skills are required of students who do not qualify for entrance into Harmony I or Solfege I, based on their scores on the theory and solfege placement tests.

- 57-090 Basic Theory Skills 0
- 57-092 Basic Solfege Skills 0
- 57-103 Beginning Piano* 3

* Beginning Piano is required of students who do not pass a piano proficiency test.

Minimum units required: 50
Introductory Courses 24 units
57-161 Eurhythmics I 3
57-161 Solfege I 6
57-152 Harmony I 6
57-173 Survey of Western Music History 9

Required Studio Courses 24 units
This requirement must be fulfilled by taking Minor Studio for 4 semesters.

Elective Courses for Non-Voice Minors 24 units
Elective courses are to be chosen from those courses listed for the School of Music in the current course catalog. Performance electives are encouraged. (An audition is required for all School of Music performance ensembles.)

Elective Courses (for voice minors) 24 units
Language course (choose 1)
82-101 Elementary French I 9
82-121 Elementary German I 9
82-161 Elementary Italian I 9

Diction course (choose 1)
An introductory course in the applicable language is a prerequisite for each of these courses.
57-221 Italian Diction 3
57-222 French Diction 3
57-223 German Diction 3

Literature and repertoire course (choose 1)
An introductory course in the applicable language is a prerequisite for each of these courses.
57-431 Italian Literature and Repertoire 3
57-432 French Literature and Repertoire 3
57-435 German Literature and Repertoire 3

Other courses (choose 9 units)
These courses are to be chosen from those courses listed for the School of Music in the current course catalog. Performance electives are encouraged. (An audition is required for all School of Music performance ensembles.) Additional diction, literature and repertoire, and language electives are encouraged for voice minors.

Minimum units required: 72

Minor in Music Technology
This sequence is for candidates who are majors from any discipline in the university other than music who have some background in music and would like to know more about music technology.

Admission Requirements
1. The student must apply to enter the program in the office of the advisor for music minors (CFA 160A).

Prerequisite Courses 3-6 units
Basic Theory Skills is required of students who do not qualify for entrance into Harmony I or Solfege I, based on their scores on the theory and solfege placement tests. Beginning Piano is required of students who do not pass a piano proficiency test.

57-090 Basic Theory Skills 0
57-103 Beginning Piano 3
99-xxx Computer Skills Workshop 3

Introductory Theory Course 6 units
57-152 Harmony I 6

Required Music Technology Courses 33 units
57-101 Introduction to Music Technology 6
57-337 Sound Recording 6

Elective Courses 24-28 units
music history course (choose 1)
57-173 Survey of Western Music History 9
57-202 Opera History 9
57-205 20th Century Music History 9

technical courses (choose 2)
xx-xxx H&SS multimedia course 9
15-100 Introductory/Intermediate Programming 10
33-114 Physics of Musical Sound 6
54-165 Introduction to Sound Design for Theater I 6
57-610 Internship 9

Minimum units required: 63

Minor in Music Theory
This sequence is for candidates who are majors from any discipline in the university other than music who have some background in music and would like to know more about music theory.

Admission Requirements
1. The student must apply to enter the program in the office of the advisor for music minors (CFA 160A).

Prerequisite Courses 0-3 units
Basic Theory Skills and/or Basic Solfege Skills are required of students who do not qualify for entrance into Harmony I or Solfege I, based on their scores on the theory and solfege placement tests. Beginning Piano is required of students who do not pass a piano proficiency test.

57-090 Basic Theory Skills 0
57-092 Basic Solfege Skills 0
57-103 Beginning Piano 3

Introductory Courses 15 units
57-152 Harmony I 6
57-161 Eurhythmics I 6
57-181 Solfege I 6

Required Theory Courses 27 units
57-151 Principles of Counterpoint 6
57-153 Harmony II 6
57-154 18th Century Counterpoint 6
57-257 Orchestration I 6
57-612 Independent Study in Music Theory 3

Elective Courses 15 units
Analysis Course (choose 1)
57-335 Analysis Seminar 6
57-408 Form and Analysis 6
57-442 Analytical Techniques 6

History Course (choose 1)
57-173 Survey of Western Music History 9
57-202 Opera History 9
57-205 20th Century Music History 9

Minimum units required: 57
### Minor in Photography, Film and Digital Imaging

The minor in Photography, Film, and Digital Imaging is an interdisciplinary minor within the College of Fine Arts.

The minor requires students to choose from one of three options:
- Photography and Film
- Photography and Digital Imaging
- Film and Digital Imaging

The Minor requires students to complete a total of 54 units. These 54 units include a total of four production courses (36 units) and two photo/film history, theory or criticism courses (18 units). Photo/Film history, theory or criticism courses taken outside of Carnegie Mellon must be pre-approved for application to the Minor. Students in the College of Fine Arts will be advised by their individual schools and students outside of the College will be advised by the Office of the Associate Dean in the College of Fine Arts, Room 100.

Students may choose from a list of courses. Students must complete the 54 unit requirements for ONE of the following modules:

#### Photography & Film

**Module A:** three Photo courses, one Film course, and two Photo/Film history, theory or criticism courses

or

**Module B:** three Film courses, one Photo course, and two Photo/Film history, theory or criticism courses

#### Photography & Digital Imaging

**Module C:** three Photo courses, one Digital Imaging course, and two Photo/Film history, theory or criticism courses

or

**Module D:** three Digital Imaging courses, one Photo course, and two Photo/Film history, theory or criticism courses

#### Film & Digital Imaging

**Module E:** three Film courses, one Digital Imaging course, and two Photo/Film history, theory or criticism courses

or

**Module F:** three Digital Imaging courses, one Film course, and two Photo/Film history, theory or criticism courses

### Course List - Production - Carnegie Mellon Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>15462</td>
<td>Computer Graphics I</td>
</tr>
<tr>
<td>18360</td>
<td>Intro to Computer-Aided Digital Design</td>
</tr>
<tr>
<td>24201</td>
<td>Engineering Graphics</td>
</tr>
<tr>
<td>48105</td>
<td>Experiments in Design with Shop &amp; Computer Modeling</td>
</tr>
<tr>
<td>48120</td>
<td>Computer Modeling</td>
</tr>
<tr>
<td>48125</td>
<td>Computer Modeling, Part II</td>
</tr>
<tr>
<td>51132</td>
<td>Introduction to Photographic Design</td>
</tr>
<tr>
<td>51221</td>
<td>Communication Design Darkroom I (mini)</td>
</tr>
<tr>
<td>51225</td>
<td>Communication Design Darkroom II (mini)</td>
</tr>
<tr>
<td>51246</td>
<td>Photo Documentation</td>
</tr>
<tr>
<td>51251</td>
<td>Digital Prototyping</td>
</tr>
<tr>
<td>51265</td>
<td>Beginning Photography</td>
</tr>
<tr>
<td>51315</td>
<td>Digital Imaging (mini)</td>
</tr>
<tr>
<td>51321</td>
<td>Photography and Communication</td>
</tr>
<tr>
<td>51330</td>
<td>Photo Book Design</td>
</tr>
<tr>
<td>51344</td>
<td>Advanced Digital Prototyping</td>
</tr>
<tr>
<td>51346</td>
<td>Production Prototyping</td>
</tr>
<tr>
<td>54270</td>
<td>Computer Applications</td>
</tr>
<tr>
<td>60210</td>
<td>Electronic Media Studio II</td>
</tr>
<tr>
<td>62141</td>
<td>Black and White Photography I</td>
</tr>
<tr>
<td>62241</td>
<td>Black and White Photography II</td>
</tr>
<tr>
<td>62266</td>
<td>The Constructed Photograph</td>
</tr>
<tr>
<td>62325</td>
<td>View Camera</td>
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<tr>
<td>62372</td>
<td>Photo Book Design</td>
</tr>
<tr>
<td>62381</td>
<td>Color Photography I</td>
</tr>
<tr>
<td>62382</td>
<td>Color Photography: Perception/Representation</td>
</tr>
<tr>
<td>70161</td>
<td>Intro to Graphic Communications II</td>
</tr>
<tr>
<td>70635</td>
<td>Desktop Publishing</td>
</tr>
<tr>
<td>70637</td>
<td>Interactive Media Design &amp; Production</td>
</tr>
<tr>
<td>76269</td>
<td>Survey of Forms: Screenwriting</td>
</tr>
</tbody>
</table>

### Production - Pittsburgh Filmmakers Courses:

All Courses offered at Filmmakers are 9 units.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM-105</td>
<td>History of Photography I</td>
</tr>
<tr>
<td>FM-218</td>
<td>Advanced Screenplay Workshop</td>
</tr>
<tr>
<td>FM-161</td>
<td>Black &amp; White Photography I</td>
</tr>
<tr>
<td>FM-219</td>
<td>Animation Basics</td>
</tr>
<tr>
<td>FM-162</td>
<td>Black &amp; White Photography II</td>
</tr>
<tr>
<td>FM-269</td>
<td>Writing Short Scripts</td>
</tr>
<tr>
<td>FM-163</td>
<td>Elements of Film</td>
</tr>
<tr>
<td>FM-270</td>
<td>Film Genres</td>
</tr>
<tr>
<td>FM-164</td>
<td>Filmmaking I</td>
</tr>
<tr>
<td>FM-271</td>
<td>Acting for the Camera</td>
</tr>
<tr>
<td>FM-166</td>
<td>Film Genre: Women in Animated Media</td>
</tr>
<tr>
<td>FM-301</td>
<td>Advanced Filmmaking</td>
</tr>
<tr>
<td>FM-167</td>
<td>Introduction to Digital</td>
</tr>
<tr>
<td>FM-302</td>
<td>Digital Possibilities</td>
</tr>
<tr>
<td>FM-169</td>
<td>Introduction to Screenwriting</td>
</tr>
<tr>
<td>FM-306</td>
<td>Cinematography</td>
</tr>
<tr>
<td>FM-170</td>
<td>American Film History</td>
</tr>
<tr>
<td>FM-307</td>
<td>Scripting &amp; Pre-Production</td>
</tr>
<tr>
<td>FM-171</td>
<td>Acting for the Camera</td>
</tr>
<tr>
<td>FM-308</td>
<td>Developing the Feature Script</td>
</tr>
<tr>
<td>FM-172</td>
<td>Film Genre: Women in Animated Media</td>
</tr>
<tr>
<td>FM-309</td>
<td>Sound for Film</td>
</tr>
<tr>
<td>FM-173</td>
<td>Contemporary European Cinema</td>
</tr>
<tr>
<td>FM-310</td>
<td>Lighting for Film and Video</td>
</tr>
<tr>
<td>FM-175</td>
<td>History of Photography II</td>
</tr>
<tr>
<td>FM-311</td>
<td>Advanced Digital Imaging</td>
</tr>
<tr>
<td>FM-176</td>
<td>International Film History</td>
</tr>
<tr>
<td>FM-314</td>
<td>Independent Study</td>
</tr>
<tr>
<td>FM-177</td>
<td>International Film Theory Criticism</td>
</tr>
<tr>
<td>FM-315</td>
<td>Technical Directing</td>
</tr>
<tr>
<td>FM-200</td>
<td>Intermediate Filmmaking</td>
</tr>
<tr>
<td>FM-316</td>
<td>View Camera Techniques</td>
</tr>
<tr>
<td>FM-201</td>
<td>Black &amp; White Photography III</td>
</tr>
<tr>
<td>FM-317</td>
<td>Advanced Video Production</td>
</tr>
<tr>
<td>FM-202</td>
<td>Color Photography I (formerly Video Production II)</td>
</tr>
<tr>
<td>FM-203</td>
<td>Color Photography II</td>
</tr>
<tr>
<td>FM-318</td>
<td>Screenwriter's Master Class</td>
</tr>
<tr>
<td>FM-209</td>
<td>Experimental Film/Video Art</td>
</tr>
<tr>
<td>FM-334</td>
<td>Producing for Film/Video</td>
</tr>
<tr>
<td>FM-210</td>
<td>Studio Lighting</td>
</tr>
<tr>
<td>FM-335</td>
<td>Directing Actors</td>
</tr>
<tr>
<td>FM-211</td>
<td>Photoshoot for Photographers</td>
</tr>
<tr>
<td>FM-345</td>
<td>Digital Effect Compositions</td>
</tr>
<tr>
<td>FM-212</td>
<td>Script Analysis</td>
</tr>
<tr>
<td>FM-360</td>
<td>Advanced Sound</td>
</tr>
<tr>
<td>FM-213</td>
<td>Contemporary European Cinema</td>
</tr>
<tr>
<td>FM-214</td>
<td>Advanced Non-Linear Editing</td>
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<tr>
<td>FM-215</td>
<td>Video Production</td>
</tr>
<tr>
<td>FM-404</td>
<td>Digital Non-Linear Editing (formerly Video Production I)</td>
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<tr>
<td>FM-407</td>
<td>Senior Film Production I</td>
</tr>
<tr>
<td>FM-216</td>
<td>Web Design</td>
</tr>
<tr>
<td>FM-408</td>
<td>Senior Film Production II</td>
</tr>
</tbody>
</table>

### Minor in Photography, Film and Digital Imaging - Carnegie Mellon

- **Photo/Film History, Theory or Criticism**
  - 51271 Design History I
  - 51272 Design History II
  - 54245 History of Clothing (1st half mini)
  - 54246 History of Clothing (2nd half mini)
  - 54281 History of Drama
  - 57399 Music, Cinema, Culture
  - 62148 Art and Culture
  - 62248 Music in American Society
  - 74246 Shakespeare and Film
  - 76239 Intro to Film Studies
  - 76339 American Cultural Visions in Hollywood Cinema

  (Course title changes each semester)

  79238 Film and the Production of History
  79246 The 1920’s & 1930’s in Film
  79247 America in Film: The 1940’s-1960’s
  79248 World War II and the Cold War in Film

  (Course title changes each semester)

  79249 Contemporary America in Film
  79306 Visual Anthropology
  79309 The Use of History in Film
  79306 East Asians in Film
  79313 History of Photography, 1920- Present
  79361 The Film Festival: Rock & Roll
  82491 Literature, Politics and Film in East Europe & Russia Today
  88314 Politics Through Film: Tyranny and Resistance

Courses subject to change by semester. Actual listing available in the Dean’s Office, CFA 100.

**Minimum units required:** 54
School of Architecture
Laura Lee, FAIA, Head
Office: CFA 201

The mission of the School of Architecture is to educate outstanding professionals with design creativity, social responsibility, historical perspective, technological innovation, and global environmental consciousness.

**Bachelor of Architecture Program**
The Bachelor of Architecture Program is five years in length and is fully accredited by the National Architectural Accrediting Board (NAAB)*. It provides preparation for entry into the practice of architecture. Beyond preparation in architectural design, history, and representation, its curriculum stresses the importance of scientific knowledge and technical know-how in the preparation of future practicing professionals. The curriculum consists of courses revolving around an Integrated Design Studio Sequence with focuses in six areas: Fundamental University Courses and Electives, History and Theory, Drawing and Digital Media, Structures and Building Technology, Environment, and Ethics, Professional Practice, and Management. All required courses in the first two years must be taken and passed before a student may enter the third year. A minimum of 508 units is required for graduation.

*In the United States, most registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB) which is the sole agency authorized to accredit US professional degree programs in architecture, recognizes two types of degrees: the Bachelor of Architecture and the Master of Architecture. A program may be granted a six-year, three-year, or two-year term of accreditation, depending on its degree of conformance with the established educational standards. Masters degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree, which when earned sequentially, comprise an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree. (National Architecture Accrediting Board Conditions and Procedures 1998)*

**Integrated Design Studios**
(10 Studios)
Architectural design studios compose the core of the undergraduate curriculum. The ten studios are organized around a sequence of semester topics that are the focus of the design projects. In sequence, these topics are: form, space, composition, materials, site construction, occupancy, systems integration, and urban design. Studio X is intended to allow for study abroad, independent studies or other areas of proposed study with a focus on urban context. As an integrated sequence, requisite courses work in conjunction with specific studios to provide students with the necessary knowledge base to successfully resolve their design projects. Design studios are taught using a team approach, with a common lecture series and a set of related exercises for each studio level. Faculty members are both practicing architects, scholars, as well as academic researchers, bringing a diverse set of perspectives to the studio environment. Studio spaces are provided to all students, with the first, second and third year studios located in Margaret Morrison Hall. Fourth and fifth year studios are located on the second floor of the College of Fine Arts Building. With the exception of the first year, where studios are larger, individual studios provide a one-on-one "conservatory" setting with 10-12 students each. In either case, the faculty to student ratio remains approximately 1:12.

**Curriculum**

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>First Year</td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>48-100 Architecture Design Studio: Methods in Form</td>
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<tr>
<td></td>
<td>48-120 Intro to Digital Media I</td>
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<tr>
<td></td>
<td>48-130 Architectural Drawing I: Tactile Foundation</td>
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<td></td>
<td>21-120 Differential and Integral Calculus</td>
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<tr>
<td></td>
<td>79-104 Introduction to World History</td>
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<tr>
<td>Spring</td>
<td>48-105 Architecture Design Studio: Methods in Space</td>
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<tr>
<td></td>
<td>48-125 Intro to Digital Media II</td>
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<tr>
<td></td>
<td>48-126 Architectural Drawing II: Appearance</td>
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<td></td>
<td>76-101 Physics for Engineers</td>
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<td></td>
<td>76-101 Designated Writing</td>
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<tr>
<td>Second Year</td>
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<tr>
<td>Fall</td>
<td>48-200 Architecture Design Studio: Composition</td>
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<td></td>
<td>48-210 Statics</td>
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<td></td>
<td>48-230 Architectural Drawing III: Perspective</td>
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<td></td>
<td>48-240 Architecture History I: Historical Survey of World Architecture &amp; Urbanism</td>
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<td></td>
<td>73-100 Principles of Economics</td>
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<tr>
<td>Spring</td>
<td>48-205 Architecture Design Studio: Materials</td>
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<td></td>
<td>48-215 Materials and Assemblies</td>
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<td></td>
<td>48-217 Structures I</td>
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<tr>
<td></td>
<td>xx-xxx Elective</td>
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<td></td>
<td>xx-xxx Elective</td>
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<tr>
<td>Third Year</td>
<td></td>
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<tr>
<td>Fall</td>
<td>48-300 Architecture Design Studio: Site</td>
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<td></td>
<td>48-310 Structures II</td>
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<tr>
<td></td>
<td>48-312 Site Engineering and Foundations</td>
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<td></td>
<td>48-34x Site Engineering and Foundations w/Computer Skills Workshop</td>
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<td></td>
<td>48-34x Site Engineering and Foundations w/Computer Skills Workshop</td>
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<tr>
<td></td>
<td>xx-xxx Architecture History II: Time or Place Elective</td>
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<tr>
<td>Spring</td>
<td>48-305 Architecture Design Studio: Advanced Construction</td>
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<tr>
<td></td>
<td>48-315 Environment I: Climate and Energy</td>
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<td>48-351 Human Factors in Architecture</td>
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<td></td>
<td>36-201 Statistical Reasoning</td>
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<td>xx-xxx Elective</td>
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<tr>
<td>Fourth Year</td>
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<tr>
<td>Fall</td>
<td>48-400 Architecture Design Studio: Occupancy</td>
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<td></td>
<td>48-410 Environment II: Acoustics and Light</td>
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<td>48-412 Environment III: Mechanical Systems</td>
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<td></td>
<td>xx-xxx Elective</td>
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<tr>
<td>Spring</td>
<td>48-405 Architecture Design Studio: Systems Integration</td>
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<td></td>
<td>48-415 Advanced Building Systems</td>
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<td></td>
<td>48-453 Urban Design</td>
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<td>48-34v/44x Architecture History II or III Elective</td>
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<td></td>
<td>xx-xxx Elective</td>
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<tr>
<td>Fifth Year</td>
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<tr>
<td>Fall</td>
<td>48-500 Architecture Design Studio: The Urban Lab</td>
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<tr>
<td></td>
<td>48-550 Issues of Practice</td>
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<tr>
<td></td>
<td>xx-xxx Elective</td>
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<td>xx-xxx Elective</td>
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<td></td>
<td>xx-xxx Elective</td>
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<tr>
<td>Spring</td>
<td>48-505 Studio X</td>
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<tr>
<td></td>
<td>48-551 Ethics and Decision Making in Architecture</td>
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<td></td>
<td>xx-xxx Elective</td>
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<td>xx-xxx Elective</td>
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<td></td>
<td>xx-xxx Elective</td>
</tr>
</tbody>
</table>
Fundamental University Courses and Electives
(7 lecture courses, 10 elective courses)

A significant set of university courses in mathematics, physical sciences, social sciences, writing, and history is prerequisite to the School’s own offerings. Beyond the preparation in fundamentals that these courses provide, this early emphasis upon core university course work allows for ease of transfer to other departments within the College and University following the first several semesters of the student’s studies. In addition to these seven prerequisite university courses, a minimum of ten electives are required for the Bachelor of Architecture degree with a minimum of seven electives taken outside of the School and a minimum of three taken within the School. The School considers these courses to be crucial for the intellectual breadth of an architect as a citizen in contemporary society. In this spirit, the School urges its students to use these courses as an opportunity to take advantage of the unique strengths of Carnegie Mellon University and to develop intellectual ties to other disciplines by earning minors or completing in-depth sequences in other departments (see minors).

21-120 Differential and Integral Calculus
33-106 Physics for Engineers
36-201 Statistical Reasoning
73-100 Principles of Economics
76-101 Designed Writing
79-104 Introduction to World History

History and Theory
(4 courses)

In addition to World History, three courses in architectural history are required for the Bachelor of Architecture degree. All second year students must complete History 1: Historical Survey of World Architecture & Urbanism which focuses on the major monuments of western civilization, as well as highlighting non-western and vernacular traditions. Two additional courses on the history of architecture of a particular time or place, or on architectural criticism are required. These two courses consider more specific topics and are intended to provide students with the skills to investigate architecture from the perspectives of culture, society, politics, theory, economics, and technology. These courses are also intended to develop speaking and writing skills. Three hundred level courses are lecture format while 400 level courses are seminar format. Students may take either two 300 level courses or one 300 and one 400 level course to meet the minimum requirements. In addition to the required architectural history courses, elective courses offering the opportunity to study more advanced topics of architectural history may be taken as departmental electives during the fourth and fifth years. Students allocating all of their departmental electives in this manner can graduate with a Minor in Architectural History.

79-104 Introduction to World History
48-240 Architectural History I: Historical Survey of World Architecture and Urbanism
48-34x Architectural History II: Time or Place
48-44x Architecture History III
48-34y/44x Architectural History Electives

Drawing and Digital Media
(5 courses, 3 studios)

Drawing and modeling both by hand and with the computer are core skills for developing powers of observation, the ability to think in three dimensions, and are fundamental in communicating architectural ideas. Computational skills, including the use of programs specializing in digital representation, in combination with traditional skills of representation are stressed in courses throughout the curriculum.

Drawing, media representation, and model making are primary topics of both first-year studios and are associated with five other specific courses: Introduction to Digital Media I and II, Architectural Drawing I and II in the first year; and Architectural Drawing III in the second year. Thereafter, students may elect to take further drawing and media courses during years three, four, and five in fulfillment of the school elective requirements. One of these courses, Computer Modeling III, covers advanced topics in computer visualization.

48-120 Introduction to Digital Media I
48-125 Introduction to Digital Media II
48-130 Architectural Drawing I: A Tactile Foundation
48-135 Architectural Drawing II: Understanding Appearance
48-230 Architectural Drawing III: Perspective
48-100 Architecture Design Studio: Methods in Form
48-105 Architecture Design Studio: Methods in Space
48-105 Architecture Design Studio: Composition

Structures and Building Technology
(6 courses, 3 studios)

The School sees technical knowledge as design knowledge and places major emphasis on understanding the state-of-the-art and major innovations in building structure, enclosure, mechanical, lighting, and interior systems. The goal of the Structures and Building sequence is to offer a rigorous introduction to science fundamentals, to provide a systematic and comprehensive introduction into the major fields of building science and technology, and to provide a solid technical foundation both for architectural design studios and for more advanced subsequent science and technology electives. Courses build one upon the other and provide technical knowledge for application in the design studio as well as providing foundations for more in-depth study and minors in associated fields.

33-106 Physics for Engineers
48-210 Statics
48-215 Materials and Assemblies
48-217 Structures I
48-310 Structures II
48-312 Site Engineering and Foundations
48-205 Architecture Design Studio: Materials
48-305 Architecture Design Studio: Advanced Construction
48-405 Architecture Design Studio: Systems Integration

Design for the Environment
(6 courses, 3 studios)

The School sets environmental education as one of its highest priorities. The goal of this sequence is to provide a thorough foundation of technical knowledge coupled with a creative design inquiry which allows students to effectively address serious environmental challenges. The courses address issues raised by concerns over the ecological responsiveness of buildings to context, energy effectiveness, and healthy building design for global environmental sustainability while considering the opportunities of human differences related to the psychology of the individual, the sociology of groups, ergonomics, ADA codes & standards and indoor environmental quality including acoustic, visual, air and thermal quality of spaces designed for human habitation.

36-201 Statistical Reasoning
48-312 Site Engineering and Foundations
48-315 Environment I: Climate and Energy
48-351 Human Factors in Architecture
48-410 Environment II: Acoustics and Light
48-412 Environment III: Mechanical Systems
48-415 Advanced Building Systems
48-300 Architecture Design Studio: Site
48-405 Architecture Design Studio: Systems Integration
48-500 Architecture Design Studio: The Urban Lab

Ethics, Professional Practice, and Management
(6 courses, 3 studios)

Architecture is a multifaceted field of practice, existing within dynamic social, organizational, economic, professional, and cognitive contexts. The goal of this sequence is to educate design professionals with expertise in: programming and diverse design decision making processes, multi-disciplinary team design processes, methods of professional practice in urban design and architecture, management and documentation, facilities management including field diagnostics and post occupancy evaluation, real property management and overriding questions of ethics in practice.

73-100 Principles of Economics
36-201 Statistical Reasoning
48-415 Advanced Building Systems
48-452 Design Economics
48-550 Issues of Practice
48-551 Ethics and Decision Making in Architecture
48-400 Architecture Design Studio: Occupancy
48-405 Architecture Design Studio: Systems Integration
48-500 Architecture Design Studio: The Urban Lab
School Electives
A minimum of three school electives, usually taken during the fourth and fifth years, is required for the Bachelor of Architecture degree (the school elective requirements can also be satisfied by taking advanced architectural history electives). The general goal of the school electives is to build knowledge of architecture within the broad context of society, specifically, in light of economic, social, technological, political, and cultural forces. A more specific goal is to build in-depth knowledge and skill in an area of interest to the student. All school electives build on prerequisite courses taken in science, technology, architectural history, and drawing. Areas in which school electives are offered are: drawing and digital media, environmental psychology, criticism, architectural history and theory, planning/management, and environmental sustainability. With approval, qualified students can take graduate level courses to satisfy the school electives requirement. Under certain conditions, such course work can provide advance placement into the M. S. program in the School of Architecture.

Dual Degrees
Building on their Architecture courses, students in the School of Architecture can pursue a dual degree with a number of CMU programs. Most frequently, students in the School receive dual degrees or minors with: iGSIA’s undergraduate Business Administration program, engineering at CIT, History in H&SS, and Industrial Design in the School of Design.

Minors in Other Disciplines
Minors may be earned in other schools in the College of Fine Arts in Art, Design, Drama, and Music as well as in other colleges at Carnegie Mellon. A full listing of these minors may be found within this catalog in the CPA section on Interdisciplinary Programs and in similar sections provided by each college.

Minors in Architecture
Undergraduate students in architecture can also qualify to earn three minors within the subject of architecture. These are: a Minor in Building Science, a Minor in Architectural History, or a Minor in Architectural, Engineering, and Construction Management. The Minors in Building Science and AEC management are intended for those degree candidates seeking in-depth knowledge in several areas of architectural science and management, and for those who are interested in gaining advance placement into the graduate M.S. programs offered by the School.

Advanced Masters Degrees: 5+1
The School has forged several alliances to support advanced study during the student’s undergraduate years and to enable them to receive a two-year Masters degree with only one additional year on campus beyond the Bachelor of Architecture program. The School has five internal 5+1 programs and other campus 5+1 options.

- Master of Science in Computational Design
- Master of Science in Building Performance and Diagnostics
- Master of Science in Sustainable Design
- Master of Urban Design
- Master of Science in Architecture Engineering Construction Management (joint with Civil Engineering)

In addition to the in-house Master of Science degrees, the School has joined with the Heinz School of Public Policy and Management to create a M.S. PPM degree program to place professional practitioners in a more active role in public policy and planning at the urban, regional, and national level. In 2005, a new joint graduate degree will begin with Oxford University in England, the School of Architecture and the Heinz School. This two-year, two-country Master of Science in Global Environmental Policy and Sustainable Development will be an outstanding opportunity for CMU B.Arch graduates.

Student Advising
At the end of every semester, the faculty reviews each student’s progress in all courses. Reviews during the first year are used to determine a student’s capabilities in relation to the study of architecture at Carnegie Mellon University, and the School works with each student to ensure placement within the university if a change is desired. Subsequent reviews monitor and ensure continued progress in all sequences of the program.

Students are urged to meet with the Associate or Assistant Head of the School to go over their academic progress and plans before each semester. Such meetings are important to take full advantage of elective possibilities within the curriculum, but they are equally important as an opportunity for discussion of long term career goals and problems. It is the policy of the School of Architecture that no student who has a QPA below 3.0 from the previous semester should take an overload. Students should also check their progress using the online academic audit (https://acs.as.cmu.edu/moksha/auditdegreeaudit.html?)

Scholarships and Awards
The School has six endowed scholarships and traveling fellowships available for outstanding fourth year students. These are the Stewart L. Brown Scholarship from the Pittsburgh Chapter of the AIA, the John Knox Shear Memorial Traveling Fellowship, the Louis F. Valenourt Traveling Scholarship Fund, the Burdett Assistantship, the Lusher Latham Award, and the Jan Junge Award.

Study Abroad and Summer Abroad Program
The School of Architecture conducts an officially recognized exchange program for fourth year students to study abroad at: the EPFL in Lausanne, Switzerland; ITESM in Monterrey, Mexico; the National University of Singapore, and the Henry van de Velde Institute in Antwerp, Belgium. Students are welcome to seek out other study abroad opportunities where course work is equivalent to studies at CMU to a maximum of 45 transfer units per semester. Students present study abroad plans to the School for review at the beginning of the third year. To receive credit for courses taken abroad, the student must have a C or better in the course and have an official transcript sent to the School of Architecture.

In addition, the school offers a study-abroad program each summer. The location at which these programs are conducted varies from year to year. Recent offerings have included Czech Republic, Austria, the Netherlands, China, Rome, Barcelona, and the Middle East. Students entering their third, fourth and fifth years of the B.Arch program are eligible to apply.

Summer Courses
Students are able to take design studios and courses in some sequences during the summer. Studios are taught in a vertical format with faculty providing individual instruction to match the focus of each semester’s topic. In addition, students can receive credit for passing comparable courses at other institutions with advance approval from the School.

Faculty Research
Significant numbers of faculty in the School conduct research. Areas of emphasis that involve multiple faculty and graduate students are computer-aided architectural design, the performance of advanced buildings systems and technologies, and sustainable design. Other faculty work individually or as members of smaller teams on subjects in urban design, cognitive design process, architectural history, media and architecture, architectural practice, and artistic production. The School has no distinction between graduate research faculty and undergraduate faculty. All faculty teach undergraduate courses as a regular part of their yearly teaching load, ensuring that undergraduate students are taught the latest research and scholarship developments, knowledge bases that are transforming professional practice.
Faculty

OMER AKIN, Professor of Architecture — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1977—.

STEHANNIE BARTOS, Associate Teaching Professor of Architecture — M.Arch., Massachusetts Institute of Technology; Carnegie Mellon, 1997—.

MARSHA BERGER, Marsha Berger Architect, Adjunct Associate Professor of Architecture — M.Arch., Carnegie Mellon University; Carnegie Mellon, 1995—.

DEE BRIGGS, Adjunct Assistant Professor of Architecture — M.Arch. Yale University; Carnegie Mellon, 2003—.

WALTER BOYKOWYCZ, Adjunct Professor of Architecture — M. U.R.P., University of Pittsburgh, M.Arch., Carnegie Mellon University; Carnegie Mellon, 1979—.

DAVID BURNS, Adjunct Assistant Professor of Architecture — M.Arch., Columbia University; Carnegie Mellon, 2003—.

LEE CALISTI, Adjunct Professor of Architecture — B.Arch., Kent State University; Carnegie Mellon, 2002—.

GARY CARLOUGH, EDGE Architecture + Graphic Design, Adjunct Professor of Architecture — B.Arch., University of Arizona; Carnegie Mellon, 1988—.

DAVID CELENTO, Celento Henn Architects, Adjunct Assistant Professor of Architecture — B.Arch., Carnegie Mellon University; Carnegie Mellon, 1994—.

DOUGLAS COOPER, Andrew Mellon Chaired Professor of Architecture — B.Arch., Carnegie Mellon University; Carnegie Mellon, 1976—.

GERARD DAMIANI, Studio d’Arc, Adjunct Associate Professor of Architecture — B.Arch., Syracuse; Carnegie Mellon, 1997—.

JEFF DAVIS, Davis Gardner Gannon Pope Architects, Adjunct Assistant Professor of Architecture — B.Arch., University of Illinois Urban Champaign; Carnegie Mellon, 1996—.

ELLEN DO, Associate Professor of Architecture — Ph.D., Georgia Tech; Carnegie Mellon, 2004—.

KEN DOYNO, Rothschild/Doyno Architects, Adjunct Assistant Professor of Architecture — B.Arch., Carnegie Mellon University; Carnegie Mellon, 2003—.

ERIC FISHER, Fisher Architecture, Adjunct Assistant Professor of Architecture — M.Arch., Harvard University; Carnegie Mellon, 2001—.

MATT FINEOUT, Adjunct Assistant Professor of Architecture — M.Arch., SCI-Arc; Carnegie Mellon, 2003—.

ULRICH FLEMMING, Professor Emeritus of Architecture — Ph.D., Technical University of Berlin; Carnegie Mellon, 1981—.

KEVIN GANNON, Davis Gardner Gannon Pope Architects, Adjunct Assistant Professor of Architecture — M.Arch., Yale University; Carnegie Mellon, 1993—.

ANTON GERMISHUIZEN, Burt Hill Kosar Rittelman Associates, Adjunct Professor of Architecture — M.Arch., University of Pennsylvania; Carnegie Mellon, 1993—.

SHELDON GOETTEL, Perfido Weiskopf Architects, Adjunct Professor of Architecture — M.Arch., University of California, Berkeley; Carnegie Mellon, 1990—.

KAI GUTSCHOW, Assistant Professor of Architecture — M.Arch., University of California, Berkeley; Carnegie Mellon, 1998—.

MARK GROSS, Professor of Architecture — Ph.D., MIT; Carnegie Mellon, 2004—.

HENRY HANSON, Hanson Design Group, Ltd., Adjunct Associate Professor of Architecture — M.Arch., Carnegie Mellon University; Carnegie Mellon, 1983—.

VOLKER HARTKOPF, Professor of Architecture — Dr. Ing. In architecture, University of Stuttgart; Carnegie Mellon, 1972—.

DELBERT HIGHLANDS, Professor Emeritus of Architecture — M.Arch., Carnegie Mellon University; Carnegie Mellon, 1964—.

JONATHAN KLINE, Adjunct Instructor of Architecture, — B.Arch., Carnegie Mellon University; Carnegie Mellon, 2002—.

RAMESH KRISHNAMURTI, Professor of Architecture — Ph.D. (Systems Design), University of Waterloo; Carnegie Mellon, 1989—.

KRISTIN KURLAND, Associate Teaching Professor in Architecture and Heinz School of Public Policy and Management, — B.S., University of Pittsburgh; Carnegie Mellon, 1996—.

KHEE POH LAM, Professor of Architecture — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2003—.

LAURA LEE, Associate Professor of Architecture and Head — M.Arch., University of Michigan; Carnegie Mellon, 1989—.

STEPHEN R. LEE, Professor of Architecture — M.Arch., Carnegie Mellon University; Carnegie Mellon, 1981—.

DAVID LEWIS, Distinguished Teaching Professor of Urban Design — M.Arch., Leeds College of Architecture; Carnegie Mellon, 1982—.

VIVIAN LOFTNESS, University Professor of Architecture — M.Arch., Massachusetts Institute of Technology; Carnegie Mellon, 1981—.

ARTHUR LUBETZ, Arthur Lubetz Associates, Adjunct Professor of Architecture — B.Arch., Carnegie Mellon University; Carnegie Mellon, 1988—.

JENNIFER LUCCHINO, Adjunct Assistant Professor of Architecture — M.Arch., Rice University; Carnegie Mellon, 2003—.

GERALD MATTERN, Adjunct Professor of Architecture — B.E., Rose Polytechnic Institute; Carnegie Mellon, 1982—.

DUTCHE MACDONALD, EDGE Architecture, Adjunct Assistant Professor of Architecture — B.Arch., Carnegie Mellon University; Carnegie Mellon, 1999—.

CHRISTINE MONDOR, Assistant Professor of Architecture — B.Arch., Carnegie Mellon University; Carnegie Mellon, 1999—.

BROCK ONQUE, Adjunct Assistant Professor of Architecture, M.Arch., University of Virginia; Carnegie Mellon, 1996—.

IRVING OPPENHEIM, Professor of Architecture and Civil Engineering — Ph.D., Cambridge University; Carnegie Mellon, 1973—.

Luis RICO-GUTIERREZ, Special Faculty in Architecture & Associate Dean of the College of Fine Arts — M.S., Carnegie Mellon University; Carnegie Mellon, 1998—.

ROBERT RIES, University of Pittsburgh, Adjunct Assistant Professor of Architecture — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1998—.

CHARLES ROSENBLUM, Adjunct Assistant Professor of Architecture — M.A., University of Virginia; Carnegie Mellon, 1998—.

PAUL ROSENBLATT, Springboard Architecture and Design, Adjunct Associate Professor of Architecture — M.Arch., Yale; Carnegie Mellon, 1987—.

DAN ROTHSCILD, Rothschild/Doyno Architects, Adjunct Assistant Professor of Architecture — M.Arch., North Carolina State University; Carnegie Mellon, 2003—.

SCOTT SMITH, Shop Director — M.F.A., Cranbrook Institute; Carnegie Mellon, 1984—.

DIANE SHAW, Associate Professor of Architecture — Ph.D., University of California Berkeley; Carnegie Mellon, 1996—.

KENT SUHRBIER, Bohlin Cywinski Jackson, Adjunct Assistant Professor of Architecture — B.Arch., Carnegie Mellon University; Carnegie Mellon, 2000—.

JAMES TAYLOR, IKM Architecture, Adjunct Assistant Professor of Architecture — M.Arch. ; Carnegie Mellon, 2003—.

SPIKE WOLFF, Adjunct Assistant Professor of Architecture — M.Arch, SCI-Arc; Carnegie Mellon, 2003—.
The university-based undergraduate program offered by the School of Art is designed to develop individuals capable of working as artists in a complex, rapidly changing global culture. The program incorporates an expansive approach to art and acknowledges that "working as artists" leads toward a wide variety of pursuits.

Admission to the undergraduate program is highly competitive. Students must show promise of excellence in both academic and artistic performance. Evidence of creative leadership is a plus.

The faculty, all practicing artists or scholars, provide an intense, professional learning environment in which students develop close ties with their instructors and each other.

Art students are encouraged to take full advantage of the university environment through exposure to faculty and students in other departments in the College of Fine Arts and throughout the University. They are also encouraged to participate in the numerous cultural opportunities on campus and in the larger Pittsburgh community.

The School of Art maintains extensive contemporary studios to make possible its wide range of media offerings. It occupies the top two floors of the College of Fine Arts building, as well as a significant portion of Doherty Hall. Numerous exhibition venues inform or present student work including the Ellis Gallery, the University Center Gallery, The Miller Gallery, and the Frame Gallery, which is managed entirely by art students.

The progressive curriculum requires that students attain high levels of knowledge, skill and commitment. The four-year undergraduate program offers one degree, the Bachelor of Fine Arts (B.F.A.) degree in art. The School of Art is a charter member of the National Association of Schools of Art and Design (NASAD) and is fully accredited by this organization.

Using five categories of courses, the curriculum presents art-making in a unique manner which respects tradition and encourages innovation. The course categories are:

I. Concept Studios
II. Media Studios
III. Advanced Studios
IV. Academic Art Courses
V. University Academic Courses

Studio courses comprise over sixty percent of the course of study and academic courses comprise the remainder. The division of the studio curriculum into conceptually-driven and media-driven courses acknowledges that neither concept nor media can be presented independently of one another. This curriculum ensures that all students experience high-quality, consistent training in a variety of approaches.

I. Concept Studios

The Concept Studios are the core of the art curriculum. One Concept Studio is offered each semester for a total of eight courses. Students are required to complete six of the eight, but may enroll in all eight semesters. In the second semesters of the sophomore and junior years, Concept Studios are optional. Experiences gained in the other four components of the program are integrated into Concept Studios. Themes and topics addressed in Concept Studios include: the self and the human being, space/time, systems/processes, context/community affiliation, and senior project.

Freshman and sophomore Concept Studios are organized around structured assignments designed to assist the student in developing a personal, non-medium-specific approach to generating art as well as in learning transferable conceptual skills. The progression from semester to semester leads toward increasing complexity and independence. In the junior year, the Art-in-Context Concept Studio, is devoted entirely to context-related issues and art that engages a variety of communities. In the senior year, the Concept Studios, titled Senior Project, are devoted to a single student-generated project.

II. Media Studios

The Media Studios can be viewed as the foundation courses for the program. Students take two Media Studios each semester during the freshman and sophomore years for a total of eight courses. These studios ensure that all students have an exploratory experience with all of the media resources of the school. They also serve as preparation for advanced studio work.

Two-Dimensional Media Studios introduce drawing during the freshman year, and painting and printmaking during the sophomore year. Electronic Media Studios introduce computer-related work during the freshman year, and video in the sophomore year. Three-Dimensional Media Studios introduce ceramics, welding and wood during the freshman year, and foundry, metals, and construction during the sophomore year.

III. Advanced Studios

Students take a total of eight Advanced Studio elective courses during the junior and senior years. These courses address specialized studio work in one of the three artistic concentration areas in the school, which are:

- Painting, Drawing, and Printmaking (PDP)
- Sculpture, Installation, and Site Work (SIS)
- Electronic and Time-Based Work (ETB)

A minimum of four courses must be taken in one of these concentration areas. One of the eight Advanced Studio courses must be a College of Fine Arts interdisciplinary course or in one of the Schools outside of Art: Architecture, Design, Drama, Music.

IV. Academic Art Courses

First-semester freshmen are required to take Contemporary Issues Forum, an introduction to current practices in the visual arts. A three-semester art history/theory survey sequence is then required of all students:

Freshman Year (spring): Pre-Industrial Visual Cultures to 1789
Sophomore Year (fall): Modern Visual Culture: 1789-1945
Sophomore Year (spring): Contemporary Visual Culture: 1945 to the Present

After the sophomore year, students must take two elective academic art courses.

V. University Academic Courses

Eleven academic courses outside of Art are required.

Freshman Year

The student is required to take the following three courses:

Computer Skills Workshop, World History, and Interpretation and Argument
After Freshman Year

The student must take one course in each of the following academic areas or "options":

- Humanities and Languages or "Culture Option"
- Math, Science and Engineering or "Technical Option"
- History, Psychology, Economics or "Social Science Option"

The student must then take at least three additional courses from ONE of the academic areas/options listed above.

Finally, the student must take two additional, but unspecified, academic electives.

In selecting courses for the university academic component of the curriculum, students are encouraged to complete a cluster of courses that appeals to and develops their interests as emerging artists. In the process of taking their university electives, students can often simultaneously earn a minor.

Bachelor of Fine Arts (B.F.A.) Curriculum

Below is the recommended distribution of courses in the four-year B.F.A curriculum. After the freshman year, students may begin to choose university electives. After the sophomore year, students have more options regarding the sequencing and selection of their coursework.

First Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-101</td>
<td>Concept Studio I</td>
<td>10</td>
</tr>
<tr>
<td>60-110</td>
<td>Electronic Media Studio I: Computer Art</td>
<td>10</td>
</tr>
<tr>
<td>60-150</td>
<td>2D Media Studio I: Drawing</td>
<td>10</td>
</tr>
<tr>
<td>60-104</td>
<td>Contemporary Issues Forum</td>
<td>3</td>
</tr>
<tr>
<td>99-103</td>
<td>Computer Skills Workshop</td>
<td></td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument</td>
<td>9</td>
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Second Year

<table>
<thead>
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<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>60-102</td>
<td>Concept Studio II</td>
<td>10</td>
</tr>
<tr>
<td>60-130</td>
<td>3D Media Studio I: Ceramics, Welding, Wood</td>
<td>10</td>
</tr>
<tr>
<td>60-151</td>
<td>2D Media Studio II: Drawing</td>
<td>10</td>
</tr>
<tr>
<td>60-105</td>
<td>Pre-Industrial Visual Cultures to 1789</td>
<td>9</td>
</tr>
<tr>
<td>79-104</td>
<td>World History</td>
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Third Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-201</td>
<td>Concept Studio III</td>
<td>10</td>
</tr>
<tr>
<td>60-230</td>
<td>3D Media Studio II: Foundry, Metals, Construction</td>
<td>10</td>
</tr>
<tr>
<td>60-250</td>
<td>2D Media Studio III: Painting</td>
<td>10</td>
</tr>
<tr>
<td>60-205</td>
<td>Modern Visual Culture: 1789-1945</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Academic Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

Fourth Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-202</td>
<td>Sophomore Honors Project or Advanced Studio</td>
<td>10</td>
</tr>
<tr>
<td>60-210</td>
<td>Electronic Media Studio II: Video Art</td>
<td>10</td>
</tr>
<tr>
<td>60-251</td>
<td>2D Media Studio IV: Printmaking</td>
<td>10</td>
</tr>
<tr>
<td>60-206</td>
<td>Contemporary Visual Culture: 1945 to the Present</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Academic Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

Sophomore and Senior Year Reviews

Students give an overview of their work twice in their four-year course of study. At the end of the sophomore year, students undergo a faculty review of their work to date in the program. A successful review is required for advancement to the junior year.

The senior review affords graduating students the opportunity to review, analyze and summarize their work and to engage a faculty committee in discussion about issues that face an artist preparing to enter a career in art.

Art Majors Minoring or Double Majoring in Another Department

About a third of current B.F.A. Art students pursue a minor or a second major. If students are contemplating this option, they must discuss their plans with academic advisors from the minor or second major department as well as with the School of Art academic advisor.

Study Abroad

Art students are encouraged to spend either a semester of their junior year, or a summer before or after their junior year, in one of many available international programs. These programs include exchange programs sponsored by the School of Art in which a student’s financial aid package remains in effect, and programs sponsored by other institutions. International exchange programs currently active include the following:

- Brazil: Escola de Comunicacoes e Artes, Universidade de Sao Paulo, Sao Paulo
- Chile: Instituto Superior de Arte y Comunicacion, Santiago
- China: Chinese University of Hong Kong, Shatin, Hong Kong
- Denmark: The Royal Danish Academy of Fine Arts, Copenhagen
- Ecuador: Universidad de San Francisco de Quito, Quito
- Finland: Kuvataideakademia, Helsinki
- Germany: Akademie der Bildenden Kunste, Munich, Universitat der Kunst Berlin, Berlin
- Ireland: Burren College of Art and Design, Burren
- Israel: Bezalel Academy, Jerusalem
- Japan: College of Art and Design, Nagoya, Tokyo Institute of Polytechnics, Tokyo
- Korea: The Korsan National University of the Arts, Seoul
- Netherlands: Gerrit Rietveld Academie, Amsterdam
- New Zealand: Auckland Institute of Technology, Auckland
- Scotland: Duncan Jordonstone College of Art and Design, Dundee, Glasgow School of Fine Art, Glasgow
- Spain: Universitat Politecnica de Valencia, Valencia
- Turkey: Bilkent University, Ankara
- Wales: University of Wales College, Newport
Programs with other Pittsburgh Institutions

Art students are eligible to take courses at the nearby University of Pittsburgh’s Art History Department, at Pittsburgh Filmmakers, and at the Pittsburgh Glass Center. Established agreements with these institutions and other Pittsburgh colleges, universities or centers offer cross-registration opportunities at no additional expense to the student.

Bachelor of Humanities and Arts (B.H.A.) Degree

Bachelor of Science and Arts (B.S.A.) Degree

Carnegie Mellon University offers a degree program that combines an Art Focus (11 courses) with a focus in the College of Humanities and Social Sciences or the Mellon College of Science. The Assistant Head of the School advises BHA and BSA majors in selecting courses in the Art Focus. A description of these programs, and a list of requirements and electives, can be found in the in the BHA and BSA section of this catalog.

Art Minors

Only students from other colleges and departments are eligible to pursue a minor in art. A minor requires six courses in the School of Art, selected from a list of requirements and electives as described in the CFA minors section of this catalog.

Master of Fine Arts (M.F.A.) Degree

The School of Art offers a three-year program leading to a Master of Fine Arts in Art. This is a unique program designed to connect artmaking to the university at large, and to Pittsburgh communities. Information about this program is available at the School of Art website: http://artserver.cfa.cmu.edu.

Master of Arts Management (M.A.M.) Degree

The College of Fine Arts and the H. John Heinz III School of Public Policy and Management co-sponsor a Master of Arts Management degree. Students admitted to the M.A.M. degree program in their junior year may complete both a Bachelor of Fine Arts degree and a Master of Arts Management degree in five years. Students interested in this graduate degree should consult with advisors early in their undergraduate program.

Pre-College Programs

The School of Art maintains two pre-college programs: a Saturday program during the academic year and a six-week program during the summer. These programs are designed to prepare the college-bound high school student for college level work in art. Information on these programs may be obtained by contacting the School of Art.

School of Art Faculty

Full-Time Tenure Track Faculty

KIM BECK, Assistant Professor of Art — M.F.A., Rhode Island School of Design; Carnegie Mellon, 2004—.

JON BECKLEY, Professor of Art — M.F.A., Ohio University; Carnegie Mellon, 1979—.

PATRICIA BELLAN-GILLEN, Professor of Art — M.F.A. Carnegie Mellon University; Carnegie Mellon, 1986—.

RON BENNETT, Professor of Art — M.F.A. Rhode Island School of Design; Carnegie Mellon, 1975—.

BOB BINGHAM, Associate Professor of Art — M.F.A. University of California, Davis; Carnegie Mellon, 1993—.

LOWRY BURGESS, Professor of Art — Post-Graduate Degree, Pennsylvania Academy of Fine Arts/University of Pennsylvania; Carnegie Mellon, 1989—.

JAMES DUESING, Professor of Art — M.F.A. University of Cincinnati; Carnegie Mellon, 1997—.

PAMELA JENNINGS, Assistant Professor of Art and HCII — M.F.A. School of Visual Arts; Carnegie Mellon, 2001—.

ANDREW JOHNSON, Associate Professor of Art — M.F.A. Carnegie Mellon University; Carnegie Mellon, 2004—.

ELAINE A. KING, Professor of Art History and Theory — Ph.D. Northwestern University; Carnegie Mellon, 1981—.

CAROL KUMATA, Professor of Art — M.F.A. University of Wisconsin, Madison; Carnegie Mellon, 1979—.

GOLAN LEVIN, Assistant Professor of Art — M.S. Massachusetts Institute of Technology; Carnegie Mellon, 2004—.

JOSEPH MANNINO, Associate Professor of Art — M.F.A. University of Southern Illinois; Carnegie Mellon, 1986—.

CLAYTON MERRELL, Associate Professor of Art — M.F.A. Yale University; Carnegie Mellon, 1998—.

AYANA MOOR, Assistant Professor of Art — M.F.A. Tyler School of Art; Carnegie Mellon, 1999—.

MARTIN PREKOP, Dean of the College of Fine Arts, Professor of Art — M.F.A. Rhode Island School of Design; Carnegie Mellon, 1993—.

SUZIE SILVER, Associate Professor of Art — M.F.A. The School of the Art Institute of Chicago; Carnegie Mellon, 1999—.

SUSANNE SLAVICK, Professor of Art — M.F.A. Tyler School of Art; Carnegie Mellon, 1984—.

MARY WEIDNER, Professor of Art — M.F.A. Washington University; Carnegie Mellon, 1976—.

Full-time Joint Appointments

CHARLEE BRODSKY, Associate Professor of Art and Photography — M.F.A. Yale University; Carnegie Mellon, 1978—.

ROGER DANNENBERG, Senior Research Computer Scientist and Artist — Ph.D. Carnegie Mellon University; Carnegie Mellon, 1982—.

PATRICIA MAURIDES, Adjunct Assistant Professor of Art and Director of BHA/BSA Programs — M.F.A. Carnegie Mellon; Carnegie Mellon, 1999—.

JUDITH MODELL, Professor of Anthropology, History, and Art — Ph.D. University of Minnesota; Carnegie Mellon, 1984—.

Visiting Faculty

BRUCE ERIKSON, Visiting Assistant Professor of Art — M.F.A. Indiana University; Carnegie Mellon, 2003—.

MICHELLE ILLUMINATO, Visiting Assistant Professor of Art — M.F.A. University of Wisconsin; Carnegie Mellon, 2003—.

MELISSA RAGONA, Visiting Assistant Professor of Art — Ph.D. State University of New York at Buffalo; Carnegie Mellon, 2003—.

FABIAN WINKLER, Visiting Assistant Professor of Art — M.F.A. University of California, Los Angeles; Carnegie Mellon, 2003—.

A Full-Time Tenure Track Faculty FULL-TIME TENURE TRACK FACULTY

KIM BECK, Assistant Professor of Art — M.F.A., Rhode Island School of Design; Carnegie Mellon, 2004—.

JON BECKLEY, Professor of Art — M.F.A., Ohio University; Carnegie Mellon, 1979—.

PATRICIA BELLAN-GILLEN, Professor of Art — M.F.A. Carnegie Mellon University; Carnegie Mellon, 1986—.

RON BENNETT, Professor of Art — M.F.A. Rhode Island School of Design; Carnegie Mellon, 1975—.

BOB BINGHAM, Associate Professor of Art — M.F.A. University of California, Davis; Carnegie Mellon, 1993—.

LOWRY BURGESS, Professor of Art — Post-Graduate Degree, Pennsylvania Academy of Fine Arts/University of Pennsylvania; Carnegie Mellon, 1989—.

JAMES DUESING, Professor of Art — M.F.A. University of Cincinnati; Carnegie Mellon, 1997—.

PAMELA JENNINGS, Assistant Professor of Art and HCII — M.F.A. School of Visual Arts; Carnegie Mellon, 2001—.

ANDREW JOHNSON, Associate Professor of Art — M.F.A. Carnegie Mellon University; Carnegie Mellon, 2004—.

ELAINE A. KING, Professor of Art History and Theory — Ph.D. Northwestern University; Carnegie Mellon, 1981—.

CAROL KUMATA, Professor of Art — M.F.A. University of Wisconsin, Madison; Carnegie Mellon, 1979—.

GOLAN LEVIN, Assistant Professor of Art — M.S. Massachusetts Institute of Technology; Carnegie Mellon, 2004—.

JOSEPH MANNINO, Associate Professor of Art — M.F.A. University of Southern Illinois; Carnegie Mellon, 1986—.

CLAYTON MERRELL, Associate Professor of Art — M.F.A. Yale University; Carnegie Mellon, 1998—.

AYANA MOOR, Assistant Professor of Art — M.F.A. Tyler School of Art; Carnegie Mellon, 1999—.

MARTIN PREKOP, Dean of the College of Fine Arts, Professor of Art — M.F.A. Rhode Island School of Design; Carnegie Mellon, 1993—.

SUZIE SILVER, Associate Professor of Art — M.F.A. The School of the Art Institute of Chicago; Carnegie Mellon, 1999—.

SUSANNE SLAVICK, Professor of Art — M.F.A. Tyler School of Art; Carnegie Mellon, 1984—.

MARY WEIDNER, Professor of Art — M.F.A. Washington University; Carnegie Mellon, 1976—.

Full-time Joint Appointments

CHARLEE BRODSKY, Associate Professor of Art and Photography — M.F.A. Yale University; Carnegie Mellon, 1978—.

ROGER DANNENBERG, Senior Research Computer Scientist and Artist — Ph.D. Carnegie Mellon University; Carnegie Mellon, 1982—.

PATRICIA MAURIDES, Adjunct Assistant Professor of Art and Director of BHA/BSA Programs — M.F.A. Carnegie Mellon; Carnegie Mellon, 1999—.

JUDITH MODELL, Professor of Anthropology, History, and Art — Ph.D. University of Minnesota; Carnegie Mellon, 1984—.

Visiting Faculty

BRUCE ERIKSON, Visiting Assistant Professor of Art — M.F.A. Indiana University; Carnegie Mellon, 2003—.

MICHELLE ILLUMINATO, Visiting Assistant Professor of Art — M.F.A. University of Wisconsin; Carnegie Mellon, 2003—.

MELISSA RAGONA, Visiting Assistant Professor of Art — Ph.D. State University of New York at Buffalo; Carnegie Mellon, 2003—.

FABIAN WINKLER, Visiting Assistant Professor of Art — M.F.A. University of California, Los Angeles; Carnegie Mellon, 2003—.
Adjunct Courtesy Appointments

ROBERT BECKMAN, Adjunct Assistant Professor of Art — M.F.A. Kent State University; Carnegie Mellon, 2001—.

VICKY CLARK, Adjunct Associate Professor of Art — Ph.D. University of Michigan; Carnegie Mellon, 1998—.

WILLIAM JUDSON, Adjunct Associate Professor of Art — A.B.D. Yale University; Carnegie Mellon, 1998—.
School of Design
Dan Boyarski, Head Office: Margaret Morrison Carnegie Hall 110
http://www.cmu.edu/cfa/design/

Design at Carnegie Mellon
Design is the thoughtful activity that humanizes our environment through visual communication and the shaping of products that help us in our daily lives. Whether in magazines and books, posters and exhibitions, video and film, human-computer interactions, or any of the myriad of everyday products such as furniture, consumer goods, vehicles, or medical equipment, designers play an important role in shaping the form and content of our experience.

Designers are concerned with aesthetics, but they are equally concerned with serving people. This requires more than skill in the fine arts. It also requires knowledge about the needs, desires, expectations, and needs of human beings. It requires skills of observation and interpretation that help us understand the people that we want to serve. More than this, however, designers must also understand the technological issues that stand behind effective products. They must understand the materials, tools, and production processes of the modern world. An education in design is an education for the mind as well as the eye and hand.

The emphasis in the School of Design is on professional preparation for an increasingly complex world in which design is an integrative discipline that supports the quality of human interaction in daily life. Designers must be able to integrate aspects of aesthetics and form giving, the social and behavioral sciences, and the natural sciences and engineering. In addition, designers must be able to work effectively in teams of experts with specialized knowledge drawn from many disciplines. Therefore, the vision of design operating behind the School of Design contrasts sharply with visions that seek to reduce design to a fine art, a branch of engineering, or an area of the social sciences. The central theme of the School is communication and human experience. This reflects a new humanistic vision of design in the contemporary world, where a premium is placed on the designer’s ability to invent, judge, make decisions, and evaluate for the purpose of improving the quality of life. For the design school at Carnegie Mellon, design is a new liberal art of technological culture.

The School offers two majors in design, with corresponding design minors programs.

B.F.A. in Communication Design
The goal of the Communication Design program is to prepare students with an understanding and mastery of the principles, theories, and skills of communication design. We define communication design as the effective presentation of ideas and information by means of type and image, whether in the traditional medium of print or the new digital medium that supports interactive computer display, multimedia communication technology, and information systems. What is common to the range of experiences in the program is a problem-solving approach to effective and expressive communication, with a special concern for the human being who will be touched by the communication artifact. We emphasize a design practice that is informed with an understanding of the social and cultural dimensions of communication, along with an appreciation of the power of words, images, sound, and movement. This is a forward looking program. While we foster a respect for the rich history of book, letterform, and print design, we are also fascinated with the potential that technology and new theories of human-machine interaction hold for the design of future modes of communication.

BFA in Industrial Design
The goal of the Industrial Design program is to equip designers for a world that places a high value on the quality of human interactions. We all need products, devices, and designs that support and enhance these exchanges. To this end, we emphasize a design process strongly flavored by user testing, observation, and modelling, while preserving the richness of the visual and formal traditions in the field. The program approaches a balance by speaking clearly to several issues in the design process: how we understand the diverse qualities and needs of human beings, how we respond to those qualities and needs, how we make creative applications of appropriate technologies, how we gain a perspective on the place of design in the economic and social life that is characteristic of contemporary culture, and how we expand our awareness of the place of design in history and in shaping the future.

Design Minors Program
The School also offers a minor in Communication Design and a minor in Industrial Design for well-qualified students. Further information on minors programs is provided earlier in the catalog.

The Design Curriculum
The design curriculum is for students who are interested in a full-time undergraduate study leading to entry-level professional employment or advanced graduate study in the areas of Communication Design or Industrial Design. The first year is a period of discovery, where students in both majors explore studio projects and supporting courses in the ideas and methods of design practice as well as courses in design studies. The second and third years are a period of concentration and development primarily within the student’s major. The fourth year is a period of integration and advanced study, with studio projects involving teams of students from both majors as well as students from related fields. There are studio courses throughout all four years, supported by departmental electives in the ideas and methods of design practice and other courses in the history, theory, and criticism of design. In addition, the School also requires all students to take a substantial number of general education courses offered by other departments throughout the university. General education is an essential part of the education of a professional designer.

The First-Year Experience: Discovery
The first-year program in design provides a broad base for later specialization. Students are introduced to the three main tracks of the department: studio experience, ideas and methods of design practice, and design studies in history, theory, and criticism. Students are exposed to fundamental design processes, techniques, and ideational methods. They learn new ways of seeing and understanding familiar objects, of drawing and visualizing ideas and concepts, and how to use all of the resources of design to give form to ideas. Faculty members review each student’s progress at the end of every semester. Faculty members also counsel students regarding both personal interests and educational objectives, so that a wise choice may be made between majoring in communication design or industrial design. In addition, students also take courses outside of the School for a sound general education. This is the first-year curriculum for all design students.

First Year

<table>
<thead>
<tr>
<th>Studio</th>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>51-101</td>
<td>Design Studio I</td>
<td>9</td>
</tr>
<tr>
<td>Ideas and Methods</td>
<td></td>
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<tr>
<td>51-121</td>
<td>Design Drawing I</td>
<td>9</td>
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<tr>
<td>Design Studies</td>
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<tr>
<td>51-171</td>
<td>Human Experience in Design</td>
<td>9</td>
</tr>
<tr>
<td>General Education</td>
<td></td>
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<tr>
<td>76-101</td>
<td>Interpretation &amp; Argument</td>
<td>9</td>
</tr>
<tr>
<td>85-101</td>
<td>Business and Professional Etiquette</td>
<td>9</td>
</tr>
<tr>
<td>99-101</td>
<td>Computer Skills Workshop</td>
<td>3</td>
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</table>
### School of Design

#### Second Year

<table>
<thead>
<tr>
<th>Studio</th>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>51-201</td>
<td>Basic Typography: CD Studio I</td>
<td>9</td>
</tr>
</tbody>
</table>

**Ideas and Methods**

| 51-221 | Communication Design: Darkroom I | 4.5 |
| 51-241 | How People Work: Human Factors | 9 |
| 51-223 | Communication Design: Darkroom II | 4.5 |
| 51-231 | Introduction to Calligraphy I | 9 |
| 51-227 | Marks, Signs & Communications | 9 |

**Design Studies**

| 51-271 | Design History I | 9 |

**General Education**

| xx-xxx | Academic Elective | 9 |
| xx-xxx | Free Elective | 3-9 |

#### Spring

<table>
<thead>
<tr>
<th>Studio</th>
<th>Units</th>
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</thead>
</table>

| 51-202 | Intermediate Typography: CD Studio II | 9 |

**Ideas and Methods**

| 51-222 | Color and Communication | 9 |
| 51-224 | Digital Prepress Production | 9 |
| 51-225 | Communication Design Fundamentals (non-majors) | 9 |

**Design Studies**

| 51-272 | Design History II | 9 |

**General Education**

| xx-xxx | Academic Elective | 9 |

#### Third Year

<table>
<thead>
<tr>
<th>Studio</th>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-301</td>
<td>Advanced Typography: CD Studio III</td>
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</table>

**Ideas and Methods**

| 51-321 | Photography and Communication | 9 |
| 51-323 | Drawing and Communication | 9 |
| 51-329 | Designing Identities | 9 |
| 51-327 | Web Design | 9 |
| 51-333 | Poster Design | 9 |

**Design Studies**

| 51-371 | Topics in Design Studies | 9 |
| 51-373 | Language in Design | 9 |

**General Education**

| xx-xxx | Academic Elective | 9 |
| xx-xxx | Free Elective | 18 |

#### Industrial Design

This is the second and third-year curriculum for students in industrial design, with required courses noted in bold type and other available courses (usually open to students of communication design as well as industrial design) noted in regular type. While required courses must be taken in proper sequence, other available courses may be taken later, when the student’s schedule permits. Special courses for minors and other students in the university are also included.

<table>
<thead>
<tr>
<th>Studio</th>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-301</td>
<td>Basic Typography: CD Studio I</td>
<td>9</td>
</tr>
</tbody>
</table>

**Ideas and Methods**

| 51-321 | Photography and Communication | 9 |
| 51-323 | Drawing and Communication | 9 |
| 51-329 | Designing Identities | 9 |
| 51-327 | Web Design | 9 |
| 51-333 | Poster Design | 9 |

**Design Studies**

| 51-371 | Topics in Design Studies | 9 |
| 51-373 | Language in Design | 9 |

**General Education**

| xx-xxx | Academic Elective | 9 |
| xx-xxx | Free Elective | 18 |

#### Second Year

<table>
<thead>
<tr>
<th>Studio</th>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-211</td>
<td>Generation of Forms: ID Studio I</td>
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**Ideas and Methods**

| 51-241 | How People Work: Human Factors | 9 |
| 51-243 | Basic Prototype Methods (mini 1) | 4.5 |
| 51-251 | Digital Prototyping (mini 2) | 4.5 |

**Design Studies**

| 51-271 | Design History I | 9 |

**General Education**

| xx-xxx | Academic Elective | 9 |

#### Spring

<table>
<thead>
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<th>Studio</th>
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| 51-212 | The Meaning of Forms (ID Studio II) | 9 |

**Ideas and Methods**

| 51-222 | Color and Communication | 9 |
| 51-242 | How Things Work: Mechanics and Electronics | 9 |
| 51-246 | Photo-Documentation for Industrial Design | 4.5 |
| 51-250 | Typography for ID and Non-Majors | 9 |
| 51-264 | Industrial Design Fundamentals (non-majors) | 9 |

**Design Studies**

| 51-272 | Design History II | 9 |

**General Education**

| xx-xxx | Academic Elective | 9 |
| xx-xxx | Free Elective | 3-9 |
### Third Year

#### Studio

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<tr>
<td>51-311</td>
<td>Product Design: ID Studio III</td>
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#### Ideas and Methods

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<tbody>
<tr>
<td>51-341</td>
<td>How Things are Made: Production Methods</td>
</tr>
<tr>
<td>51-331</td>
<td>Advanced Calligraphy I</td>
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</table>

#### Design Studies

<table>
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<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-371</td>
<td>Topics in Design Studies</td>
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<tr>
<td>51-373</td>
<td>Language in Design</td>
</tr>
<tr>
<td>51-379</td>
<td>Emotion &amp; Reason in Design</td>
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#### Other

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-399</td>
<td>Junior Independent Study</td>
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#### General Education

<table>
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<tr>
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<th>Units</th>
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<tbody>
<tr>
<td>xx-xxx</td>
<td>Academic Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Free Elective</td>
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#### Studio

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<tr>
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<th>Units</th>
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<tbody>
<tr>
<td>51-312</td>
<td>Products in Systems: ID Studio IV</td>
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#### Ideas and Methods

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<tbody>
<tr>
<td>51-332</td>
<td>Advanced Calligraphy II</td>
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<tr>
<td>51-344</td>
<td>Adv. Digital Prototyping</td>
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<td>51-346</td>
<td>Production Prototyping</td>
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<td>51-350</td>
<td>Visualization</td>
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#### Design Studies

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<tbody>
<tr>
<td>51-372</td>
<td>Contemporary Design</td>
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#### Other

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<tr>
<th>Spring</th>
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<tbody>
<tr>
<td>51-399</td>
<td>Junior Independent Study</td>
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#### General Education

<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx-xxx</td>
<td>Academic Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Free Elective</td>
</tr>
</tbody>
</table>

### The Fourth-Year Experience: Integration and Advanced Study

In the senior year, the studio experience is primarily about team projects. These projects typically involve cooperation with an external sponsor or client, with a combination of communication designers and industrial designers working in teams. The student agrees to participate as an information source, consultant, and project critic. All members of the team typically work on different aspects of a complex problem which is defined in conjunction with the client. Individual initiative and self-pacing are essential, but frequent group discussions and client reviews keep each student accountable to the team. This is the fourth-year curriculum for all students, with required courses noted in bold type and other available courses (usually open to students of both communication design and industrial design) noted in regular type. Each senior signs up for one senior project in each semester.

### Fourth Year

#### Studio

<table>
<thead>
<tr>
<th>Fall (You are required to choose one.)</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-403</td>
<td>Sr. Project: Interaction Design</td>
</tr>
<tr>
<td>51-405</td>
<td>Sr. Project: Communication Design</td>
</tr>
<tr>
<td>51-407</td>
<td>Sr. Project: Product Design</td>
</tr>
<tr>
<td>51-409</td>
<td>Sr. Project: Environmental Design</td>
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#### Ideas and Methods

<table>
<thead>
<tr>
<th>Fall (You are required to choose one.)</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-421</td>
<td>Visual Interface Design</td>
</tr>
<tr>
<td>51-423</td>
<td>Design Computing</td>
</tr>
<tr>
<td>51-433</td>
<td>Advanced Interaction &amp; Visual Interface</td>
</tr>
<tr>
<td>51-451</td>
<td>Fundamentals of Joinery and Furniture Design (I)</td>
</tr>
<tr>
<td>51-441</td>
<td>Product Planning &amp; Development</td>
</tr>
<tr>
<td>51-426</td>
<td>Letterpress &amp; Bookbinding</td>
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#### Design Studies

<table>
<thead>
<tr>
<th>Fall (You are required to choose one.)</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-411</td>
<td>Issues of Professional Practice</td>
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<tr>
<td>51-472</td>
<td>Globalization in Design</td>
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#### Other

<table>
<thead>
<tr>
<th>Fall (You are required to choose one.)</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-499</td>
<td>Senior Independent Study</td>
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### General Education

| xx-xxx | Academic Elective | 9 |
| xx-xxx | Free Elective | 9 |

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<th>Spring (You are required to choose one.)</th>
<th>Units</th>
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<tr>
<td>51-404</td>
<td>Sr. Project: Interaction Design</td>
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<tr>
<td>51-406</td>
<td>Sr. Project: Communication Design</td>
</tr>
<tr>
<td>51-408</td>
<td>Sr. Project: Environmental Design</td>
</tr>
<tr>
<td>51-408</td>
<td>Sr. Project: Integrated Product Development</td>
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#### Ideas and Methods

<table>
<thead>
<tr>
<th>Spring (You are required to choose one.)</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-426</td>
<td>Letterpress and Bookbinding</td>
</tr>
<tr>
<td>51-452</td>
<td>Furniture Design (II)</td>
</tr>
<tr>
<td>51-424</td>
<td>Interactive Programming for Design</td>
</tr>
<tr>
<td>51-428</td>
<td>Time, Motion &amp; Communication</td>
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#### Design Studies

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<th>Spring (You are required to choose one.)</th>
<th>Units</th>
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<tbody>
<tr>
<td>51-472</td>
<td>Topics in Design Studies</td>
</tr>
<tr>
<td>51-488</td>
<td>Design, Management &amp; Organizational Behavior</td>
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</table>

#### Other

<table>
<thead>
<tr>
<th>Spring (You are required to choose one.)</th>
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</thead>
<tbody>
<tr>
<td>xx-xxx</td>
<td>Academic Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Free Elective</td>
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</tbody>
</table>

### Other Requirements

General education courses should be selected from other departments throughout the university. Students are strongly advised to select a balanced set of general education electives— in addition to Interpretation and Argument, World History and Introduction to Intelligence—from three broad areas of study: arts and humanities, social and behavioral sciences, and natural sciences and engineering, including mathematics. Specific recommendations (and general requirements) for electives in all of these areas are available from advisors in the School of Design. The School places strong emphasis on the value of general education for personal growth as well as professional development. General education electives allow a student to obtain a minor in another department or program, such as business, engineering, professional and technical writing, or architecture.

Students may enroll for no more than 18 units of independent study courses, and no more than one independent study per semester. A minimum 3.0 GPA is required for independent study. Independent study is permitted only in the third and fourth years of the program. Proposals for independent study courses must be developed jointly by the student and a faculty advisor. Guidelines are available from the School.

A minimum GPA of 2.0 is required to maintain Professional Program status. Grades lower than “C” in required Design courses will result in academic probation, suspension, or drop from the School of Design. Full-time students are required to enroll for a minimum of 45 units per semester (typically five courses). The minimum number of units required for graduation in Design is 360.

### Standards

The design curriculum adheres closely to the fundamental professional entry-level standards established by the two leading national design organizations: the American Institute of Graphic Arts (AIGA) and the Industrial Designers Society of America (IDSA). The curriculum is accredited by the National Association of Schools of Art and Design (NASAD).

### Applications

The School of Design accepts applications from students who are completing secondary education or who wish to transfer from within Carnegie Mellon University. The School also accepts applications from students who wish to transfer from other institutions. Students applying for the program are asked to either 1) submit a portfolio or 2) complete a design project (available as a PDF on the Design web site) as evidence of design ability. This is considered in balance with evidence of academic ability, based on secondary school grades, SAT scores, class rank, and letters of recommendation. The School also accepts applications for the design minors program for a limited number of spaces. Details are available from the design office.
Faculty

ERIC ANDERSON, Associate Professor of Design — M.A., Ohio State University; Carnegie Mellon, 1998—.

MARK BASKINGER, Assistant Professor of Design — M.F.A., University of Illinois; School for Design, Kunstgewerbeschule, Basel, Switzerland; Carnegie Mellon, 1982—.

DANIEL BOYARSKI, Professor of Design, Head, School of Design — M.F.A., Indiana University; School for Design, Kunstgewerbeschule, Basel, Switzerland; Carnegie Mellon, 1982—.

CHARLEE MAE BRODSKY, Professor of Photography — M.F.A., Yale University; Carnegie Mellon, 1978—.

RICHARD BUCHANAN, Professor of Design — Ph.D. University of Chicago; Carnegie Mellon, 1992—.

SHELLEY EVENSON, Associate Professor of Interaction Design — B.S Ohio State University; Carnegie Mellon, 2003—.

BRUCE HANINGTON, Associate Professor of Design — Master of Environmental and Industrial Design, University of Calgary; Carnegie Mellon, 1998—.

KRISTIN HUGHES, Assistant Professor of Design — M.F.A., Virginia Commonwealth University; Carnegie Mellon, 2001—.

MARK MENTZER, Professor of Drawing — B.F.A., Carnegie Mellon University; Carnegie Mellon, 1975—.


KAREN MOYER, Senior Lecturer in Design — B.F.A., Philadelphia College of Art; Carnegie Mellon, 1978—.

STACY ROHRBACH, Assistant Professor of Design — MGD, North Carolina State University; Carnegie Mellon, 2003—.

STEPHEN J. STADELMEIER, Associate Professor of Design — M.S., Cornell University; Carnegie Mellon, 1977—.

ROBERT O. SWINEHART, Professor of Design — M.F.A., Northern Illinois University; Carnegie Mellon, 1974—.

CRAIG M. VOGEL, Professor of Design — M.I.D., Pratt Institute; Carnegie Mellon, 1990—.

ELIZABETH WELLMAN, Associate Teaching Professor in Design — M.Arch., Virginia Polytechnic Institute and State University; Carnegie Mellon, 1996—.

JOHN ZIMMERMAN, Assistant Professor, joint faculty in Design and Human Computer Interaction Institute — MDes, Carnegie Mellon University; Carnegie Mellon, 2002—.

Adjunct Faculty

AUDREY BROWN, Adjunct Instructor — B.F.A., Edinboro University

VICTORIA CROWLEY, Adjunct Instructor — B.F.A., Carnegie Mellon University

EDWARD PETROSKY, Adjunct Instructor

MYRNA ROSEN, Adjunct Instructor

MATTHEW SASS, Adjunct Instructor — B.F.A., Carnegie Mellon University

LISA VITALBO, Adjunct Instructor — B.F.A., Carnegie Mellon University

DYLAN VITONE, Adjunct Instructor — M.F.A., Massachusetts College of Art

Special Faculty


HOWARD WORNER, Associate Professor of Design, Emeritus.

Adjunct Faculty

RANDY PAUSCH, Associate Professor and Co-Director of the Entertainment Technology Center — Ph.D., Carnegie Mellon University.

JONATHAN CAGAN, George Tallman Ladd Professor of Mechanical Engineering — Ph.D., University of California Berkeley.
The School of Drama at Carnegie Mellon University is the oldest drama program in the country. CMU Drama offers rigorous, world-class classical training in theatre while providing thorough preparation for contemporary life.

As a member of the Consortium of Conservatory Theatre Training Programs, the school chooses students to participate in the program based on their potential ability. Students are only asked to remain in the conservatory program if they progress in the training and show promise in relation to the demands of the profession. Every Drama student is treated as a member of a theatrical organization and must acquire experience in all phases of the dramatic arts. Students are also asked to broaden their knowledge through courses in the other colleges of the university. The undergraduate Drama program, which incorporates approximately 200 students, leads to a bachelor of fine arts degree in drama. The options available are: acting, music, theatre, design, theatre studies, performance technology and management, and directing. The continuous production of plays, a natural extension of demanding class work, constitutes one of the school’s major activities. Each semester, 15 to 25 productions, directed by faculty, guest directors, and advanced students, are presented in our two theater spaces. The productions range from completely mounted, full-length dramatic and musical works to more simply produced directing projects and one-acts. Drama programs are rigorous and exacting, making demands on students that necessitate good health, a willingness to work and a commitment to professional discipline at all times. Because of full daytime class work and heavy production schedules, much production preparation takes place in the evening. Drama students, therefore, are advised to live in residence halls or in the immediate vicinities of the campus.

**Acting Option**

The Acting option is designed to prepare the student for immediate entry into the profession. It is a sequenced based training program with accumulative skills building upon each other over the course of four years. It is a conservatory training course, and the curriculum focuses primarily on the technique and craft of theatre. At the same time it offers skills that are applicable to all media. Courses in acting, voice, speech, movement, and theatre history are integral parts of the program at all four levels.

In addition to studio classes, Acting majors are required to take at least one liberal arts class each semester outside the school of drama to expand their intellectual curiosity and worldview.

All students must demonstrate a commitment to growth, show continued progress in their work and in the knowledge of their craft, and show a respect for professional standards in discipline, quality and ethics.

The freshman year is a discovery year and provides an introduction to basic skills—working from self, learning to play objectives and actions and the beginning of character exploration.

In the sophomore year these skills are solidified and deepened as more sophisticated, verbally complex material is introduced, through a focus on in-depth scene study, both contemporary and Shakespeare.

In the junior year students continue to develop their craft by investigating a variety of styles, including Greek, Brecht, and Restoration. Skills are now tested and strengthened through public performance.

The senior year provides a bridge from training to the professional world and offers the opportunity to appear on the School of Drama’s main stage.

At the end of the senior year, students are introduced to the profession through showcase performances in New York City and Los Angeles. The privilege to participate in the showcase is subject to the approval of the School of Drama faculty and as a rule is granted only to students who have obtained the necessary credits for graduation.

**Music Theatre Option**

The students in the Music Theatre program share the training philosophy and much of the same curriculum as others in the acting option. In addition, they take courses particular to the demands of music theatre. These include individual singing lessons, training in a variety of dance techniques (Ballet, Jazz and Tap) and music theatre styles and skills.

The School of Drama considers the Music Theatre program to be the equivalent of a double major.

**Directing Option**

The undergraduate directing program promotes creativity, intellectual curiosity, a broad and well-rounded understanding of the theatre and leadership ability. It provides a detailed exploration of the technique of directing for stage and for camera. The curriculum is designed for those serious about the art of directing and intending to pursue a career in theatre, film or television.

Course work in scene design, lighting and costume design develops the students’ visual sophistication as well as an understanding of how these elements combine in practical production situations. Stage management skills are studied and practiced. Theatre history, criticism, playwriting, play development and theatre management classes introduce the student to the wide range of knowledge necessary for directing. There are many avenues open for practical application: scene work in class, a short film written and directed by the students, opportunities in multi-camera directing and a studio project. The broad scope of the directing curriculum encourages the director’s interaction with all the theatrical disciplines. Collaboration, so necessary to the art, is the goal.

**Design Option**

Design students are expected to develop artistic ability in the conception and execution of scene, lighting, and costume design for plays of all periods under varying theatrical conditions. Students may elect to have a focus on one or two areas but must have a solid background in all three. Freshmen in design receive instruction in drawing and painting, three-dimensional techniques, and in the application of basic design principles through courses in drawing and design. Sophomores learn to apply design principles to the theatre through research, play analysis, and studies in the fundamentals of scene, lighting, and costume design. Design assignments cover various styles and periods and include the preparation of models, renderings, and working drawings, lighting storyboards, and light plots. Juniors and seniors take specialized courses in two areas of stage design and are expected to head studio and mainstage production crews. As part of the degree work, juniors may design sets, lights, or costumes for a production in the Studio Theatre and seniors may design sets, lights, or costumes for a Master’s thesis show or a mainstage production.

**Design Option Yearly Goal Statements**

**Freshman Year (Design and PTM)**

The Freshman Year in Design/PTM introduces the student to the broader foundation skill sets upon which they will build their CMU education and subsequent careers. One of the primary educational objectives of this year is for the student to develop their creative problem solving skills. Freshman Year is also designed to foster a sense of community as a member of the School of Drama ensemble through work on productions and to instill a sense of personal responsibility.

**Sophomore Year**

The Sophomore Year builds upon the skills obtained during the Freshman Year by attaching those skills to particular theatrical or storytelling applications and concepts. Student’s problem solving skills begin to be directed toward the theatrical design and production
processes. Breadth and depth of knowledge in theater and the larger world become ongoing curricular objectives. Ensemble work continues, as students get more involved in the theater making process through production. Sophomores will also choose an Option and area of focus in the Sophomore Year.

**Junior Year**

During the Junior Year the student establishes some depth in a particular area or areas of design. Design classes are rigorous and focused and encourage students to explore idea building, process and in-depth skill work. Juniors will also significantly extend their knowledge base with history classes specific to design, more skills classes and production work specific to their areas of study. Production work includes an opportunity for the first realized design and a chance to participate in crew leadership. The Junior’s curricular work is broadened by an out of School of Drama elective each semester.

**Senior Year**

The Senior Year is designed to sharpen and polish the processes and skills learned in the first three years. Seniors are also involved in preparations for launching a career; resumes and portfolios will be created and any holes in the student’s design process will be addressed. The core design classes continue to be intensive and even more focused. Seniors are leaders in the production process and have an opportunity to design productions supported by crews and a greater degree of material resources. The student’s curricular work continues to be broadened by an out of School of Drama elective each semester.

**Production Technology and Management Program**

The Production Technology and Management Program develops the technologists and managers of the future with an intensive curriculum designed to synthesize academic development and production experience. The curriculum focuses on the production requirements of live performance, in the form of traditional theatrical presentation, while also providing exposure to television, film and emerging technology-based art forms. Integrated in a world class research university environment, the School of Drama is uniquely positioned to contribute to the advancement of the collaborative arts. The goal of the PTM program is to prepare today’s students to become tomorrow’s leading professionals in the entertainment industry. All undergraduate students begin with the development of visual and written communication skills. The first four semesters immerse the student in a range of collaborative and individual studies: scenery, costume and lighting design fundamentals; dramatic structure and interpretation; manual and computer-based drafting; perspective and figure drawing, fundamentals of directing, production management and preparation, history of art and history of architecture and décor. The last four semesters focus in the student’s analytical skills within their chosen area of concentration: technical direction or production management.

Technical Directors are offered classes in: material applications, metal working techniques, structural design, scenic crafts, fabrication design and detailing, machinery design, rigging techniques, power system and electronic design fundamentals, introduction to sound design, automation system technology, technical management and production management. Technical Directors may take a single semester internship at an approved regional or commercial producing organization, in lieu of one semester of study. Student selected elective courses, outside the School of Drama, provide balance and breadth to the professional undergraduate education offered in the PTM program of study.

Production Managers are offered classes in: stage management, production planning and scheduling, theater management, introduction to accounting, cash budgeting, producing for television and film, camera lab, computer applications, technical management, organizational behavior, principles of economics, business communications and production management workshop. Production Managers may take a single semester internship at an approved regional or commercial producing organization, in lieu of one semester of study. Student selected elective courses, outside the School of Drama, provide balance and breadth to the professional undergraduate education offered in the PTM program of study.

**Theatre Studies Option**

The Theatre Studies program offers students from any of the School’s conservatory areas of specialized study the opportunity to continue developing their theatre related skills while expanding their interests to other artistic and academic areas. This option will only be available to Drama students that have completed the freshmen year of the training program.

The goal of the Theatre Studies program is to enable students to explore the diverse opportunities for which conservatory drama training can be a basis, and to examine the possibility of post graduate education in a new area of specialization after obtaining a BFA in Drama. As the intent of the Theatre Studies option is to broaden your experiences, a semester studying abroad or participating in a recommended internship is required for one semester, either in the Fall or Spring.

Individualized courses of study are established for each student in consultation with the Theatre Studies program director which reflect the students current interest. However the following requirements for core course work must also be fulfilled.

**Acting Option**

**Freshman Year**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
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<tbody>
<tr>
<td>54-011 Dynamics</td>
<td>1</td>
<td>54-012 Dynamics</td>
<td>1</td>
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<tr>
<td>54-101 Acting I</td>
<td>10</td>
<td>54-102 Acting I</td>
<td>10</td>
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<tr>
<td>54-103 Speech I</td>
<td>6</td>
<td>54-104 Speech I</td>
<td>6</td>
</tr>
<tr>
<td>54-105 Voice</td>
<td>6</td>
<td>54-106 Voice</td>
<td>6</td>
</tr>
<tr>
<td>54-107 Introduction to Movement</td>
<td>4</td>
<td>54-108 Movement I</td>
<td>4</td>
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<tr>
<td>54-111 Text</td>
<td>3</td>
<td>54-164 Introduction to Production (Crew)</td>
<td>3</td>
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<tr>
<td>54-163 Introduction to Production (Crew)</td>
<td>6</td>
<td>54-177 Text to Stage</td>
<td>6</td>
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<tr>
<td>79-xxx Introduction to World History</td>
<td>9</td>
<td>76-101 Interpretation and Argument (English)</td>
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<tr>
<td>99-xxx Computer Skills Workshop</td>
<td>3</td>
<td>xx-xxx Non-Drama Elective</td>
<td>min. 6</td>
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**Second Year**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>54-201 Acting II</td>
<td>12</td>
<td>54-202 Acting II</td>
<td>12</td>
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<tr>
<td>54-203 Voice and Speech II</td>
<td>6</td>
<td>54-204 Voice and Speech II</td>
<td>6</td>
</tr>
<tr>
<td>54-207 Movement II (Neutral Mask)</td>
<td>4</td>
<td>54-208 Movement II (Commedia dell’Arte)</td>
<td>2</td>
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<tr>
<td>54-215 Acting Lab</td>
<td>6</td>
<td>54-242 Improvisation</td>
<td>4</td>
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<tr>
<td>54-221 Directing I</td>
<td>9</td>
<td>54-262 Production Preparation II (Crew)</td>
<td>7</td>
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<tr>
<td>54-259 Production Preparation II (Crew)</td>
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<td>54-281 History of Drama</td>
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**Third Year**

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School of Drama 183
Spring
- 54-214 Singing for Actors 3
- 54-302 Acting III 9
- 54-304 Speech III (Dialects) 6
- 54-306 Voice III 6
- 54-308 Movement III/Combat 5
- 54-312 Rehearsal and Performance 12
- 54-318 Mime and Pantomime 2
- 54-394 SPIOC (optional) 6
- 54-406 Graduate Directing/Acting Lab 6
- 54-502 Junior Auditioning (optional) 2
- 54-516 Dance (optional) 2
- 54-xxx History of Drama (if necessary) var.
- xx-xxx Non-Drama Elective min. 6

Fourth Year
- Fall
  - 54-214 Singing for Actors 3
  - 54-401 Camera Lab (mini) 6
  - 54-403 Voice Over (optional) 6
  - 54-405 Graduate Directing 6
  - 54-407 Movement IV (Mask Work) 4
  - 54-409 Theatre Lab 9
  - 54-411 Rehearsal and Performance 12
  - 54-437 Acting IV 6
  - 54-494 Business of Acting 3
  - 54-xxx History of Drama (if necessary) var.
  - xx-xxx Non-Drama Elective min. 6

Spring
- 54-402 Camera Lab (mini) 6
- 54-410 Theatre Lab 9
- 54-412 Rehearsal and Performance 12
- 54-414 Leagues/Acting 6
- 54-420 Stage Combat (mini) 4
- 54-437 Acting IV 6
- 54-xxx History of Drama (if necessary) var.
- xx-xxx Non-Drama Elective min. 6

Music Theater Option
The Drama Department considers this option to be the equivalent of a double major. No non-drama electives are required.

First Year
- Fall
  - 54-011 Dynamics 1
  - 54-101 Acting I 10
  - 54-103 Speech I 6
  - 54-105 Voice I 6
  - 54-107 Introduction to Movement 4
  - 54-123 Dance I 5
  - 54-125 Music Skills I 3
  - 54-163 Introduction to Production 4
  - 54-177 Text to Stage 6
  - 54-500 Singing Lesson/Lab 5
  - 79-xxx Introduction to World History 9
  - 99-xxx Computer Skills Workshop 3

Spring
- 54-012 Dynamics 1
- 54-102 Acting I 10
- 54-104 Speech I 6
- 54-106 Voice I 6
- 54-108 Movement I 4
- 54-124 Dance I 5
- 54-125 Music Skills II 3
- 54-164 Introduction to Production 6
- 54-178 Text to Stage 6
- 54-500 Singing Lesson/Lab 5
- 76-101 Interpretation and Argument (English) 6

Second Year
- Fall
  - 54-201 Acting II 12
  - 54-203 Voice and Speech II 6
  - 54-207 Movement II (Neutral Mask) 3
  - 54-219 Music Theatre Ensemble Singing 4
  - 54-223 Dance II 6
  - -Ballet 3 units
  - -Jazz 2 units
  - -Tap 1 unit
  - 54-259 Production Preparation II (Crew) 7
  - 54-281 History of Drama 6
  - 54-500 Singing Lesson/Lab 5

Spring
- 54-202 Acting II 12
- 54-204 Voice and Speech II 6
- 54-208 Movement II (Commedia dell’Arte) 3
- 54-224 Dance II 6
  - -Ballet 3 units
  - -Jazz 2 units
  - -Tap 1 unit
- 54-226 Acting a Song 4
- 54-262 Production Preparation II (Crew) 7
- 54-282 History of Drama 6
- 54-294 Make-up 2
- 54-500 Singing Lesson/Lab 5

Third Year
- Fall
  - 54-294 Make-up 2
  - 54-301 Acting III 9
  - 54-303 Speech III (Dialects/Accents) 6
  - 54-305 Voice III 6
  - 54-311 Rehearsal and Performance 12
  - 54-319 Cabaret 6
  - 54-323 Dance III 6
  - -Ballet 3 units
  - -Jazz 2 units
  - -Tap 1 unit
- 54-393 SPIOC (optional) 6
- 54-500 Singing Lesson/Lab 5
- 54-502 Junior Auditioning (optional) 4
- 54-xxx History of Drama (if necessary) var.

Fourth Year
- Fall
  - 54-401 Camera Lab (mini) 6
  - 54-403 Voice Over (optional) 6
  - 54-409 Theatre Lab IV 9
  - 54-411 Rehearsal and Performance 12
  - 54-413 Leagues 6
  - 54-415 Coaching 2
  - 54-423 Dance IV 9
  - -Ballet 3 units
  - -Broadway Styles 4 units
  - -Tap 2 units
- 54-437 Acting IV 6
- 54-494 Business of Acting 3
- 54-500 Singing Lesson/Lab 5
- 54-xxx History of Drama (if necessary) var.

Spring
- 54-401 Camera Lab (mini) 6
- 54-410 Theatre Lab 9
- 54-412 Rehearsal and Performance 12
- 54-413 Leagues 6
- 54-415 Coaching 2
- 54-423 Dance IV 9
  - -Ballet 3 units
  - -Broadway Styles 4 units
  - -Tap 2 units
- 54-437 Acting IV 6
- 54-500 Singing Lesson/Lab 5
- 54-xxx History of Drama (if necessary) var.

99-xxx Computer Skills Workshop 3
### School of Drama

#### Design Option

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<td>54-177 Stage to Text</td>
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<td>99-XXX Computer Skills Workshop</td>
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**Spring**

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<td>54-172 Media Studio</td>
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<td>54-251 Introduction to Lighting</td>
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<td>54-259 Production Preparation II</td>
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<td>54-269 Autocad</td>
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<td>54-272 Standard Scenery Construction</td>
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<td>54-281 History of Drama</td>
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**Spring**

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**Third Year**

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**Lighting Design**

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**Costume Design**

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<td>54-343 Costume Construction I</td>
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<td>54-347 Figure Drawing</td>
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**Scene Design**

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**Spring**

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**Lighting Design**

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**Costume Design**

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**Fourth Year**

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#### Directing Option

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**Third Year**

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Production Technology and Management Option

All Tracks

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Second Year

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Spring

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Third Year

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Fourth Year

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Theatre Studies (curriculum to be individually tailored)

Units: 40 to 55 units per semester

Core Courses: History, English and CSW by the close of the sophomore year.

Electives: at least two non-drama electives per semester.

History of Drama: 6 minis required

Production: Production III & IV

Theses: 54-291/92, 9 units

Production Assignments could involve one of the following activities:

- Production Research
- Production Promotion
- Stage Managing
- Assistant Stage Managing
- Assistant Directing
- Producing a project in corporation with another department

Graduation Thesis

Each student will be required to give an individual creative presentation in their area of study. Any creative thesis must be thoroughly documented and formally presented. Their presentation might take many forms and could be developed through an independent study with a faculty member upon approval of the Option Head.

General Electives

The following are suggested department electives for Drama students. All other students may elect these courses only by permission of the instructor.
### General Electives

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### Electives for Non-Drama Department Students

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* Permission of Instructor Required

### Faculty

**BARBARA BENZ ANDERSON**, Professor of Drama/Design — M.F.A., Yale University; Carnegie Mellon, 1968—.

**NATALIE BAKER**, Associate Professor of Voice & Speech — M.F.A., University of Pittsburgh; Carnegie Mellon, 1992—.


**DICK BLOCK**, Associate Head, School of Drama, Associate Teaching Professor of Design — M.F.A., Northwestern University; Carnegie Mellon. 1988—.

**DAVID BOEVERS**, Assistant Professor of Technical Design, Option Coordinator, PTM — M.F.A. Yale University; Carnegie Mellon, 2000—.

**ELIZABETH BRADLEY**, Head, School of Drama — B.F.A. Honors, York University, Toronto; Carnegie Mellon, 2001—.

**KARL BRAKE**, Lecturer of Design — M.F.A., Utah State University, Carnegie Mellon, 1998—.

**JAMES CATON**, Associate Teaching Professor of Dance — Carnegie Mellon, 1988—.

**JUDITH CONTE**, Associate Teaching Professor of Dance — B.F.A., University of Wisconsin/ Milwaukee; Carnegie Mellon, 1978—.

**THOMAS DOUGLAS**, Lecturer of Music Theatre — M.M. Duquesne University; Carnegie Mellon 1991—.

**JANET FEINDEL**, Associate Professor of Voice/Speech/Acting/Alexander — M.F.A. in Drama, Carnegie Mellon; Carnegie Mellon, 1996—.


**KEVIN HINES**, Lecturer of Technical Direction — M.F.A. Yale University; Carnegie Mellon, 1998—.

**GEOFFREY HITCH**, Associate Teaching Professor of Directing and Acting — M.F.A. Carnegie Mellon; Carnegie Mellon 1992—.

**BRIAN JOHNSTON**, Professor of Dramatic Literature — M.A. Honors, Cambridge University, England; Carnegie Mellon, 1986—.

**MLADEN KISELOV**, Associate Professor of Directing/Acting, Option Coordinator, Directing — Honors Graduate, Moscow Theatre Institute; Carnegie Mellon, 1992—.


**JAQUES LECOQ**: Carnegie Mellon, 1996—.


**CINDY LIMAuro**, Professor Lighting Design — M.F.A., Florida State; Carnegie Mellon, 1987—.

**BARBARA MacKENZIE WOOD**, Associate Professor of Drama/Acting; Option Coordinator, Acting/MT — M.F.A., Carnegie Mellon; Carnegie Mellon, 1986—.

**DON MARINELLI**, Professor of Drama and Arts Management, Co-Director of ETC — Ph.D., University of Pittsburgh; Carnegie Mellon, 1981—.

**ANTHONY LORING McKay**, Associate Professor of Drama/Acting — B.F.A. Carnegie Mellon; Carnegie Mellon, 1985—.

**CATHERINE MOORE**, Assistant Professor of Movement — M.F.A. University of Cincinnati, College-Conservatory of Music; Carnegie Mellon, 2000—.

**ANNE MUNDELL**, Associate Professor of Design; Option Coordinator, Design — M.F.A. Brandeis University; Carnegie Mellon, 1989—.

**MICHAEL OLICH**, Associate Professor of Design — MFA, Carnegie Mellon; Carnegie Mellon, 1999—.

**KEN LEIGH ROGERS**, Associate Teaching Professor of Dance — Carnegie Mellon, 2001—.

**INGRID SONNICHSEN**, Associate Teaching Professor of Acting — M.A. Wayne State University, Carnegie Mellon, 1995—.

**MILAN STITT**, Professor of Dramatic Writing, Option Coordinator, Graduate Dramatic Writing — M.F.A., Yale University; Carnegie Mellon, 1997—.

**PAUL TAZEWELL**, Associate Professor of Costume Design, Carnegie Mellon—2003

**SUSAN TSU**, Professor of Costume Design — M.F.A. Carnegie Mellon, 2003—

**DON WADSWORTH**, Professor of Drama/Voice & Speech, Associate Coordinator, Acting — M.F.A., University of Pittsburgh; Carnegie Mellon, 1989—.

**KAF WARMAN**, Associate Teaching Professor of Movement — M.F.A., Goddard College, Ecole
The School of Music

Alan Fletcher, Head
Office: The College of Fine Arts 105

The School of Music at Carnegie Mellon is a conservatory set within a great university, combining preparation for a lifetime in performance with the advantages of learning in an intense academic environment. The School of Music is an accredited institutional member of the National Association of Schools of Music.

Each student is challenged to develop as a performer through individual instruction with master teachers. The School's relationship with the renowned Pittsburgh Symphony is among the strongest conservatories – symphony orchestra relationships in the United States, and Pittsburgh's uniquely strong sense of musical community fosters close relationships with the Pittsburgh Opera, Opera Theater, Chamber Music Society, Ballet, Mendelssohn Choir, and a host of other professional musical organizations. The Cuarteto Latinoamericano, now in its third decade in residence, has toured throughout the world and enjoys universal acclaim for its advocacy of new music. All teaching is entrusted to professional faculty – there are no assistant studio teachers or doctoral teaching fellows – and specialists in Musicology, History, Counterpoint, Analysis, Composition, Computer Music, Eurythmics, Solfege, Pedagogy, Music Education, Accompanying and Coaching, Diction, Acting and Movement, Literature and Repertoire, Chamber Music, Jazz, Conducting, and Recording Science provide a broad and rich platform for comprehensive preparation.

Regular performing ensembles include the Carnegie Mellon Philharmonic, Wind Ensemble, Jazz Ensemble, Concert Choir, Repertory Chorus, Contemporary Ensemble, Jazz Vocal Ensemble, Opera/Music Theater Production, Repertoire Orchestra, and special orchestras devoted to Baroque and Classical repertoire. Some of the School's most outstanding and popular ensembles are instrument specific: the Percussion Ensemble, Flute Ensemble, Horn Choir, Trombone Choir, and Brass Ensemble, among others.

Every student in the School of Music is a performance or composition major. Opportunities for performance are stressed – undergraduates perform junior and senior recitals, all chamber music is juried, frequent opportunities on and off campus are provided, and community outreach is vigorously supported. At the same time, the university provides the greatest possible support for students combining this performance study with minors in all disciplines, unique joint degree programs, and double major programs. These opportunities significantly increase a student's career options and marketability in the changing professional world of music.

The School of Music has an intense commitment to new music, led by its composition faculty, conductors who devote fully rehearsed cycles of the honors Philharmonic Orchestra to works by student composers, studio faculty whose own performing careers regularly feature new works, regular performances of student works in almost every Contemporary Ensemble program, readings by the Cuarteto Latinoamericano culminating in public performance of student work, frequent opportunities for performance with professional choirs, and inclusion on student recitals. The School's state of the art recording facilities are an especially important resource for composers beginning their public careers.

Facilities

The teaching facilities of the School of Music are located on the ground, main, and mezzanine floors of the College of Fine Arts, on the first floor of Margaret Morrison Hall, and in the basement of the Student Center. All teaching, rehearsal, and practice rooms are equipped with Steinway pianos. Music students also have access to a state-of-the-art recording studio and music technology cluster. Performances take place in Kresge Recital Hall, Carnegie Music Hall, and Alumni Concert Hall. The Hunt Library houses a fine collection of books, records, and scores. Listening and conference rooms are also available in the library.

School of Music Options

The School of Music offers a Bachelor of Fine Arts in the following areas:
- Performance (Instrumental, Voice, Piano, Organ)
- Composition

To earn a Bachelor's degree in either of these options, a candidate must satisfactorily fulfill all the requirements of the School of Music.

Within the options listed above students may elect specializations in the following areas:
- Dalcroze Eurhythmics Certificate
- Piano Pedagogy Certificate
- Accompanying Minor
- Conducting Minor
- Jazz Performance Minor
- Music Education Certification Minor
- Music Technology Minor

Dalcroze Eurhythmics Certificate

This program is designed to prepare teachers in the Dalcroze approach to music learning. The course of study includes eurythmics, piano improvisation, and Dalcroze pedagogy. Carnegie Mellon undergraduates may enter the Dalcroze Training Program during their junior year. However, the certificate will be granted only upon completion of their undergraduate degree. This program is recommended particularly to students who would like to incorporate Dalcroze principles into their teaching and to those who want to obtain more experience in this field.

Piano Pedagogy Certificate

A two-year program leading to certification in piano pedagogy is open to current Carnegie Mellon piano majors and to pianists with bachelor's degrees. Piano and organ majors learn to teach piano in a closely supervised environment of class piano instruction. This program has received national acclaim as a model of excellence, with Carnegie Mellon children consistently capturing prestigious awards in national piano competitions.

Accompanying Minor

The accompanying minor consists of a six-semester sequence of courses designed to give the students experience with vocalists and instrumentalists, and it can include chamber music. There are individual coaching sessions as well as practical experience in vocal studios, dance studios, and instrumental studios.

Conducting Minor

This program is designed for students who are interested in acquiring conducting skills, in anticipation of either graduate study in conducting or a music education career. It includes required courses in basic conducting techniques for both choral and instrumental ensembles, orchestration, score reading/keyboard harmony, and elective courses in instrumental and vocal methods, diction, and literature and repertoire.

Jazz Performance Minor

With an emphasis on developing the "complete musician," all performance majors are encouraged to study jazz along with their classical training. Course offerings include Jazz Studio, two Jazz Ensembles, Jazz Vocal Ensemble, Jazz Piano, Jazz Chamber Music, Jazz Ear Training, Jazz Improvisation, Jazz Arranging, Jazz Composition, Jazz History, and Jazz Transcription and Analysis.

Music Education Certification Minor

Music Education Certification is a five-year program, with courses starting in the sophomore year. Bachelor of Fine Arts candidates who complete this program and pass the Praxis tests will receive Pennsylvania state certification in music (K-12), which is recognized in almost all other states.
Music Technology Minor

The student will take a series of courses which may include electronic and computer music, recording technology, the physics of sound, and computer programming. A rich computer music research environment enables talented students to work as programmers with outstanding faculty researchers, whose current projects are gaining international recognition in the areas of computer music and artificial intelligence.

Performances and Activities of the School of Music

The School of Music sponsors performances, master classes, and lectures by outstanding national and international guest artists. Announcements of faculty, student, and guest performances are released every month to the students and the community.

General Requirements for BFA Candidates

Candidates for the Bachelor of Fine Arts degree in performance are required to give public performances in their junior and senior years. Candidates for the Bachelor of Fine Arts degree in composition are required to complete a composition for orchestra in their senior year. Candidates for the Bachelor of Fine Arts degree in applied areas other than piano are required to pass a piano proficiency test.

All candidates are required to participate in a major choral ensemble or major instrumental ensemble as assigned and to attend Convocation every semester of residence in the School of Music.

Music Curriculum

The music curriculum is based on the following five building blocks:

Studio
Theory
History
Ensemble
Academics

1. **Studio** - This is the heart of the school. Students receive individualized instruction with senior faculty in their major area of study: performance or composition.

2. **Theory** - These courses are designed to help students develop listening skills; to acquire theoretical knowledge, to recognize structural techniques and manipulate technological resources. It includes courses in sight-reading, ear-training, eurhythmics, contrapuntal techniques, harmony, analysis of musical forms, 20th century techniques, orchestration, score reading, and electronic and computer music for compositional and educational purposes. One music support course in the piano, organ, and instrumental curricula must be an analysis course.

3. **History** - These courses cover in depth the music of the western world and survey the styles and musical structures of non-western music.

4. **Ensemble** - This area includes student participation in some of the following ensembles: Carnegie Mellon Philharmonic, Wind Ensemble, Jazz Ensemble, Concert Choir, Repertory Chorus, Jazz Vocal Ensemble, Opera/Music Theater Production, Contemporary Ensemble, Repertoire Orchestra, Flute Ensemble, Horn Choir, Trombone Choir, Percussion Ensemble, and various chamber groups. One performance elective course in the piano, organ, and instrumental curricula must be a Literature, Repertoire, and Pedagogy course.

5. **Academics** - The School of Music requires one General Studies course (outside of the School) per semester and six semesters of Elective courses for graduation. These accumulated credits may be applied to minors or majors in other disciplines. Exceptional students in good academic and musical standing within the School are permitted to take additional courses beyond the number required for graduation. There is no charge for extra credits taken at Carnegie Mellon.

Credits - The total number of units required for graduation is 396. Three units equal one credit.

### Piano

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## Voice

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### Second Year

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**Third Year**

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**Fourth Year**

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## Minor in Accompanying for Piano Majors in the School of Music

**Admission Requirements:**

The student must apply to enter the program in the office of the Director of Student Services (CFA108A).

### Required Courses

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<td>57-385 Accompanying V</td>
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### Electives (choose from the following courses)

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**Minimum required for Accompanying Minor: 54 units**

## Minor in Conducting for Students in the School of Music

**Admission Requirements:**

1. The student must apply to enter the program in the office of the Director of Student Services (CFA108A) and have an interview with a member of the conducting faculty.

2. A 3.0 cumulative overall QPA and good academic standing are required for acceptance into the minor in conducting. Note that only a limited number of students can be accepted into the program.

3. In addition to the prerequisite courses listed below, the student must display superior solfege skills, by completing Advanced Solfege I and II with "A" or "B" grades before the student can register for the advanced conducting courses.

4. Introduction to Conducting and Instrumental/Choral Conducting must be completed during the sophomore year with "A" grades before the student can register for the advanced conducting courses.

5. Conducting practicum must be taken during the same semester as Independent Study in Conducting.

6. A 3.0 cumulative overall QPA is required for graduation with the minor in conducting

### Prerequisite Courses

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**Dalcroze Eurhythmics Certificate**: 24 Units

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<td>57-691/692 Dalcroze Pedagogy/Practice Teaching</td>
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**Piano Pedagogy Certificate**: 30 units

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<tr>
<td>57-276 Piano Pedagogy IV</td>
<td>6</td>
</tr>
<tr>
<td>57-429 Beginning Piano for Children</td>
<td>6</td>
</tr>
</tbody>
</table>

### Spring Units

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>57-521 Studio</td>
<td>9</td>
</tr>
<tr>
<td>57-4xx Major Ensemble</td>
<td>6</td>
</tr>
<tr>
<td>57-292 Keyboard Studies IV</td>
<td>3</td>
</tr>
<tr>
<td>57-154 18th Century Counterpoint</td>
<td>6</td>
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<tr>
<td>57-164 Eurhythmics IV</td>
<td>3</td>
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<tr>
<td>57-184 Solfege IV</td>
<td>6</td>
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<tr>
<td>57-258 20th Century Techniques</td>
<td>6</td>
</tr>
<tr>
<td>xx-xxx History Elective Course</td>
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<tr>
<td>xx-xxx Elective</td>
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### Fall Units

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>57-521 Studio</td>
<td>12</td>
</tr>
<tr>
<td>57-4xx Major Ensemble</td>
<td>6</td>
</tr>
<tr>
<td>57-332 Introduction to Conducting</td>
<td>6</td>
</tr>
<tr>
<td>57-xxx Music Theory Course</td>
<td>6</td>
</tr>
<tr>
<td>57-271 Orchestration II</td>
<td>6</td>
</tr>
<tr>
<td>xx-xxx General Studies Course</td>
<td>9</td>
</tr>
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<td>xx-xxx Elective</td>
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### Third Year

**Electives (choose from the following courses) 18 units**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>57-272 Orchestration III</td>
<td>6</td>
</tr>
<tr>
<td>xx-xxx General Studies Course</td>
<td>9</td>
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<tr>
<td>xx-xxx Elective</td>
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**Fourth Year**

**Spring Units**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>57-521 Studio</td>
<td>12</td>
</tr>
<tr>
<td>57-4xx Major Ensemble</td>
<td>6</td>
</tr>
<tr>
<td>57-349 Supervised Theory Teaching</td>
<td>6</td>
</tr>
<tr>
<td>57-xxx Music Support Course (Theory/History)</td>
<td>6</td>
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<tr>
<td>xx-xxx General Studies Course</td>
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<tr>
<td>xx-xxx Elective</td>
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### Dalcroze Eurhythmics Certificate 24 Units

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>57-465 Eurhythmics V</td>
<td>3</td>
</tr>
<tr>
<td>57-466 Eurhythmics VI</td>
<td>3</td>
</tr>
<tr>
<td>57-691/692 Dalcroze Pedagogy/Practice Teaching</td>
<td>6</td>
</tr>
<tr>
<td>57-350 Dalcroze Piano Improvisation</td>
<td>6</td>
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<tr>
<td>xx-xxx Creative Movement/Choreography</td>
<td>3</td>
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<tr>
<td>57-641 Dalcroze Research Paper</td>
<td>3</td>
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### Piano Pedagogy Certificate 30 units

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>57-273 Piano Pedagogy I</td>
<td>6</td>
</tr>
<tr>
<td>57-274 Piano Pedagogy II</td>
<td>6</td>
</tr>
<tr>
<td>57-275 Piano Pedagogy III</td>
<td>6</td>
</tr>
<tr>
<td>57-276 Piano Pedagogy IV</td>
<td>6</td>
</tr>
<tr>
<td>57-429 Beginning Piano for Children</td>
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### Corequisite Courses for Voice Majors

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>57-151</td>
<td>Introduction to Counterpoint</td>
<td>6</td>
</tr>
<tr>
<td>57-154</td>
<td>18th Century Counterpoint</td>
<td>6</td>
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### Required Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>57-332</td>
<td>Introduction to Conducting</td>
<td>6</td>
</tr>
<tr>
<td>57-336</td>
<td>Instrumental/Choral Conducting</td>
<td>6</td>
</tr>
<tr>
<td>57-308</td>
<td>Form and Analysis</td>
<td>6</td>
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<tr>
<td>57-257</td>
<td>Orchestration I</td>
<td>6</td>
</tr>
<tr>
<td>57-271</td>
<td>Orchestration II</td>
<td>6</td>
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<tr>
<td>57-459</td>
<td>Score Reading/Keyboard Harmony</td>
<td>6</td>
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<tr>
<td>57-364</td>
<td>Conducting Practicum</td>
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<tr>
<td>57-618</td>
<td>Independent Study in Conducting</td>
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</table>

### Electives (Choose from the following courses)

<table>
<thead>
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<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>57-220</td>
<td>English Diction</td>
<td>3</td>
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<td>57-221</td>
<td>Italian Diction</td>
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<tr>
<td>57-222</td>
<td>French Diction</td>
<td>3</td>
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<tr>
<td>57-223</td>
<td>German Diction</td>
<td>3</td>
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<tr>
<td>57-258</td>
<td>20th Century Techniques</td>
<td>6</td>
</tr>
<tr>
<td>57-272</td>
<td>Orchestration III</td>
<td>6</td>
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<tr>
<td>57-335</td>
<td>Analysis Seminar</td>
<td>6</td>
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<tr>
<td>57-337</td>
<td>Sound Recording</td>
<td>6</td>
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<td>57-338</td>
<td>Sound Editing and Production</td>
<td>6</td>
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<tr>
<td>57-360</td>
<td>Brass Methods</td>
<td>3</td>
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<tr>
<td>57-363</td>
<td>String Methods</td>
<td>3</td>
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<tr>
<td>57-431</td>
<td>Italian Literature and Repertoire</td>
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<td>57-432</td>
<td>French Literature and Repertoire</td>
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<td>57-435</td>
<td>German Literature and Repertoire</td>
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<tr>
<td>57-450</td>
<td>Jazz Ear Training</td>
<td>3</td>
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<tr>
<td>57-457</td>
<td>Vocal Methods</td>
<td>3</td>
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<tr>
<td>57-459</td>
<td>Contemporary Ensemble</td>
<td>3</td>
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<tr>
<td>57-227</td>
<td>Jazz Ensemble</td>
<td>3</td>
</tr>
<tr>
<td>57-228</td>
<td>Chamber Music</td>
<td>3</td>
</tr>
<tr>
<td>57-329</td>
<td>Jazz Chamber Music</td>
<td>3</td>
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</tbody>
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Minimum required for Conducting minor: 57 units

### Minor in Jazz Performance for Students in the School of Music

**Admission Requirements:**

1. The student must apply to enter the program in the office of the Director of Student Services (CFA 108A).

2. The student must perform an acceptable audition. For the audition, the student should perform two contrasting pieces and demonstrate the potential for the development of improvisatory skills.

### Prerequisite Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>57-152</td>
<td>Harmony I</td>
<td>6</td>
</tr>
<tr>
<td>57-181</td>
<td>Solfege I</td>
<td>6</td>
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### Required Jazz Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>57-xxx</td>
<td>Jazz Ensemble or Jazz Vocal Ensemble</td>
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</tr>
<tr>
<td>57-xxx</td>
<td>Jazz Ensemble or Jazz Vocal Ensemble</td>
<td>3</td>
</tr>
<tr>
<td>57-319</td>
<td>Jazz Piano</td>
<td>3</td>
</tr>
<tr>
<td>57-320</td>
<td>Jazz Piano</td>
<td>3</td>
</tr>
<tr>
<td>57-328</td>
<td>Jazz Chamber Music</td>
<td>3</td>
</tr>
<tr>
<td>57-328</td>
<td>Jazz Chamber Music</td>
<td>3</td>
</tr>
<tr>
<td>57-450</td>
<td>Jazz Ear Training</td>
<td>3</td>
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<tr>
<td>57-453</td>
<td>Jazz Improvisation</td>
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</table>

### Required Studio Courses

<table>
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<tr>
<td>57-496</td>
<td>Minor Studio</td>
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<tr>
<td>57-497</td>
<td>Minor Studio</td>
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<tr>
<td>57-498</td>
<td>Minor Studio</td>
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<tr>
<td>57-499</td>
<td>Minor Studio</td>
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### Elective Courses (Choose 1)

<table>
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<tr>
<td>57-451</td>
<td>Jazz Arranging</td>
<td>6</td>
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<tr>
<td>57-452</td>
<td>Jazz Composition</td>
<td>6</td>
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<tr>
<td>57-454</td>
<td>Jazz Transcription and Analysis</td>
<td>6</td>
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<tr>
<td>57-457</td>
<td>Jazz History I</td>
<td>6</td>
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<tr>
<td>57-458</td>
<td>Jazz History II</td>
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</tbody>
</table>

Minimum units required for Jazz Performance Minor: 54
Minor in Music Technology for Students in the School of Music

Admission Requirements:

1. The student must apply to enter the program in the office of the Director of Student Services (CFA108A).

Prerequisite Course

Computer Skills Workshop must be passed before taking any of the required technology courses.

99-xxx Computer Skills Workshop

Introductory Theory Course

57-152 Harmony I

6 units

Required Music Technology Courses

57-101 Introduction to Music Technology

57-337 Sound Recording

57-338 Sound Editing and Production

57-347 Electronic and Computer Music

57-438 Multi-track Recording

33 units

Elective Courses

Other courses may also be approved as electives with the approval of the advisor for music minors.

Music History Course (Choose 1)

57-173 Survey of Western Music History

57-202 Opera History

57-205 20th Century Music History

9 units

Technical Courses (Choose 2)

xx-xxx H&SS Multimedia Course

15-100 Introductory/Intermediate Programming

33-114 Physics of Musical Sound

54-165 Introduction to Sound Design for Theater I

57-610 Internship

10 units

Minimum units required for Music Technology Minor: 63

Faculty

DENNIS ABELOSON, Artist Lecturer in French Horn — B.M., Duquesne University; Carnegie Mellon, 1987—.

TIMOTHY ADAMS, Associate Professor of Percussion — Carnegie Mellon, 1995—.

DOUGLAS AHLLSTEDT, Associate Professor of Voice — M.M., Eastman School of Music; Carnegie Mellon, 1998—.

ALBERTO ALMARZA, Associate Teaching Professor of Flute — M.F.A., Carnegie Mellon University; Carnegie Mellon, 1991—.

EDUARDO ALONSO CRESPO, Artist Lecturer in Music History and Conducting — M.F.A., Carnegie Mellon University; Carnegie Mellon, 1989—.

DONNA AMATO, Accompanist — Carnegie Mellon, 1998—.

EFFRAIN AMAYA, Artist Lecturer in Music Theory and Resident Conductor — Carnegie Mellon, 1993—.

TOBY APPEL, Artist Lecturer in Viola — Curtis Institute of Music; Carnegie Mellon, 2002—.

KEITH BAURA, Music/Information Technology — Carnegie Mellon, 1999—.

LEONARDO BALADA, Professor of Composition; University Professor — Diploma, The Juilliard School of Music; Carnegie Mellon, 1970—.

JEANNE BAXTRESSER, Vira I. Heinz Professor of Flute — B.M., The Juilliard School of Music; Carnegie Mellon, 1997—.

SCOTT BELL, Artist Lecturer in Oboe — Carnegie Mellon, 1994—.

NEAL BERNTSEN, Artist Lecturer in Trumpet — Carnegie Mellon, 2003—.

ANTHONY BIANCO, Artist Lecturer in String Bass — Carnegie Mellon, 1945—.

ALVARO BITRAN, Artist-in-Residence in Cello, Cuarteto Latinoamericano — Diploma, National Conservatory of Mexico; Carnegie Mellon, 1987—.

ARON BITRAN, Artist-in-Residence in Violin, Cuarteto Latinoamericano — Diploma, National Conservatory of Mexico; Carnegie Mellon, 1987—.

SAUL BITRAN, Artist-in-Residence in Violin, Cuarteto Latinoamericano — B.M., Rubin Academy of Tel Aviv; Carnegie Mellon, 1987—.

RAY BLACKWELL, Staff Accompanist / Vocal Coach — Carnegie Mellon, 2003—.

ANDRES CARDEÑES, Dorothy Richard Starling and Alexander Speyer, Jr. Professor of Violin; University Professor — Carnegie Mellon, 1989—.

DAVID CARROLL, Associate Teaching Professor — M.M., New England Conservatory; Carnegie Mellon, 2000—.

MARIA CARUSO, Artist Lecturer in Alexander Technique — Carnegie Mellon, 2003—.

L. MARK CARVER, Associate Teaching Professor of Coaching and Accompanying — M.M., Carnegie Mellon University; Carnegie Mellon, 1995—.

REBECCA CHERIAN, Artist Lecturer in Trombone — Carnegie Mellon, 1993—.

DENIS COLWELL, Associate Professor, Conductor of Wind Ensemble — Carnegie Mellon, 1980—.

MURRAY CREWE, Artist Lecturer in Bass Trombone — Carnegie Mellon, 2001—.

JOHN D'AMICO, Artist Lecturer in Jazz Piano — Carnegie Mellon, 1995—.

CYNTHIA DE ALMEIDA, Artistic Consultant — M.M., Temple University; Carnegie Mellon, 1992—.

ALAN FLETCHER, Head, School of Music, Professor of Music — D.M.A., The Juilliard School of Music; Carnegie Mellon, 2001—.

CYPRESS FOROUGH, Professor of Violin — Carnegie Mellon, 2001—.

NANCY GALBRAITH, Professor of Composition — M.M., West Virginia University; Carnegie Mellon, 1984—.

PAUL GERLACH, Artist Lecturer in Music Education — M.F.A., Carnegie Mellon University; Carnegie Mellon, 1992—.

ALASDAIR GILLIES, Artist Lecturer in Bagpipes, Director of Bagpipe Band — Pipe Majors Certificate, Army School of Bagpipe Music; Carnegie Mellon, 1997—.

MARY BETH GLASGOW SCHOTTING, Artist Lecturer in Violin — Carnegie Mellon, 1998—.

NANCY GOERES, Artist Lecturer in Bassoon — B.M., Boston University; Carnegie Mellon, 1988—.
ENRIQUE GRAF, Artist Lecturer in Piano — Carnegie Mellon, 1996—.  DAVID PELLOW, Director of Jazz Studies, Artist Lecturer in Double Bass and Bass Guitar — M.M., Duquesne University; Carnegie Mellon, 1991—.

ANDREA HANSON, Assistant Professor of Voice — M.M. in Voice and M.F.A. in Opera, Oklahoma City University; Carnegie Mellon, 2000—.  DILSHAD POSNOCK, Director, Artist Diploma Program, Artist Lecturer in Flute — Carnegie Mellon, 1999—.


ROSEANNA IRWIN, Associate Teaching Professor of Coaching and Accompanying — M.M., Duquesne University; Carnegie Mellon, 1990—.  DAVID PREMO, Artist Lecturer in Cello — Carnegie Mellon, 1994—.

JUAN PABLO IZQUIERDO, Professor/Director of Orchestral Studies — Composition, University of Chile; Carnegie Mellon, 1990—.  SANDRA RAGUSA, Director of Recruitment, Artist Lecturer in Music Education — B.M. University of Southern California; Carnegie Mellon, 2003—.


ROBERT PAGE, Paul Mellon Professor of Music and Director of Choral Studies — M.M., Indiana University; Carnegie Mellon, 1976—.  RICCARDO SCHULZ, Associate Teaching Professor and Director of Recording Activities — M.A., University of Pittsburgh; Carnegie Mellon, 1988—.


MARIANNE MARSEY, Artist Lecturer in Voice — Carnegie Mellon, 2000—.  REZA VALI, Associate Professor of Composition — Ph.D., University of Pittsburgh; Carnegie Mellon, 1988—.


JUAN PABLO IZQUIERDO, Professor/Director of Orchestral Studies — Composition, University of Chile; Carnegie Mellon, 1990—.  FRANKO SCHULZ, Associate Teaching Professor and Director of Recording Activities — M.A., University of Pittsburgh; Carnegie Mellon, 1988—.


REZA VALI, Associate Professor of Composition — Ph.D., University of Pittsburgh; Carnegie Mellon, 1989—.  ANNE MARTINDALE WILLIAMS, Artist Lecturer in Cello — Carnegie Mellon, 1981—.

JUAN PABLO IZQUIERDO, Professor/Director of Orchestral Studies — Composition, University of Chile; Carnegie Mellon, 1990—.  FRANKO SCHULZ, Associate Teaching Professor and Director of Recording Activities — M.A., University of Pittsburgh; Carnegie Mellon, 1988—.

The College of Humanities and Social Sciences

John P. Lehoczky, Dean
Kristina Straub, Associate Dean
Joseph E. Devine, Associate Dean and Director of the H&SS Academic Advisory Center
Undergraduate Office: Baker Hall A57
www.hss.cmu.edu/

The College of Humanities and Social Sciences (H&SS) is one of Carnegie Mellon’s seven principal colleges. The College consists of the departments of Economics, English, History, Modern Languages, Philosophy, Psychology, Social and Decision Sciences, Statistics, and a college-wide interdisciplinary program in Information Systems. The College accounts for approximately one-fifth of the university’s undergraduate population; 80% of the college’s students are undergraduates. The college is staffed by 180 full-time faculty.

Like its counterparts in engineering, science, computer science, business, and the fine arts, the College has three primary thrusts: undergraduate education, graduate education, and research or creative pursuits. Thus, the College shares in the University identity as an institution that merges first-rate, innovative research and creativity with undergraduate education. All faculty engage in both teaching and research or creative work. Undergraduates, thus, benefit from contact in the classroom with highly accomplished faculty researchers and creative artists.

For example, beginning with the College’s General Education (GenEd) program, H&SS students are taught by some of the College’s most accomplished and senior faculty. They bring with them into the classroom a contagious excitement from their active involvement at the forefront of their fields. Freshmen also select from an array of freshman seminars in which students explore exciting and topical areas of study with regular faculty in small groups of no more than 15-20 students. Sophomores and second-semester freshmen may also select a "Faculty Research Training" course which involves them in a faculty research project. These freshman/sophomore features are complemented during the junior and senior years by small classroom a contagious excitement from their active involvement at the forefront of their fields. Freshmen also select from an array of freshman seminars in which students explore exciting and topical areas of study with regular faculty in small groups of no more than 15-20 students. Sophomores and second-semester freshmen may also select a "Faculty Research Training" course which involves them in a faculty research project. These freshman/sophomore features are complemented during the junior and senior years by small elective courses, the option of overseas study, seminars and project courses, and a range of undergraduate research options (including a senior honors program) that students can pursue with regular faculty.

Liberal/Professional Education

Edward Fiske, former Education Editor of The New York Times and author of the Fiske Guide to Colleges, has noted that the College and University have done "perhaps the most original thinking of any American university in pursuing the twin goals of liberal-professional education." In its belief that these two types of knowledge ("liberal" and "professional") are highly complementary, H&SS embraces a philosophy that has its roots in Carnegie Mellon’s institutional origins: namely, that the traditional liberal arts disciplines merit close, rigorous study, while at the same time practical skills are also worthy of mastery, and of the most serious intellectual examination.

The College’s educational program is liberal in that it stresses breadth and invites wide-ranging inquiry, both through its general education curriculum and through programs in the humanities, behavioral sciences, and social sciences; the "professional" dimension of the College’s educational program derives from general emphases on analytical sophistication and application, and also from a subset of in-depth major programs which prepare students for specific career fields as well as for graduate or professional school training. The rationale for this liberal/professional approach stems from the premise that the intellectual foundations of a challenging liberal education and meaningful professional education are essentially the same. Knowledgeable and effective citizens are as much in need of broad intellectual perspectives, analytical skills, and problem-solving strategies as are most professionals. Moreover, as leaders in American higher education generally agree, undergraduate education is not well served if professional specialization in undergraduate programs is achieved prematurely. The challenge is to strike a balance between breadth and depth, both within and outside of one’s specialty; such a balance insures versatility in one’s profession and the knowledge and ability to keep pace as individuals and citizens with changes in our social, technical, and cultural environments. Thus, the objectives of both liberal and professional education can and should work in tandem to complement and enhance one another.

Degree Options

H&SS offers a large number and wide range of innovative, rigorous majors and a comparable number of minors. In addition, H&SS students may also apply for admission to one of a number of accelerated masters programs that result in both a bachelor’s and master’s degree. These options provide H&SS students with a great deal of flexibility and choice in designing a program of study.

H&SS Majors

Name of Major (Degree Options)

<table>
<thead>
<tr>
<th>Major</th>
<th>Degree Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economics</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>English</td>
<td>(B.A.)</td>
</tr>
<tr>
<td>Creative Writing</td>
<td>(B.A.)</td>
</tr>
<tr>
<td>Professional Writing</td>
<td>(B.A.)</td>
</tr>
<tr>
<td>Technical Writing and Communication</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>Anthropology and History</td>
<td>(B.A. or B.S.)</td>
</tr>
<tr>
<td>History and Policy</td>
<td>(B.A. or B.S.)</td>
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<tr>
<td>Social and Cultural History</td>
<td>(B.A. or B.S.)</td>
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<tr>
<td>Environmental Policy</td>
<td>(additional major only)</td>
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<tr>
<td>Ethics, History, and Public Policy</td>
<td>(B.A. or B.S.)</td>
</tr>
<tr>
<td>European Studies</td>
<td>(B.A.)</td>
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<td>Information Systems</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>International Relations</td>
<td>(additional major only)</td>
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<tr>
<td>Russian Studies</td>
<td>(B.A.)</td>
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<td>Student-Defined</td>
<td>(B.A. or B.S.)</td>
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<tr>
<td>French and Francophone Studies</td>
<td>(B.A.)</td>
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<tr>
<td>German</td>
<td>(B.A.)</td>
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<tr>
<td>Japanese</td>
<td>(B.A.)</td>
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<tr>
<td>Modern Languages with a concentration in English as a Second Language</td>
<td>(B.A.)</td>
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<tr>
<td>Hispanic Studies</td>
<td>(B.A.)</td>
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<tr>
<td>Logic and Computation</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>Cognitive Science</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>Psychology</td>
<td>(B.A. or B.S.)</td>
</tr>
<tr>
<td>Psychology and Biological Sciences</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>Decision Science</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>Policy and Management</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>Political Science</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>Statistics</td>
<td>(B.S.)</td>
</tr>
<tr>
<td>Mathematical and Statistical Sciences **</td>
<td>Statistics</td>
</tr>
</tbody>
</table>

*jointly sponsored with the Department of Biological Sciences
** joint sponsored with the Mathematical Sciences Department and the Statistics Department
Additional Majors

Many H&SS students pursue additional majors and/or minors in the college, and in some cases in other Carnegie Mellon colleges. An additional major refers to the completion of the full requirements for a major program in addition to those required for the primary major. In most cases, requirements for an additional major are the same as those for a primary major. Minors are like majors in that they consist of coherent programs of study in a department, or across departments. Minors differ from majors in the breadth and depth reflected in the number of courses required.

Most H&SS majors are available as additional majors; a few are available only as additional majors. Students from outside H&SS are also eligible to attain an additional major in H&SS programs that offer an additional major option. In such cases, non-H&SS students would be required to complete only those courses in the H&SS General Education (GenEd) program that are prerequisites to courses required for the H&SS major they are pursuing.

Minors

In H&SS there are two types of minors: departmental minors, which are fully housed in a single H&SS academic department, and interdepartmental minors, which are sponsored by more than one department and administered through the academic department of the faculty advisor.

In general, H&SS minors are available to undergraduate students from all colleges in the University.

H&SS Departmental Minors

<table>
<thead>
<tr>
<th>Department</th>
<th>Minor</th>
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</thead>
<tbody>
<tr>
<td>Economics</td>
<td>Economics</td>
</tr>
<tr>
<td>English</td>
<td>English</td>
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<tr>
<td>History</td>
<td>History</td>
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<tr>
<td>Chinese</td>
<td>Modern Languages</td>
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<tr>
<td>German</td>
<td>Modern Languages</td>
</tr>
<tr>
<td>Japanese</td>
<td>Modern Languages</td>
</tr>
<tr>
<td>Second Language Acquisition</td>
<td>Modern Languages</td>
</tr>
<tr>
<td>Hispanic Studies</td>
<td>Modern Languages</td>
</tr>
<tr>
<td>Ethics</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Logic and Computation</td>
<td>Philosophy</td>
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<tr>
<td>Philosophy</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Psychology</td>
<td>Psychology</td>
</tr>
<tr>
<td>Decision Science</td>
<td>Social and Decision Sciences</td>
</tr>
<tr>
<td>Policy and Management</td>
<td>Social and Decision Sciences</td>
</tr>
<tr>
<td>Political Science</td>
<td>Social and Decision Sciences</td>
</tr>
<tr>
<td>Statistics</td>
<td>Statistics</td>
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</tbody>
</table>

H&SS Interdepartmental Minors

<table>
<thead>
<tr>
<th>Minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts in Society*</td>
</tr>
<tr>
<td>Environmental Studies</td>
</tr>
<tr>
<td>European Studies</td>
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<tr>
<td>Film and Media Studies</td>
</tr>
<tr>
<td>Gender Studies</td>
</tr>
<tr>
<td>Health Care Policy and Management**</td>
</tr>
<tr>
<td>International Relations</td>
</tr>
<tr>
<td>Linguistics</td>
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<tr>
<td>Minority Studies</td>
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<tr>
<td>Multimedia Production</td>
</tr>
<tr>
<td>Religious Studies</td>
</tr>
<tr>
<td>Russian Studies</td>
</tr>
<tr>
<td>Science, Technology and Society</td>
</tr>
<tr>
<td>Sociology</td>
</tr>
<tr>
<td>Student-Defined</td>
</tr>
</tbody>
</table>

*-sponsored by the Center for the Arts in Society (College of Humanities and Social Sciences, and College of Fine Arts)

**intercollege minor with the H. John Heinz III School and the Mellon College of Science, and the College of Humanities and Social Sciences

Accelerated Graduate Degree Options

A number of Five-Year programs are available to H&SS students that lead to both an undergraduate and graduate degree. Refer to the College and/or Department section for further descriptions of these graduate options.

Bachelor of Arts (B.A.) vs. Bachelor of Science (B.S.)

H&SS majors lead in some cases only to a Bachelor of Arts (B.A.) degree, in other cases only to a Bachelor of Science (B.S.) degree, and in some cases to a choice for the student between a B.A. or a B.S. degree.

B.A. degree programs usually require less course work in technical and/or quantitative disciplines, and more depth and breadth in various humanities and (in some cases) arts disciplines.

In contrast, B.S. degrees are offered in areas requiring special technical, quantitative or scientific competencies beyond those required in the H&SS General Education Program. To provide background for such programs and to insure basic proficiency in these areas, some B.S. degrees granted through the College require additional courses in calculus and statistics, and in some instances, additional courses in the physical, natural, and computational sciences.

H&SS 2004 General Education Program

Carnegie Mellon’s educational legacy emphasizes the connection between theoretical knowledge and praxis: the university’s interdisciplinary approach to education embraces the practical application and analysis of knowledge in institutional, social, and historical contexts. Carnegie Mellon graduates are excellent practitioners in their chosen fields. The General Education Program (GenEd) supports that expertise and ensures that students gain the well-informed perspectives necessary to grow and change with their professions, to interact wisely with the natural environment, and to be responsible and informed citizens in an increasingly technological world and a complex global culture.

Broad Aims

The 2004 GenEd program provides the integrative component to a Carnegie Mellon education and extends through the entire undergraduate experience. It sets crucial cornerstones and draws important connections among different facets of the students’ education. Its distinctive emphases and directions foster intellectual curiosity and encourage students to gain: wide, historically informed appreciation of the arts and humanities and sciences, broad understanding of mathematics and the experimental method, critical openness to ethical reflection and social responsibility, and an acute global and environmental awareness.

It differs sharply from more traditional liberal arts or general education programs in its emphasis on integration, not only breadth. Its courses give students essential knowledge in academic disciplines, while encouraging them to connect fields and to think comparatively about the methods and materials constituting a field of knowledge. The integrative feature of the program goes beyond the purely academic and disciplinary: it asks students to reflect on their role as citizens in a world that crucially demands informed perspectives on social and international issues, diverse cultures, the natural environment, uses of technology, the allocation of human and material resources, and many other problems challenging our future.

Categories

To transcend narrow disciplinary confines, the program isolates five broad intellectual activities – exercised in almost all disciplines: Communicating, Reflecting, Modeling, Deciding and Creating. To indicate their primary or perhaps most striking applications, the activities are supplemented by indications of general subject areas. These activities together with the broad indications are the bases for categories, in which suitable courses are organized from all parts of the University. There are five categories: Communicating; Language and Interpretations, Reflecting; Societies and Cultures, Modeling; Mathematics and Experiments, Deciding: Social Sciences and Values, and Creating: Designs and Productions.

The schematic framework highlights central features of an ideal
learning environment and the University’s intellectual core mission, which is seen as part of a broader human and social enterprise. These features have been identified because they are pervasive and by no means limited to the indicated areas; for example, communicating is crucial across all fields and reflecting is not restricted to thinking about societies and cultures. Students learn to communicate, reflect, model, decide, and create as crucial components of a whole, integrative educational experience: students gain expertise in their chosen discipline and exercise the integrative skills within them.

**Categorical Themes.** The program includes a rich variety of courses. Some classes encourage students to explore a subject in a basic way, providing them with the key building blocks of knowledge in the particular subject. Others are designed to ask students explicitly to reflect on knowledge, to look at the building blocks from different disciplinary, social, or global perspectives in order to gain a deeper understanding of the arts, humanities, and sciences. Here are, more explicitly, the themes for the different categories.

**Structure and Implementation for H&SS.** The GenEd Program is supported by all colleges and properly integrated into their educational programs. However, each college recommends to its students the best combination of thematic courses from the Categories. So while there is considerable agreement in these recommendations across college lines, the program can vary in its concrete instantiation from college to college. The GenEd Program is to be taken over the four years of the typical undergraduate career, with a natural progression in the level of courses taken. (i.e., seniors should not take courses that are intended primarily for freshmen.)

**Student complete:**

- **18 units** (minimum) from each Category 1, 2, 4, 5.
  (76-101, 79-104 and 36-201 required)

- **27 units** (minimum) from Category 3 (restrictions: 9 units (minimum) from Mathematics, 9 units (minimum) from Natural Science, and 9 more units (minimum) from any course listed in Category 3)

- **18 additional units** (minimum) from any Category

Only **18 units** may be counted toward any other requirement (ex., majors, minors); courses that are listed as “Prerequisites” for major and/or minor requirements are exempt from this rule. Five courses are required to be completed in the 1st year: 76-101, 79-104, 36-201, Freshman Seminar Requirement (FSR) and Computing Skills Workshop (CSW). The Freshman Seminar Requirement may not double count toward the GenEd or any other requirement (ex., majors, minors). No more than **45 units** may be completed in the junior/senior years (minimum **72 units** to be completed in the first two years).

1. **GenEd Communicating: Language and Interpretations** (18 units minimum: 76-101 required)

2. **GenEd Reflecting: Societies and Cultures** (18 units minimum: 79-104 required)

3. **GenEd Modeling: Mathematics and Experiments** (27 units minimum: 9 from Mathematics, 9 from Natural Science, 9 from any course listed in Modeling)

4. **GenEd Deciding: Social Sciences and Values** (18 units minimum: 36-201 required)

5. **GenEd Creating: Designs and Productions** (18 units minimum)

6. Plus 18 additional units from any GenEd Category

7. **University Requirement (UR) (1 mini-course from 99-101, 99-102 or 99-103) Computing Skills Workshop (CSW) is completed in the 1st semester.**

8. **Freshman Seminar Requirement (FSR) (1 designated course)**

The seminar is completed in the 1st year by taking one course from a specific list of courses each semester. It seeks to insure that all entering H&SS 1st year students have a highly interactive small-group course experience with a faculty member in the Fall or Spring. These seminars are taught by selected members of the College’s faculty. Seminar topics stem from faculty research and teaching interests. They draw on faculty expertise developed in designing and teaching successful freshman courses and also take advantage of opportunities to address issues of student socialization to university life and study.

**Humanities Scholars Program (HSP) (1 designated course per semester; 8 total)**

This curriculum is required (only) for students in H&SS admitted to HSP; each course in the 1st two years is substituted toward an GenEd Category.

**2004 GenEd Category Courses**

1. **Communicating: Language and Interpretations (complete 18 units minimum)**

Courses in this category give special attention to the study of language as interpretation, expression and argument within and across multiple discourses. Students examine language for its internal logics and structures. They also explore its rhetorical, historical, cultural, or philosophical dimensions, assessing how it functions while expanding their writing skills and sharpening their analytical abilities.

76-101 Interpretation and Argument - REQUIRED

If a score of 5 is obtained on the either of the English Advanced Placement examinations, the approved substitutions are selected each semester. The approved substitution for non-native English speakers is: 82-065, Reading and Writing in a Multi-Cultural Setting

76-272 Talking Across Difference

76-318 Communicating in the Global Marketplace

76-355 The Rhetoric of Making a Difference

76-377 The Rhetoric of Fiction

76-378 Community Literacy and Intercultural Interpretation

76-387 Sociolinguistics

76-393 Rhetorical Traditions

80-180 The Nature of Language

80-181 Language and Thought

80-280 Linguistic Analysis: Syntax

80-380 Philosophy of Language

82-101 Elementary French I

82-102 Elementary French II

82-103 Elementary French I online

82-104 Elementary French II online*

82-121 Elementary German I

82-122 Elementary German II*

82-123 Directed Language Study: Elementary German I & II

82-131 Elementary Chinese I

82-132 Elementary Chinese II*

82-135 Intensive Elementary Chinese

82-141 Elementary Spanish I

82-142 Intermediate Spanish II*

82-143 Elementary Spanish I Online

82-144 Elementary Spanish II Online*

82-147 Accelerated Elementary Spanish

82-161 Elementary Italian I

82-162 Elementary Italian II*

82-163 Directed Language Study: Elementary Italian I & II

82-171 Elementary Japanese I

82-172 Elementary Japanese II*

82-191 Elementary Russian I

82-192 Elementary Russian II*

82-201 Intermediate French I*

82-202 Intermediate French II*

82-203 Intermediate French I online*

82-204 Intermediate French II online*

82-221 Intermediate German I*

82-222 Intermediate German II*

82-225 Intermediate German II

82-231 Intermediate Chinese I

82-232 Intermediate Chinese II*

82-235 Intensive Intermediate Chinese*

82-241 Intermediate Spanish I*

82-242 Intermediate Spanish II

82-243 Intermediate Spanish I Online*

82-244 Intermediate Spanish II Online*

82-261 Intermediate Italian I*

82-262 Intermediate Italian II

82-271 Intermediate Japanese I*

82-272 Intermediate Japanese II*

82-291 Intermediate Russian I*

82-292 Intermediate Russian II*

82-334 Structure in Chinese*

82-337 Mandarin Chinese for Oral Communication I*

82-338 Mandarin Chinese for Oral Communication II*

82-371 Advanced Japanese I*

82-372 Advanced Japanese II*

82-373 Structure of the Japanese Language

82-374 Technical Japanese*

82-399 Special Topics in Russian*
## 2. Reflecting: Societies and Cultures (complete 18 units minimum)

This category emphasizes the study of history, society, and culture from local and global perspectives. Courses investigate contemporary societies as well as those of the past, along with their rich array of cultural products, artifacts, and ideas. They encourage a comparative and reflective approach to the understanding of the past and what it can bring to the constitution of present social relations and cultural outlooks.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>79-104</td>
<td>Introduction to World History - REQUIRED</td>
</tr>
<tr>
<td>76-221</td>
<td>Books You Should Have Read by Now</td>
</tr>
<tr>
<td>76-230</td>
<td>19th Century American Literature and Culture</td>
</tr>
<tr>
<td>76-231</td>
<td>20th Century American Literature and Culture</td>
</tr>
<tr>
<td>76-232</td>
<td>African-American Studies</td>
</tr>
<tr>
<td>76-233</td>
<td>Post-Colonial Literature</td>
</tr>
<tr>
<td>76-235</td>
<td>British Literature and Culture Before 1800</td>
</tr>
<tr>
<td>76-241</td>
<td>Introduction to Gender Studies</td>
</tr>
<tr>
<td>76-246</td>
<td>British and American Literature and Culture</td>
</tr>
<tr>
<td>76-319</td>
<td>Environmental Rhetoric</td>
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<tr>
<td>76-320</td>
<td>The Cultural History of Print in Britain and America</td>
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<tr>
<td>76-330</td>
<td>Medieval Literary and Cultural Studies</td>
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<tr>
<td>76-331</td>
<td>Renaissance Literary and Cultural Studies</td>
</tr>
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<td>76-332</td>
<td>African-American Studies</td>
</tr>
<tr>
<td>76-333</td>
<td>Postcolonial Studies</td>
</tr>
<tr>
<td>76-334</td>
<td>19th Century Literary and Cultural Studies</td>
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<tr>
<td>76-335</td>
<td>20th Century Literary and Cultural Studies</td>
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<tr>
<td>76-338</td>
<td>The American Cinema</td>
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<tr>
<td>76-343</td>
<td>South Asian Literature and Film</td>
</tr>
<tr>
<td>76-349</td>
<td>The Lost Generation</td>
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<tr>
<td>76-353</td>
<td>Advanced Gender Studies</td>
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<td>79-113</td>
<td>Culture and Identity in American Society</td>
</tr>
<tr>
<td>79-206</td>
<td>Development of American Culture</td>
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<tr>
<td>79-207</td>
<td>Development of European Culture</td>
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<tr>
<td>79-237</td>
<td>The City in Indian History: A Case-Study of Delhi</td>
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<tr>
<td>79-242</td>
<td>African-American History II</td>
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<td>79-250</td>
<td>Europe’s Two Revolutions: Dynamics of Change in the 19th Century</td>
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<tr>
<td>79-253</td>
<td>The Development of Caribbean Culture</td>
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<td>79-258</td>
<td>Introduction to African History: 18th Century to Neo-Colonialism</td>
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<tr>
<td>79-270</td>
<td>Chinese Culture and Society</td>
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<td>79-289</td>
<td>Society and Culture in South Asia</td>
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<tr>
<td>79-290</td>
<td>Between Revolutions: The Emergence of Modern Latin America, 1879-1917</td>
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<tr>
<td>79-352</td>
<td>The Arab-Israel Condition: War &amp; Peace</td>
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<td>79-383</td>
<td>African History: From the Slave Trade to the Present</td>
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<td>79-384</td>
<td>Medicine and Society</td>
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<td>80-100</td>
<td>What Philosophy Is</td>
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<td>80-135</td>
<td>Introduction to Political Philosophy</td>
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<td>80-150</td>
<td>Nature of Reason</td>
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<td>80-151</td>
<td>God in the West</td>
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<td>80-201</td>
<td>Introduction to Epistemology</td>
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<td>80-250</td>
<td>Ancient Philosophy</td>
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<td>80-251</td>
<td>Modern Philosophy</td>
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<td>80-252</td>
<td>Kant</td>
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<td>80-253</td>
<td>Continental Philosophy</td>
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<td>80-254</td>
<td>Analytic Philosophy</td>
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<td>80-255</td>
<td>Pragmatism</td>
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<td>80-256</td>
<td>Modern Moral Philosophy</td>
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<td>80-257</td>
<td>Nietzsche</td>
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<td>80-258</td>
<td>Leibniz, Locke and Hume</td>
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<td>80-275</td>
<td>Metaphysics</td>
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<td>80-276</td>
<td>Philosophy of Religion</td>
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<td>82-273</td>
<td>Japanese Language and Culture</td>
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<td>82-274</td>
<td>Japanese Literature in Translation*</td>
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<tr>
<td>82-303</td>
<td>French Culture*</td>
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<td>82-304</td>
<td>Francophone World*</td>
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<tr>
<td>82-305</td>
<td>French in its Social Contexts*</td>
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<tr>
<td>82-323</td>
<td>Germany, Austria and Switzerland in the 20th Century*</td>
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<tr>
<td>82-324</td>
<td>Contemporary Germany, Austria, and Switzerland*</td>
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<tr>
<td>82-325</td>
<td>Introduction to German Studies*</td>
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<tr>
<td>82-331</td>
<td>Advanced Chinese I*</td>
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<tr>
<td>82-332</td>
<td>Advanced Chinese II*</td>
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<tr>
<td>82-333</td>
<td>Introduction to Chinese Language and Culture*</td>
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<tr>
<td>82-335</td>
<td>Selected Readings in Chinese*</td>
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<tr>
<td>82-396</td>
<td>Faust Legend at Home and Abroad</td>
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<tr>
<td>82-397</td>
<td>Russia’s Demons*</td>
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<tr>
<td>82-415</td>
<td>Topics in French and Francophone Studies*</td>
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<tr>
<td>82-416</td>
<td>Topics in French and Francophone Studies*</td>
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<tr>
<td>82-420</td>
<td>German Classical Literature*</td>
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<td>82-421</td>
<td>German Literature of the 19th Century*</td>
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<td>82-422</td>
<td>German Literature of the Early 20th Century*</td>
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<td>82-423</td>
<td>Postwar German Literature*</td>
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<td>82-424</td>
<td>The New Germany*</td>
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<td>82-425</td>
<td>Studies in German Literature: Germany Between the Wars*</td>
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<tr>
<td>82-426</td>
<td>Studies in German Literature: Survey of Children’s and Youth Literature*</td>
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<tr>
<td>82-427</td>
<td>Nazi and Resistance Culture*</td>
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<tr>
<td>82-428</td>
<td>History of German Film*</td>
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<td>82-433</td>
<td>Topics of Contemporary Culture of China*</td>
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<td>82-434</td>
<td>Studies in Chinese Traditions*</td>
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<td>82-436</td>
<td>Introduction to Classical Chinese*</td>
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<td>82-441</td>
<td>Studies in Peninsular Literature and Culture: Poets and Playwrights of Exile*</td>
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<td>82-445</td>
<td>U. S. Latino Literature: Necessity is the Mother of all Coyotes*</td>
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<td>82-451</td>
<td>Studies in Latin American Literature and Culture*</td>
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<td>82-452</td>
<td>The Latin American Fin de Siglo*</td>
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<td>82-453</td>
<td>Voices from Within: The Crisis of Latin American Identity*</td>
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<td>82-454</td>
<td>The Hispanic Caribbean*</td>
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<td>82-455</td>
<td>Topics in Hispanic Studies*</td>
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<td>82-456</td>
<td>Contemporary Latin American Texts: Revision, Rewriting and Representation*</td>
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<td>82-461</td>
<td>Political Drama of Spain*</td>
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<td>82-474</td>
<td>Topics in Japanese Studies: Youth Culture*</td>
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<td>82-475</td>
<td>Topics in Japanese Studies: Aspects of Daily Life in a Buddhist Perspective*</td>
</tr>
<tr>
<td>82-491</td>
<td>Literature, Politics, and Film in Russia and East Europe Today</td>
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<td>82-492</td>
<td>Historical Imaginatio in 19th Russian Literature*</td>
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<td>82-493</td>
<td>Joseph Brodsky in Context</td>
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<tr>
<td>85-100</td>
<td>Introduction to Intelligence in Humans, Animals and Machines</td>
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<tr>
<td>85-375</td>
<td>Cross-Cultural Psychology*</td>
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<tr>
<td>88-184</td>
<td>Topics of Law: The Bill of Rights</td>
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<tr>
<td>88-205</td>
<td>Comparative Politics</td>
</tr>
<tr>
<td>88-314</td>
<td>Politics Through Film</td>
</tr>
</tbody>
</table>

* Corequisite and/or Prerequisite

## 3. Modeling: Mathematics and Experiments (complete 27 units minimum)

Courses in this category stress the interplay of mathematical (formal) theories and experimental work. Some courses investigate the internal structure of theories, whereas others use them as models for producing real-world knowledge. Such models may be drawn from a variety of disciplines including the natural sciences, but also, for example, psychology and computer science. The interactions between theorizing and experimenting (observing) can be understood within an intellectual framework that invites comparative assessment.

### Mathematics (Required: complete 9 units)

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>21-110</td>
<td>Problem Solving in Recreational Mathematics</td>
</tr>
<tr>
<td>21-111</td>
<td>Calculus I</td>
</tr>
<tr>
<td>21-112</td>
<td>Calculus II*</td>
</tr>
<tr>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
</tr>
<tr>
<td>21-121</td>
<td>Integration and Differential Equations*</td>
</tr>
<tr>
<td>21-122</td>
<td>Integration, Differential Equations and Approximation*</td>
</tr>
<tr>
<td>21-123</td>
<td>Calculus of Approximations* (5 units)</td>
</tr>
<tr>
<td>21-127</td>
<td>Concepts of Mathematics</td>
</tr>
<tr>
<td>21-256</td>
<td>Multivariate Analysis and Approximation*</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus of Three Dimensions*</td>
</tr>
<tr>
<td>22-110</td>
<td>Nature of Mathematical Reasoning</td>
</tr>
<tr>
<td>22-210</td>
<td>Logic and Proofs</td>
</tr>
<tr>
<td>22-211</td>
<td>Arguments and Inquiry</td>
</tr>
</tbody>
</table>

### Natural Science (Required: complete 9 units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-121</td>
<td>Modern Biology</td>
</tr>
<tr>
<td>03-122</td>
<td>Organismic Botany*</td>
</tr>
<tr>
<td>03-125</td>
<td>Evolution and the History of Life*</td>
</tr>
<tr>
<td>03-130</td>
<td>Biology of Organisms*</td>
</tr>
<tr>
<td>03-231</td>
<td>Biochemistry. The Intermediates</td>
</tr>
<tr>
<td>03-232</td>
<td>Biochemistry I*</td>
</tr>
<tr>
<td>03-310</td>
<td>Introduction to Computational Biology*</td>
</tr>
<tr>
<td>03-360</td>
<td>The Biology of the Brain II</td>
</tr>
<tr>
<td>09-101</td>
<td>Introduction to Experimental Chemistry</td>
</tr>
<tr>
<td>09-103</td>
<td>Atoms, Molecules and Chemical Change (non-major)</td>
</tr>
<tr>
<td>09-104</td>
<td>Fundamental Aspects of Organic Chemistry and Biochemistry (non-major)</td>
</tr>
<tr>
<td>09-105</td>
<td>Introduction of Modern Chemistry I</td>
</tr>
<tr>
<td>09-106</td>
<td>Modern Chemistry I</td>
</tr>
<tr>
<td>09-217</td>
<td>Organic Chemistry I*</td>
</tr>
<tr>
<td>33-102</td>
<td>Concepts of Modern Physics (non-major)</td>
</tr>
<tr>
<td>33-xxx</td>
<td>Physics I for Engineering Students*</td>
</tr>
</tbody>
</table>
4. Deciding: Social Sciences and Values (complete 18 units minimum)

The theme of this category is the exploration of cognitive, behavioral and ethical dimensions of decision-making on both the individual and social level. Making decisions requires a broad understanding of human rationality and social interaction. Some courses examine also the critical collection and analysis of data for achieving such an understanding, whereas others emphasize the historical development of policies and values, which form the matrix for decision-making.

12-090 Technology and the Environment
36-303 Sampling Surveys and Society*
73-100 Principles of Economics
79-222 Religion in American Society
79-337 Educational Policy in Historical Perspective
79-348 Objects of Value
79-386 The Global Environment: Historical Perspectives and Policy Dilemmas
80-130 Introduction to Ethics
80-136 Ethics and Public Policy
80-201 Philosophy of Social Science
80-203 Ethical Theory
80-205 Political Philosophy
80-236 Philosophy and the Law
80-241 Ethical Judgments in Professional Life
80-242 Conflict, Dispute Resolution
80-245 Medical Ethics
80-270 Philosophy of Mind
80-271 Philosophy and Psychology
80-305 Rational Choice
80-321 Causation and Social Policy
80-330 Research Ethics
80-335 Philosophy, Politics, and Economics
80-340 Environmental Ethics
80-341 Computers and Ethics
80-342 Ethics and Oppression
80-346 Value, Fact, and Policy
85-102 Introduction to Psychology
85-211 Cognitive Psychology
85-213 Human Information Processing and Artificial Intelligence*
85-219 Biological Foundations of Behavior
85-221 Principles of Child Development
85-241 Social Psychology
85-251 Personality
85-261 Abnormal Psychology
88-104 Decision Processes in American Political Institutions
88-120 Reason, Passion, and Cognition
88-220 Policy Analysis I
88-307 Principles of Individual and Collective Irrationality
88-324 Electoral Systems and Processes
88-330 Political Economy of Inequality and Redistribution*
88-343 Economics of Technological Change*
88-358 Policy Making Institutions*

* Corequisite and/or Prerequisite

5. Creating: Designs and Productions (complete 18 units minimum)

In the arts, the humanities, the sciences, and in engineering, it is essential to produce artifacts: e.g., a painting, a poem, a musical performance, a piece of technology, the design of an experiment, or the proof of a mathematical theorem. Courses may center on the students' creation of artifacts, but they may also analyze such creations by exploring creative processes at work within and across disciplines. Such explorations should be informed by a deep understanding of contexts of production and reception.

05-331 Building Virtual Worlds
36-315 Statistical Graphics and Visualization*
48-130 Introduction to Architectural Drawing
48-135 Drawing 2
48-230 Drawing 3: Perspective*
48-240 Architectural History I: Survey*
51-171 Human Experience
51-261 Communication Design Fundamentals
51-263 Industrial Design Fundamentals
51-271 Design History
51-379 Emotion & Reason in Design
51-425 Letterpress & Bookbinding
53-609 Game Design
54-113 Non-Major Dance
54-114 Non-Major Dance
54-163 Introduction to Production
54-177 Text to Stage
54-178 Text to Stage
54-187 Introduction to Play-Writing
54-188 Introduction to Play-Writing*
54-191 Acting Elective
54-192 Acting Elective
54-239 History of Architecture and Déco
54-240 History of Architecture and Décor
54-245 History of Clothing
54-246 History of Clothing
54-251 Introduction to Lighting Design*
54-252 Introduction to Lighting Design*
54-259 Crew*
54-260 Crew*
54-281 History of Drama
54-309 Theatre Lab
54-310 Theatre Lab
54-351 Lighting Design*
54-352 Lighting Design*
54-433 Producing for Television and Film
54-475 Theatre Management
57-xxx For Music courses, see registration guidelines handout*
60-xxx For Art courses, see registration guidelines handout*
76-206 Introduction to Creative Writing
76-227 Comedy
76-245 Shakespeare: Tragedies & Histories
76-247 Shakespeare: Comedies & Romances
76-363 Reading Contemporary Poetry
79-210 Picturing Others: A Course on Ethnographic Film
79-303 Visual Anthropology*
79-361 Film Festival
79-364 Art, Anthropology, and Empire
76-366 Reading Contemporary Fiction*
80-120 Reflections on Science
80-291 Issues in Multimedia Authoring
82-387 Film Festival
82-407 The Arts in Society: French Modernism
82-413 The Arts in Society: Theaters of Love

* Corequisite and/or Prerequisite

6. Plus, TWO Additional GenEd courses (complete 18 units)

These courses can be taken from any GenEd category.

7. University Requirement (UR) (complete one mini-course)

This course is a 3 unit mini-course, pass/no credit, completed in the 1st semester.

Designated seminar is completed in the 1st year. This requirement ensures that all students entering H&SS have a small-group course experience in their 1st year. These seminars consist of substantive academic content drawn from the faculty members’ expertise, as well as providing a supportive environment for the enhancement of academic skills. Required of all students entering H&SS as 1st year students.

Humanities Scholars Program (HSP) (1 course per semester; 8 in total)
The Humanities Scholars Program (HSP) is designed for students who wish to combine the challenge and excellence of a scholars program with the breadth of an interdisciplinary, comparative education in the humanities. HSP brings together faculty in the different humanities to create distinctive interdisciplinary courses. These courses are often team-taught, allowing scholars access, not only to the expertise of different faculty members, but unique insight into the interdisciplinary dialogues that make university life intellectually exciting. They provide an opportunity for students to explore connections among different disciplines and to work collaboratively with faculty mentors.

Each semester, scholars take one such course, open exclusively to them. They are encouraged to live together in their own campus residential space, as part of the opportunity to create a vital intellectual community with interests in the humanities. In addition, they will be invited to join in extracurricular events, such as discussion groups, workshops, lectures, and other activities relating to the humanities. In addition to a core humanities curriculum, scholars have the opportunity to attend lectures by Carnegie Mellon faculty members and speakers from off-campus. Because our conception of “community” includes what lies beyond the campus, other activities include visits to local and regional sites, museums and areas of cultural interest. In the interdisciplinary spirit that guides the program, visits could include tours of historic neighborhoods, a Frank Lloyd Wright house, the Andy Warhol Museum, or a trip to the Strip, a popular multi-ethnic shopping and entertainment district.

During the first two years of the program, scholars take seminars designed to introduce them to different humanities and disciplinary approaches. These courses, specially developed for the program by humanities faculty, might include: the exploration of the idea of democracy, revolution and revolt in France 1789-1968, language and death of tragedy, twentieth-century Western European literature and many others. The educational programs in H&SS are complemented by a number of services, special programs, centers, and computing facilities. Some of these are housed in the College, while others reside elsewhere in the University, but with accessibility for H&SS students. Some of the most salient of these are described below.

H&SS College-Wide Services, Programs and Research Centers
The educational programs in H&SS are complemented by a number of services, special programs, centers, and computing facilities. Some of these are housed in the College, while others reside elsewhere in the University, but with accessibility for H&SS students. Some of the most salient of these are described below.

Academic Advisory Center
Joseph E. Devine, Associate Dean Center
Office: Baker Hall A57
www.hss.cmu.edu/departments/deans_office/aac/default.html

The Academic Advisory Center (AAC) for the College of Humanities and Social Sciences is primarily responsible for monitoring the progress of H&SS students prior to declaration of, and entry into, a major program. As departmental “home base” for these students, the AAC provides information, advice, and counsel about scheduling, the college’s General Education (GenEd) program requirements, the various majors and minors available, and the adjustments involved in the transition to university life and study. The Center’s advisors consider this kind of information and advice to be vital for students adapting to a new and demanding academic environment, working their way through the H&SS GenEd Program, and preparing for various academic and professional choices to follow. In addition, the AAC provides information about various relevant scholarships, internships, post-graduate fellowships, and the like. The AAC is a walk-in center, although individual appointments can be made on request. The AAC’s hours are 8:30 a.m. to 5:00 p.m., Monday through Friday.

Carnegie Mellon Children’s School
Sharon Carver, Director
Office: Margaret Morrison Carnegie Hall 17

The Children’s School is the laboratory school for Carnegie Mellon’s Psychology Department. Its goals and responsibilities include 1) development and management of laboratories for research in developmental psychology, 2) training of undergraduate and graduate students in child development theory, research, and related applica- tions, 3) implementation of a model half-day preschool and full-day kindergarten program for children ages 3-6, 4) provision of resources to parents, 5) provision of resources to the community of early childhood educators, and 6) training of students earning teaching certificates (in collaboration with other local colleges and universities). The Children’s School’s approach to preschool and kindergarten education is based on theories and research in Developmental Psychology. It uses its developmental goals as a systematic framework for focusing its program and assessment design. It strives to recruit a diverse student population, both ethnically and socioeconomically, to provide a diverse subject pool for research, broad experiences for psychology students and student teachers, and an enriched learning environment for the children and their families.

Carnegie Mellon University Press
Gerald Costanzo, Director
Office: Baker Hall 233

Established in 1975, the University Press has published several titles in contemporary poetry including Thomas and Beulah by Rita Dove, which won the 1987 Pulitzer Prize for Poetry. In recent years the Press offerings have expanded to include literary criticism, art history, economics, music, social history, novels, and short fiction. A number of undergraduate students serve internships with the Press each year, many of whom have gone on to careers in publishing.

Center for the Advancement of Applied Ethics
Preston Covey, Director
Office: Baker Hall 148

The Center for the Advancement of Applied Ethics (CAAE), located in Carnegie Mellon’s Philosophy Department, aims to advance applied ethics in exemplary ways in line with the University’s mission to create and disseminate knowledge, to provide the best possible education in ethics and values for our students, and to serve our community and society through outreach programs. In particular, the Center’s mission is to recover ethics from excessive academic abstraction and to confront contemporary issues in practical settings. The CAAE supports four kinds of activity: Teaching & Curriculum Development: As Philosophy faculty, CAAE members teach innovative graduate and undergraduate courses, with new courses continually under development. These courses are innovative by virtue of their use of new educational technology and
media, their practical applications to real-world case studies derived from our applied research, and their emphasis on practical reasoning and problem-solving skills to prepare our students for their lives as humane and responsible individuals, citizens, and professionals.

Innovation with Educational Technology & Media: The CAAE explores the use of computer-based interactive multimedia environments as well as linear video, public and satellite broadcast programs for ethics education. This enterprise provides internship and applied research opportunities for students. One award-winning project of this type ("Project THEORIA") explores multimedia technology as a realistic laboratory for ethical reasoning, much as a science lab provides hands-on opportunities for practicing skills of scientific inquiry. Multimedia combines text, animation, graphics, sound, photographs and full-motion video in ways that allow students to analyze realistic scenarios, explore documentary case studies and thereby confront ethical issues embedded in real-life situations.

Campus and Community Outreach: CAAE members field professional training programs in both the public and private sectors as well as extracurricular campus workshops for students, faculty, and staff.

Applied Research: The CAAE’s applied research is largely focused on needed innovation in professional training in applied ethics. In this area, the Center aims to advance our understanding of how ethics “applies” not just in theory, but in reality and practice. Consequently, CAAE faculty conduct practical field research in collaboration with professionals in domains besides academic ethics, such as multimedia technology and pedagogy, community-based conflict resolution, public policy, public administration and corporate management, law-enforcement and criminal justice.

Center for Arts and Society
Director: Judith Schachter
Office: Baker Hall 242D

The Center for the Arts in Society is dedicated to energizing research and teaching in the College of Humanities and Social Sciences and the College of Fine Arts. The Center supports graduate and undergraduate courses as well as research. It explores pressing issues such as cultural production and social responsibility, and encourages innovative disciplinary approaches - visual anthropology, public funding policy, and more. By its example and through its projects, research findings, and comprehensive outreach, the Center will work to improve and to guide new educational approaches to the arts and their role in society.

Educational Computing
Kimberly Jordan, Director of Computing
Office: Baker Hall 154

H&SS has its own Director of Computing, houses a number of its own computer facilities, and sponsors a number of educational computing initiatives. Together they represent the College's commitment to the effective use of computers as essential tools in instruction, research, and administration. Facilities accessible to students consist of personal computers, some of which are connected to one or more local networks, and all of which are also connected to the University's centrally supported campus network. These central systems include "Andrew," the computing environment jointly developed by Carnegie Mellon University and IBM. The College's Director of Computing is responsible for communicating with the College community about the information and skills necessary to utilize available computing resources; advising students and members of the faculty on the use of computers; training; solving problems; suggesting programs, applications, and data possibilities; and staying abreast of new developments in the field of educational computing in general and the Carnegie Mellon campus in particular. These activities are coordinated with related programs of the University's Academic Services Division, Office of Technology Education, Computing Services, the School of Computer Science, the Statistics Department, the Psychology Department, and the Laboratory for Computational Linguistics.

Humanities Center
David Shumway, Director
Office: Baker Hall 145D

The center was developed to strengthen research and teaching in the humanities; foster collaborations among the humanities faculty and faculty in other disciplines; and to nurture a greater role for the humanities in an increasingly technological and global society. It is a collaboration of faculty members from all four humanities departments: English, History, Modern Languages and Philosophy. "The Humanities Center will broaden the university's reputation beyond being a premier institution for technology and the arts, and establish Carnegie Mellon as a unique and innovative place to study the humanities," said Jared L. Cohn, the president of Carnegie Mellon. David Shumway, the director of the Humanities Center, said the center will enrich the university’s intellectual life in part by bringing to campus scholars from other institutions as visiting fellows and speakers, making available to students and faculty the resources of disciplines and specialties not normally represented at Carnegie Mellon.

H&SS Honors Program
Office of the Associate Dean
Office: Baker Hall A57
www.hss.cmu.edu/departments/deans_office/aac/default.html

From its inception in 1982, the H&SS Honors Program has provided outstanding undergraduate students with the opportunity to work individually with faculty members throughout the College. The Honors Program is a senior-year program. Admission to the Program is based on achievement of a QPA of at least 3.50 in the major and 3.25 overall, departmental recommendation, and endorsement by a faculty sponsor. Honors Students enroll in an honors course for both the Fall and Spring semesters of the senior year. Upon successful completion of the honors thesis, an H&SS Honors student qualifies for graduation with H&SS "College Honors," and will have this designation as well as the thesis title noted on the final transcript.

Students have found the Honors Program to be a very positive experience in allowing for focused, individualized work on a sustained independent project. The annual growth in the number of student participants in the program, the diversity of the topics investigated and the breadth of interest across departments attest to the popularity and impact of the program. In the opportunity it provides to demonstrate one's abilities for achievement at this level, it comprises an experience that helps significantly in presenting oneself to prospective employers or graduate programs.

Internship Programs

H&SS recognizes the value of work-related experiences for its majors in the College’s different departments. Students may have these experiences in a variety of ways, depending on the discipline and the department through 1) non-credit part-time work and/or summer jobs; 2) departmentally-conducted project courses, which earn academic credit, and 3) credit-bearing internships both on-campus and off-campus.

Internships-for-credit are "courses" in the conventional sense in that they are programs of study organized by (or at least with) a faculty member, and for which students receive a grade and credit. Such internships are unconventional in that they involve a significant "experiential," real-world component in a setting outside of the traditional classroom. Students may use internships to help achieve the stated purpose of their programs and to complement their classroom-based courses. However, such internships-for-credit must be more than just an experience in the "real world." As legitimate "courses," they must also constitute a learning experience based on careful academic preparation. (See the H&SS catalog section entitled "Academic Standards, Actions and Regulations" for additional information about College "Internships-for-Credit" policies.) Conceivably, an internship could be appropriate for any H&SS major. Some majors incorporate internships into their program requirements, while others consider internships optional. Recent internships have been arranged for H&SS students with such off-campus businesses and organizations as Westinghouse Electric, PPG Industries, The Pittsburgh Post-Gazette, WPXI television, Duquesne Systems, the Graphic Arts Technical Foundation, the Carnegie Institute, the American Civil Liberties Union, Senator H. John Heinz III
Regional History Center, WQED Television and Radio, Juvenile Court Project, DKA Television and Radio, Ketchum Communications, Inc., Equibank, South Side Chamber of Commerce, Penn Southwest, Inc., the Three Rivers Poetry Journal, Catholic Charities, Western Psychiatric Institute and Clinic, Allegheny General Hospital, Creamer Dickson Basford, various federal legislative groups, agencies, and interest groups (through, for example, the Washington Semester program). Internships have also been arranged on-campus with such university offices as Admissions, Alumni Relations, Public Relations, Enrollment Services, the Career Center, the Children's School, Campus Security, the University Health Center, Physical Plant, Sports Information, Estate Planning, the Carnegie Mellon University Press, the Robotics Institute, the Center for the Design of Educational Computing, the Software Engineering Institute, the Center for Art and Technology, and the School of Computer Science.

While the College's academic departments help students in generating internship ideas, students are responsible for finding an interested faculty member and/or Internship Director who will help plan for and supervise an internship-for-credit. H&SS-sponsored internships combine supervised workplace experience and academic rigor. During the actual internship, the student meets at regular intervals with the faculty advisor and/or Internship Director to report on the progress of the internship. Depending on the department and placement, students may be asked to develop a research paper or project related to the internship; keep reflective journals including specific interview and research assignments; or submit work samples done as part of the internship as a portion of their grade. These assignments are read and evaluated by department faculty members and/or internship director.

**Modern Language Resource Center**
Christopher Jones, Director
Cesar Valencia, Coordinator
Office: Porter Hall 225 C

Drawing on the unique interdisciplinary climate of the Carnegie Mellon campus, the undergraduate major in Modern Languages encourages the acquisition of multiple skills by students with varied backgrounds, talents and interests. An important resource in support of these goals is Carnegie Mellon's Language Learning Resource Center, which is a state-of-the-art facility providing students with access to authentic foreign language materials such as satellite television broadcasts, interactive multimedia materials and computerized assessment tools. Use of the Center is required in most lower-level Modern Language courses, either through direct individual or class attendance or through network access to the digital materials on file and web servers hosted by the Center.

**Washington Semester Program**
Connie Angermeier, Advisor
Office: Porter Hall 208

As part of its internship offerings, Carnegie Mellon is one of a number of universities throughout the nation which participate in "The Washington Semester Program," a cooperative arrangement with The American University in Washington, D.C. Students are selected by each of the participating colleges to spend a semester in the nation's capital. The program consists of study through a seminar; an elective course or an individual research project; and an internship at one of the hundreds of Washington-based organizations. Programs are available in the following areas: American Politics; Economic Policy; Foreign Policy; Gender and Politics; IT and Telecom Policy; International Business and Trade; International Environment and Development; Journalism; Justice; Law Enforcement; Security vs. Liberty; Peace and Conflict Resolution; Public Law; and Transforming Communities. More information can be found on their website: www.american.edu/washingtonsemester/

**Academic Standards, Actions and Regulations**

**Grading Practices**
General undergraduate grading regulations are detailed in the University section entitled "Undergraduate Academic Regulations."

**Transferring into H&SS**
All undergraduate students in other Carnegie Mellon colleges who wish to transfer into H&SS apply in the H&SS Academic Advisory Center, Baker Hall A57. Approved transfer will be into the college. Decisions regarding transfer requests will be based on evidence of adequate prior academic performance and on the applicant’s prospects for success in the H&SS major requested (further details concerning transfer are located on the H&SS AAC website www.hss.cmu.edu/deans_office/aac/forms.html).

**Academic Actions**
In order to maintain good academic standing, students in the College must reach or exceed minimum quality point averages (for each semester and cumulatively), and also maintain adequate progress toward completing graduation requirements. Quality point averages for good academic standing are 1.75 in the freshman year and 2.00 thereafter.

When a student fails to meet minimum performance criteria, an "academic action" normally results. Depending on the circumstances, one of three actions are taken: Probation, Suspension, or Drop. These academic actions are recommended by the College's departments at the end of each semester and imposed by the College Council. They are based on the guidelines described below.

**Probation**
A student is placed on probation when the student's performance either for the semester or cumulatively fails to meet the minimum standard. The term of "Academic Probation" is one semester, and signifies to the student the College's insistence that academic performance return to at least minimum acceptable level. A student is removed from probation, and returned to good academic standing, when both the semester and cumulative quality point averages meet or exceed stated minimums. A student who has had one semester on probation and is not yet meeting minimum requirements, but whose records indicates sufficient progress toward meeting minimum requirements, may be continued on academic probation.

**Suspension**
Academic Suspension is the usual action when a student fails to meet the minimum semester and cumulative requirements for two consecutive semesters. In general, a freshman will be suspended if the semester and overall QPA are below 1.75; for sophomores, juniors, and seniors, if these are below 2.00. Failure to maintain adequate progress toward graduation may also be a contributing factor in such decisions.

The minimum period of suspension is two semesters. At the end of that period, a student may seek readmission (on Final Academic Probation). In order to receive clearance to return, the student must do the following.

1. Formally request this clearance in writing, describing in detail the relevant activities pursued during the suspension period.
2. Provide transcripts from other colleges and universities if courses have been taken while on suspension. The College limits the number of courses that can be taken while on suspension for transfer credit. See policy statements on this subject in this section under "Non-CMU Courses."
3. Provide evidence of satisfactory on-the-job performance if the student has worked while on suspension.
4. Furnish the names and addresses of three individuals with whom he or she has worked or studied, to whom the College will write with a request for a letter of reference on the student's behalf.
Once cleared to return from suspension by the College Dean’s Office, the student must file an Application for Return from a Leave of Absence and obtain all necessary signatures. While on Suspension, students are considered to be on a “Leave of Absence” (albeit mandatory), and are governed by College and university policies concerning leaves of absence and withdrawals. See subsequent discussions of “Leave of Absence and Withdrawal from the College.”

Drop
The most severe academic action occurs when the student is dropped from the College, and not permitted to be enrolled again. This normally results when a student, already on Final Academic Probation, continues to perform at levels less than the minimum set by the College for good academic standing, and shows no indication of being able to reach an acceptable level of performance or maintain steady progress toward completing graduation requirements.

The relation indicated above between probation, suspension and drop is not automatic in all cases. These “academic actions” are based on individual student performance and are not determined purely by formula. Thus, a student who achieves a 2.00 quality point average may be placed on probation for a very erratic performance; and in special circumstances, College Council may drop or suspend a student without prior probation.

H&SS Dean’s Honor List
Each semester the College recognizes those students who have attained outstanding academic records by naming them to the College’s Dean’s List. H&SS students are eligible for the Dean’s List who complete a minimum of 45 factorable units of work with a quality point average of at least 3.50 and with no conditional grades (I, X) at the time final grades are recorded.

Students who attain a minimum semester QPA of 3.50 through 3.74 are named to the Dean’s List, with Honors; students who attain a minimum semester QPA of 3.75 or higher are named to the Dean’s List, with High Honors.

Those who have completed 36 to 45 factorable units and attain a minimum semester QPA of 3.75 are named to the Dean’s List with Honors.

Course Overloads
Overloading is defined as taking more than the equivalent of five full-term courses; it usually means registering for more than 50 units per semester. Eligibility for overloading is defined as having a QPA of 3.00 (or higher) in the last completed semester and a current cumulative QPA of 3.00 (or higher). Eligibility does not automatically allow the student to register for more than 50 units; eligible students must be granted special permission through the following:

• completing this “Petition to Carry an Overload for H&SS Students” form
• meeting with the student’s primary academic advisor to discuss overloading
• if written permission is granted on this petition, online processing of the unit increase is through the academic advisor.

All petitions approved before the posting of final grades for the semester preceding the overload semester are subject to revocation if the student does not achieve a 3.00 semester QPA (or higher). It is the student’s responsibility to discuss this matter with their academic advisor.

Physical Education, StuCo and Military Science Courses
A maximum combination of nine units of credit for Physical Education, StuCo and all Military Science courses may be counted for credit toward graduation as free electives in any H&SS program. Physical Education, StuCo and Military Science courses are not included when calculating a student’s QPA or when calculating units to determine eligibility to “overload.”

Course Failures and Course Repetitions
Students who fail a required course must repeat and pass it (or take and successfully complete another approved course that fulfills the requirement). Exceptions: Freshman Seminar courses may not be repeated. If a failed course is a prerequisite to more advanced course work within a particular course sequence, the failed course must in general be repeated before moving on to the higher level course.

Failed courses that are repeated and passed, or courses that are passed but repeated in order to obtain a higher grade, are not replaced on the student’s record; both course grades remain on the record, and are included in calculating the student’s official QPA. The College may exclude the units and quality points for the lower grade in calculations to determine eligibility for Dean’s List, University Honors, and the like.

Internships-for-Credit
Policies and practices with respect to internships-for-credit vary among the College’s departments. No department is obligated to provide or offer credit for an internship for its majors.

Definition of an Internship-for-credit:
An internship-for-credit is a supervised professional work experience with clear links to a student’s academic program performed primarily or totally outside a regular course and for which a student may be able to earn academic credit.

Departmental Policy/Practices Statement:
Each department in the College that allows its majors to earn academic credit for an internship has a statement that describes its internship policies and practices. This statement addresses the following items.

1. Each department has a coordinator (or a committee) that approves, administers and monitors departmentally-sponsored internships.
2. Each department determines how (and if) an internship may be applied to its curriculum for fulfilling course requirements (i.e., whether as a required course, a course that fulfills a major requirement, or as an elective course). Credits are earned according to the following scale:
   9 units = the equivalent of 1 day (9-12 hours) per week during a semester (100 hours)
   18 units = the equivalent of 2 days (12-20 hours) per week during a semester (200 hours)
   No H&SS student may earn more than 18 units of internship credit during a semester.
3. No H&SS student may count more than 27 units of internship credit toward fulfilling graduation requirements.
4. An internship-for-credit is a graded experience. Each department, through its monitor or monitoring committee, will determine appropriate criteria for the grade in an internship.
5. Students doing an internship for credit must be registered for the internship during the term (including the summer) when they are doing the work.

Academic Credit and Pay for an Internship
Some internship sponsors offer payment to an intern in addition to whatever academic credit the University offers. Although a student may earn both credit and pay for an internship, no department is obligated to find paid internships for its majors.

Liability Insurance
The University’s liability insurance for students does not cover a student while he or she is doing an off-campus internship.

Exceptions: Internship-for-Credit Guidelines
Exceptions to the guidelines require a petition and approval by both the student’s department and the College (i.e., the Academic Advisory Center).

H&SS Policy Regarding Credit for Non-CMU Courses
The following policy governs the practice of H&SS undergraduates taking courses elsewhere and requesting that the credits for these courses transfer to Carnegie Mellon.

Limits
Once a student enrolls in the university as a degree candidate, he or she may take a maximum of five courses (or their rough unit equivalent) elsewhere and transfer these back for credit toward their CMU degree.
No courses may be transferred for these courses in the Integrative Liberal Studies (ILS) program:

- 76-101, Interpretation and Argument (or 82-085) from ILS Category 1.
- 79-104, Introduction to World History from ILS Category 2.
- 36-201, Statistical Reasoning from ILS Category 4.

**Grades**

Courses taken elsewhere must be taken for a grade of A, B or C (not Pass/Fail), and credit will be transferred only for courses in which a grade of at least the equivalent of a Carnegie Mellon "C" is earned. A "C-") is not a transferable grade when its equivalent value is below a 2.00 or 70%. Only units (and not grades or quality points) transfer for such courses; hence, they do not affect the Carnegie Mellon QPA.

**External Transfer Students**

For students entering CMU/H&SS as external transfers, the same five course limit applies until and unless their transfer credits reach the 180 unit ceiling stipulated by college policy. The college has a residency requirement of a minimum of 180 CMU units. If a degree has been already obtained at another institution (outside of CMU), courses that were counted toward that degree may not be used again as transfer credit toward a CMU undergraduate degree.

**Internal Transfer Students**

This policy applies retroactively to students who enter H&SS through internal transfer. Hence, this quota system counts courses taken elsewhere and approved for transfer credit prior to internal transfer into H&SS.

**H&SS Department Limits**

H&SS academic departments must not exceed these college limits, but are free to impose stricter limits regarding courses students propose to take elsewhere to fulfill major requirements.

**Community and Junior College**

The College's strong preference is that students interested in taking courses elsewhere take them at four-year degree-granting colleges or universities. Community college and junior college courses will be considered, although students requesting permission to take community or junior college courses for credit must furnish a detailed course description/syllabus with their course permission request, as well as evidence that the institution in question is fully accredited.

**Students on Suspension**

Students on suspension from H&SS will be permitted to receive credit for no more that three courses per semester elsewhere, and no more than a total of five courses elsewhere, while on suspension. These limits may be lower if the student has already (prior to suspension) had credits transferred under the quota limits described above in item #1. Clearance to take these courses for credit should be approved in advance.

**Exceptions**

These limits do not apply to credit received through Advanced Placement Examinations, International Baccalaureate, approved Cross-Registration through the Pittsburgh Consortium for Higher Education, approved Washington Semester program courses, or approved Study-Abroad, Exchange and Education-Abroad courses. In addition, the college may relax these limits in instances where students have unique opportunities to take part in a semester or year-long program. Exceptions to these restrictions may be made only by way of written petition to the H&SS College Council (c/o the Academic Advisory Center).

**Transfer Credit Approval**

Any courses to be taken elsewhere for which students wish to receive credit must be approved by the college through established transfer course credit request procedures. For courses yet to be taken, students should obtain these permissions in advance; no guarantees of credit are offered for courses taken without advanced approval. In that these credit request procedures specify how course credits will be applied (i.e., to integrative liberal studies requirements, to majors, minor requirements, or as electives), these steps should be followed for all courses taken outside CMU.

**Double-Counting Courses**

“Double-counting” refers to instances when a course taken to fulfill one requirement counts simultaneously toward a requirement in another major or minor program. While the College encourages interdepartmental study in complementary areas where majors and minors frequently share common requirements, it also wants to keep clear the meaning and integrity of the labels “major” and “minor.”

To preserve the integrity of these definitions, the College permits double-counting requirements for its students on a very limited basis, and generally only in those instances when the course(s) in question represent only a small portion of the second program. When it is allowed, it is viewed not as “double-counting,” but rather as a waiver of the course requirement in question in the second program.

The College and its departments have developed program-specific guidelines for this practice that appear throughout the H&SS section of this catalog, and particularly in the case of major and minor programs that students frequently pursue in combination.

In general, the College requires that an additional major be based on at least five independent courses, excluding prerequisites, and a minor based on at least four independent courses (“independent courses” are courses not counted toward any other program requirement).

**Leave of Absence and Withdrawal from the College**

The student leave policy is detailed in the University’s section entitled “Enrollment Services.”

**Graduation Requirements**

Eligibility for graduation in H&SS requires that a student:

1. complete all General Education (GenEd) requirements,
2. complete all course requirements in his or her primary major (including any minimum QPA performance standards set by academic departments for courses taken in their majors),
3. achieve a cumulative quality point average of at least 2.00 for all courses taken after the 1st year,
4. complete 360 units with at least the minimum 180 units taken at Carnegie Mellon University - all undergraduate degrees in H&SS require completion of at least 360 units,
5. be recommended (certified) for a degree by the faculty of the College,
6. meet all financial obligations to the University, and
7. qualify for graduation no more than eight years from the date units completed toward the undergraduate degree were earned.

Any H&SS student who wishes to have any part of these graduation requirements modified must petition the H&SS College Council in writing for approval. For its part, the College reserves the right to modify these academic standards, actions, and regulations.

**Graduation with University Honors**

H&SS students who achieve an overall QPA of at least 3.50 (by the end of the 7th semester) will be recommended for graduation “With University Honors.”

**Graduation with College Honors**

Students who successfully complete a senior honors thesis (66-501 and 66-502) under the auspices of the H&SS Senior Honors Program qualify for graduation with “H&SS College Honors.”
Student-Defined Major Program

Joseph E. Devine, Associate Dean,
H&SS Academic Advisory Center
Office: Baker Hall A57

For H&SS students whose educational goals cannot be as adequately served by the curricula of existing majors, the College provides the opportunity to self-define a major or minor. The procedure for establishing such a major centers on a written proposal, submitted to the College’s Dean’s Office (c/o the H&SS Academic Advisory Center). This proposal, which is to be built on the College’s General Education Program, consists of two parts:

Major Description and Rationale: A description of the components of the proposed program of study; a presentation of the objectives of the program of study, why it represents a coherent and (given available faculty, courses, and other resources) viable course of study, and the reason(s) why these objectives cannot be accomplished within one or more of the College’s existing majors.

The Curriculum: Presentation of a complete outline of all courses that will comprise the requirements for the major. These courses should be categorized in two ways: first, according to that component of the major program to which each belongs (e.g., mathematics prerequisites; research methods; theoretical perspectives; etc.), and second, a semester-by-semester outline that indicates when each course is to be taken (or, for any already taken, when taken and grade received). In addition to courses taken at Carnegie Mellon, the major’s curriculum may include courses taken (or to be taken) at other schools, related projects or internships, or programs of study abroad. The minimum requirement for graduation is, as with all majors in the College, 360 units of credit.

Proposals and curricula are evaluated for clarity of focus, coherence and depth in related areas, and viability within the context of the College and university. Proposals should generally be developed no later than the sophomore year, and approved majors begin their program generally no later than the junior year. All Student-Defined Majors must complete the H&SS General Education Program.

Additional details and guidelines for the H&SS Student-Defined program are available in the College’s Academic Advisory Center, Baker Hall A57.
H&SS Interdepartmental Majors

When addressing complex issues in society, pursuing research in industry, in government, or at the university, and in many other contexts, we often rely on approaches that take advantage of a variety of relevant disciplines. The College houses the special category of "Interdepartmental Majors" for programs where this interdisciplinary spirit is most pronounced and in which the varied disciplinary perspectives are more fully integrated. These majors are presented separately, rather than as departmentally-based options, to reflect and underscore their sponsorship by more than one H&SS department, and the unique flavor that follows from this structure.

Interdepartmental majors are administered by the academic department of the major’s faculty advisor.

**Additional Major in Environmental Policy**

**Peter Madsen, Faculty Director**

Office: Baker Hall 150A

The additional major (only) in Environmental Policy focuses attention on the interaction of humans with the environment from a multitude of perspectives. Human activities have had and continue to have large-scale and long-term consequences for environmental quality. Environmental quality relates to the quality of our daily lives, to our physical health, and to the future vitality and even survival of human society. The Additional Major in Environmental Policy is designed to provide students with the interdisciplinary background and skills necessary to understand environmental issues. It emphasizes three general areas: (1) humanities and the arts; (2) social sciences; and (3) natural science and technology. The humanities emphasize the ethical, legal, and historical basis of environmental concerns as well as their aesthetic manifestations. The social science area concentrates on the economic and political nature of environmental problems and possible policy options and responses. The natural science and technology focus includes the exploration of ecology as well as the role of technology as both problem creator and problem solver.

The Environmental Policy major is open to all students as an additional major. It is administered by an interdepartmental committee, together with Peter Madsen, of the Philosophy Department, as principal advisor. The major features training in relevant research methods; a set of core courses on environmental issues from several disciplinary vantage points; an elective; and a project course experience.

**Prerequisites**

**47-56 units**

Two courses in calculus (e.g., 21-111/112 or 21-121/256)
Two courses in statistics (e.g., 36-201 or the equivalent)
Two courses in biology (e.g., 03-121 and 122, 124 or 130) or
Two courses in chemistry (e.g., 09-103/104 or 09-105/106) or
Chemistry 09-103 and 06-100 Introduction to Chemical Engineering

The following courses are recommended, although not required, to complete: 73-100, Principles of Economics or 73/88-110, Experiments with Economic Principles

**Research and Analytical Methods**

**18 units**

79-200 Historical Evidence and Interpretation
or
85-340 Research Methods in Social Psychology

73-250 Intermediate Microeconomics

**Theory and Context**

**54 -57 units**

66-210 Science and Technology for the Environment
or
79-345 American Environmental History: Critical Issues

Required

**45-48 units**

79-346 International Environmental Affairs and Policy
or
90-792 Environmental Values and Decision Making
80-340 Environmental Ethics and Decision Processes

**Required Electives**

**9-12 units**

Complete one course in one of the following areas:

**Science and Technology**

12-100 Innovation and Design in Civil Engineering*
12-251/252 Introduction to Environmental Engineering (if not taken in the required category)
12-655 Water Quality Engineering*
12-656 Environmental Engineering: Air Pollution*
19-101 Introduction to Engineering and Public Policy*
19-321 Law and Technology
19-420 Chemical Technologies, the Environment, and Society
19-422 Radiation, Health, and Policy
19-448 Science, Technology, and Ethics
24-244 Energy-Environmental Systems (also listed as 19-424)
42-604 Biological Transport

* particularly extensive prerequisites; not to be taken by students whose primary major is in CIT

**Humanities**

76-322 Reading the Built Landscape
76-395 Science Writing
76-476 The Rhetoric of Science
79-384 Medicine and Society
80-244 Management, Environment and Ethics

**Social Sciences**

19-446 Quantitative Risk Analysis
73-250 Intermediate Microeconomics
73-357 Regulation: Theory and Policy
73-359 Benefit-Cost Analysis
85-241 Social Psychology
88-220 Policy Analysis I (if not taken in the required category)
88-221 Policy Analysis II
88-223 Decision Analysis and Decision Support Systems
88-302 Behavioral Decision Theory
88-425 Politics of Economic Deregulation
90-765 Natural & Built Environments in Urban America
90-773 Technology, Environment and Economic Development
90-789 Design, Environment and Economic Development
90-798 Environmental Policy & Planning

**Evaluation and Design**

**12 units**

19-451 Engineering and Public Policy Projects (pre-approved sections);
or
88-222 Policy Analysis III (pre-approved sections);
or
79-410 History and Policy Project (pre-approved sections)
The Major in Ethics, History, and Public Policy
Faculty Director: Preston Covey, Department of Philosophy
Office: Baker Hall 150A

Preparing students for leadership positions is a vital goal of colleges and universities in every democratic and technologically advanced society. The intellectual challenges facing public and private sector leaders expand dramatically each year, and there will be a compelling need in 21st century America for broadly educated, ethically sensitive, and technically skilled public servants. They will have to demonstrate sophisticated interdisciplinary knowledge, historical understanding of how modern-day problems have evolved, and an operational grasp of clear, rational criteria for ethical decision-making. The major in Ethics, History, and Public Policy seeks to provide students with a solid humanistic and social-scientific foundation for developing such high-level leadership capabilities. It also provides ample room for specialization, technical skill development, and internship experience in a wide range of policy areas.

Curriculum
Offered jointly by the Departments of History and Philosophy, the Ethics, History, and Public Policy major is offered for either a B.A. or a B.S. degree, or as an Additional Major (see below). The requirements for either degree or for an additional major include a minimum of 117 units (thirteen 9-unit courses) divided into History and Philosophy Core Courses (72 units) and Elective Track courses (45 units). The Internship Option (9 units) may be substituted for 9 units of an Elective Track for students who qualify (with a 3.0 overall GPA, a 3.25 GPA in their EHPP courses, and acceptance by the Internship Coordinator). Students are strongly advised to complete their core courses, the B.S. option (if they elect this degree option), and the Internship option (if they elect this option and qualify for an Internship) by their senior year or sooner. Only one course taken for the EHPP major may double count for an H&SS General Education requirement. Only one course taken for an EPHP major may double count towards any additional major or minor.

Bachelor of Science Option 18 units

Complete two of the following courses. None may double count for an H&SS General Education requirement.

21-257 Models & Methods for Optimization (Prerequisite 21-256) 36-303 Sampling, Surveys, & Society (Prerequisites include 36-201)
36-207 Probability & Statistics for Business (Prerequisites: 21-116 or 21-211) 36-208 Regression Analysis (Prerequisites: 36-207 or 21-116 or 21-211)
80-222 Measurement & Methodology (Prerequisite: 21-228) 80-305 Rational Choice (Prerequisites: none)
80-316 Probability & Artificial Intelligence (Prerequisites: none) Or: Any DCR5 course option that is not used to fulfill the H&SS DCR5 requirement

Internship Option 9 units

79-505 Undergraduate Internship research course*

*For an internship to receive academic credit it must be pre-approved by the History Department Internship Coordinator. The internship research course may count towards the Elective Track. The internship and 79-505 must be taken before spring semester of senior year.

History Core Courses 36 units

1) Complete one of the following courses in American history, preferably before junior year.
79-204 20th Century America 79-206 Development of American Culture Recent United States History 1945-Present
2) Complete one of the following courses in policy history/social history.
79-242 African American History II 79-331 Crime and Punishment in American Society
79-336 Epidemic Disease & Public Health 79-373 Children and Youth in History and Policy
3) Complete one of the following courses in international history
4) Complete one other course from the options under (2) or (3).

Philosophy Core Courses 36 units

1) Complete one of the following ethics courses.
80-130 Introduction to Ethics 80-230 Ethical Theory 80-256 Modern Moral Philosophy
2) Complete one of the following courses in political philosophy
80-135 Introduction to Political Philosophy 80-235 Political Philosophy 80-335 Philosophy, Politics, & Economics
3) Complete one of the following courses in applied philosophy/applied ethics.
80-136 Social Structure, Public Policy, & Ethical Dilemmas 80-221 Philosophy of Social Science 80-236 Philosophy & Law 80-241 Professional Ethics 80-242 Conflict & Dispute Resolution 80-246 The American Criminal Justice System: Realities & Ideas 80-321 Causality in the Social Sciences 80-346 Value, Fact, & Policy
4) Complete one other course from any of the options above.

Elective Tracks 45 units

Complete 45 units (five 9-unit courses) from one of the two Elective Tracks below: Social Policies; or, Business & Economic Policies. An approved 9-unit Internship research course (79-505) may be substituted for one of these.

Social Policies Track
19-319 Law & the Engineer [See EPP catalog for prerequisites] 19-321 Law & Technology [See EPP catalog for prerequisites]
Sample Elective Track Concentrations

Students may, if they wish, concentrate their Elective Track courses in a topical area of special interest to them. The following four sample concentrations are illustrated with course options under the Social Policies Elective Track. The Business & Economic Policies Elective Track similarly accommodates special-interest concentrations, for example concentrations emphasizing international business and economic policies, or environmental policy. Students interested in International Relations are well advised to pursue the International Relations additional major or minor along with the EHPP major and to choose an EHPP Elective Track and concentration consonant with their International Relations interests. Only one course taken for the EHPP major may be double counted for any additional major or minor.

Medicine & Health Policy
19-422 Radiation, Health, & Policy  [See EPP catalog for prerequisites]
79-256 Biology & Society
79-333 History of Biomedical Research

Business & Economic Policies Track
19-319 Law & the Engineer  [See EPP catalog for prerequisites]
19-424 Energy & the Environment  [See EPP catalog for prerequisites]
19-426 Environmental Decision Making  [See EPP catalog for prerequisites]
70-311 Organizational Behavior
70-332 Business & Society
70-413 Conflict Resolution: Negotiation & Mediation
70-430 International Management
73-251 Public Finance
73-356 Political Economy of Public Institutions
73-357 Regulation: Theory & Policy
73-359 Benefit-Cost Analysis
73-365 Industrial Organization
73-371 International Trade
73-372 International Money & Finance
73-476 American Economic History
79-230 Technology in American Society
79-245 American Environmental History: Critical Issues
79-258 Complex Technological Systems: Past, Present, and Future
79-386 The Global Environment: Historical Perspectives and Policy Dilemmas

Ethics, History, and Public Policy Sample Curriculum

Junior Year
Fall  Spring

Core Requirement in History and Philosophy
Core Requirement in History and Philosophy
Internship 79-505 or Elective Track Course

Core Requirement in History and Philosophy
Core Requirement in History and Philosophy
Elective Track Course

Introduction to Political Philosophy 80-135
Elective
Elective Track Course

Social Structure, Public Policy, and Ethical Dilemmas 80-136
Elective
Elective

Senior Year
Fall  Spring

Elective
Elective Track Course

Elective
Elective

B.S. degree option courses and certain core courses (79-204 or 79-206 and 80-130) should be completed prior to the Junior year.

The above sample program is presented as a two-year (junior-senior year) plan for completing EHPP major requirements. Its purpose is to show that this program can be completed in as few as two years; not that it must be. Students may enter their EHPP major, and begin major course requirements, as early as the start of the sophomore year, or even in the first year. Students should consult their advisor when planning their program.

Additional Major

All Ethics, History, and Public Policy requirements for an additional major are the same as those for non-B.S. degree candidates whose primary major is EHPP. Only one course may double count for both a student's EHPP additional major and the student's primary major.
The Major in European Studies

Beryl Schlossman, Professor of French; European Studies Advisor

Europe constitutes a vital part of our cultural heritage and has been a source of both great creativity and massive devastation in the modern era. The European Studies program seeks to enhance students’ understanding of the historical evolution and contemporary dimensions of European society, politics, and culture. It aims as well to train students in an area of growing national need and professional opportunity. It offers an interdepartmental major that furnishes students with substantive knowledge of Western European society through two approaches. First, it provides a solid foundation in one of the continental Western European languages. Second, it encourages comparative inquiry across boundaries of time, nation, and scholarly discipline.

Curriculum

Offered jointly by the Departments of Modern Languages and History, the European Studies major is offered as a B.A. degree.

European Studies majors must take two prerequisite courses (18 units) in one foreign language (French, Spanish, or German) or demonstrate the equivalent in language ability through the Carnegie Mellon Language Placement Test. The requirements include a minimum of 99 units divided into core courses (63 units) and electives (36 units). Students are strongly advised to fulfill prerequisite and core courses by the end of their junior year. Students are encouraged to take advantage of the Study Abroad Program.

Students are urged to check with the Major Advisor in selecting courses for this major.

The Major in European Studies 99 units

Students who arrive at Carnegie Mellon with previous language study and/or who have high AP or CEEB scores will be able to begin taking courses toward the major earlier in their undergraduate program and will also be able, should they so desire, to complete an additional major. Progress toward the major will be accelerated by study abroad.

1. Core Courses in Modern Languages 36 units

Language courses are to be completed in the same language: French, German, or Spanish.

Complete two courses in a 200-level language sequence* 18 units
82-2xx 200-level language course
82-2xx 200-level language course
*Students who place out of 200-level language courses must take at least two 300-level courses instead of the required one 300-level language course.

Complete one course in a 300-level language course 9 units
82-3xx 300-level language course
Complete one course in a 400-level language course 9 units
82-4xx 400-level language course

2. Core Courses in History 27 units

Required Course 9 units
79-207 Development of European Culture
Pre-20th Century European History 9 units
Complete one 200-level (or above) course in Pre-20th century European history.
79-2xx/3xx Pre-20th century European History course

European History 9 units
Complete one 300-level course in European history.
79-3xx European History course

3. Electives 36 units

This list includes samples of courses that can be taken as appropriate electives in European history, literature, and culture in relevant departments. In any given semester, offerings differ. Students are urged to consult with the Major Advisor and with relevant departments for current offerings. Electives also may include additional 400-level courses in the target language, additional courses in Modern Languages, 200- and 300-level courses in History, and some offerings in English and CFA.

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Sample Curriculum (B.A.)

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Senior Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>300-level Language Course 82-3xx</td>
<td>400-level Language Course 82-4xx</td>
</tr>
<tr>
<td>Development of European Culture 79-207</td>
<td>Pre-20th Century European Course 79-2xx/3xx</td>
</tr>
<tr>
<td>Elective Elective Elective Elective</td>
<td>Elective Elective Elective Elective</td>
</tr>
</tbody>
</table>

This is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed within two years. Students may enter their major, and begin major course requirements, as early as the start at the beginning of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

This plan is an example of the suggested sequence of study for students who have had little or no prior exposure to the language. These students would need to satisfy the prerequisites (elementary and intermediate language study) during their freshman and sophomore years.
The Major in Information Systems

Faculty Program Director: Randy S. Weinberg
Office: Porter Hall 223G rweinberg@cmu.edu
Program Advisor: Stephen Pajewski
Office: Porter Hall 100B spg@andrew.cmu.edu
Faculty: Cleotilde Gonzalez, C.F. Larry Heimann, Kevin Stolarick

Information Systems (IS) is a unique and innovative undergraduate interdisciplinary program, drawing on a wide range of existing college and university strengths. Information Systems is an internationally recognized undergraduate major for students who want to design and implement effective solutions to meet organizational and management needs for information and decision support. IS majors study the organizational, technological, economic and societal aspects of information systems, and learn how these elements work together to affect real outcomes. Students completing the program will be well grounded in the fundamentals of organization theory, decision-making, teamwork and leadership, and research methods as well as current and emerging information systems technologies. Graduates of the Information Systems program are ideally situated to take a leading role in shaping our information-based future.

Information Systems appeals to outstanding students with a wide range of backgrounds and interests. The major provides students with a broad liberal education (being situated in the College of Humanities & Social Sciences) along with training in the essential aspects of the design and implementation of information systems. The flexible nature of the program encourages students to explore their own interests in a contemporary concentration area - Communication Design, Organizations and Technology, Decision Sciences, and Statistics/Data Mining. While all IS majors will become proficient in information technologies, they share a common interest in the effective applications of these technologies to real organizational, managerial and societal needs for better information management and decision making.

In addition to the H&SS General Education Requirements and basic prerequisites in mathematics, statistics and computer programming, IS students must complete a professional core, a disciplinary core and achieve expertise in an area of concentration. In the professional core (consisting of four courses), students learn the basic skills necessary to analyze, design and implement information systems using current and emerging organizational and technological practices. Two of the professional core courses are project-based experiences in which small teams of students must develop and communicate solutions to real information problems.

In the disciplinary core (consisting of three courses), students study three areas that are fundamental to understanding and solving problems in information systems: organizations, decision sciences and research methods. The organizations area emphasizes how groups of people can organize and coordinate their behaviors to perform complex tasks. The decision sciences component focuses on the fundamentals of good decision making on individual and organizational levels. The research methods area illuminates the process of gathering, summarizing, evaluating and communicating information.

IS students must also complete four courses within a concentration area. Currently, there are four concentration areas: (1) Communication Design, (2) Policy, Organization and Technology, (3) Decision Science and Rational Choice, and (4) Statistics/Data Mining.

Our students meet an important need in the information-age workplace. IS students have experienced a very strong job market in past years, and national trends indicate that this is likely to continue. IS majors often take jobs in consulting companies, major software firms, large corporations, and start-up companies. Internship opportunities closely parallel the job market.

IS students are well prepared to pursue graduate work in information systems, business administration, technology management and policy, and other related areas. Because of the broad training received within the H&SS curriculum, some IS students may wish to pursue graduate degrees in some disciplinary field of the social and behavioral sciences or in the humanities, as well. For students interested in master’s degree-level graduate work at Carnegie Mellon University, there are various possibilities, including an accelerated Masters of Information Systems Management (MISM) program. Some of the undergraduate coursework for the IS major can be counted towards the graduate requirements of the MISM program and the degree can usually be completed in two additional semesters.

Only Information System students with junior or senior status are allowed to enroll in the Professional Core courses. The target class size of these courses is determined annually by the College. If the target size is not met by existing IS students, then additional students may be admitted to the IS major and required to begin the Professional Core courses during the next available semester. (IS students are currently admitted directly into IS as incoming freshmen). The availability of space, admissions criteria, and application procedure will be publicly announced. Applications for admission to the major will be considered at the end of each semester. Students interested in applying for admission to the IS major should keep in touch with the IS advisor for information regarding availability, application procedures and deadlines. Potential applicants to the IS major should be working toward a sensible alternative major, so that their success at CMU is not predicated on admission to the IS program.

Curriculum

The Information Systems major is offered only as a Bachelor of Science (B.S.) degree. In addition to major requirements outlined below, all Information Systems majors must fulfill all H&SS General Education requirements.

Disclaimer: Requirements are subject to revision. Advisor approval is required for each student’s major curriculum plan.

Prerequisites

The prerequisites common to all Information Systems majors are presented below. All prerequisites must be successfully completed no later than the start of fall semester, junior year.

Mathematics & Statistics 28-29 units
Complete any of the following calculus sequences:
21-111 Calculus I and 21-112 Calculus II or 21-120 Differential and Integral Calculus and 21-256 Multivariate Analysis and Approximation or 21-120 Differential and Integral Calculus and 21-122 Integration, Differential Equations, and Approximation or 21-121 Integration and Differential Equations and 21-123 Calculus of Approximation and 36-201 Statistical Reasoning and Practice

Computer Science Fundamentals 10-20 units
Units needed to fulfill this requirement category could vary based on placement into the appropriate programming course from programming placement test results.
15-100 Introductory/Intermediate Programming (10 units) and 15-200 Advanced Programming/Practicum (9 units) or 15-111 Intermediate/Advanced Programming (10 units)

Professional Core 42 units
Complete all four courses.
67-271 Fundamentals of Systems Development I (9 units) (prerequisite: 15-200 or 15-111); 67-272 Application Design and Development (9 units) (prerequisite: 15-200 or 15-111); 67-373 Software Development Project (12 units) (prerequisites: 67-271 and 67-272); 67-475 Information Systems Applications (12 units) (prerequisite: 67-373)

Disciplinary Core 27 units
Organizations
Complete one course.
70-311 Organizational Behavior 88-260 Organizations

Decision Science and Computability
Complete one course.
73-200 Macroeconomics (prereq: 73-100)
80-211 Arguments and Inquiry
80-305 Rational Choice
88-220 Policy Analysis I
88-223 Decision Analysis and Decision Support Systems (prereq: 36-201)

Research Methods
Complete one course. It is recommended that this requirement be completed in the sophomore year. All courses below have the same prerequisite of 36-201.
36-202 Statistical Methods
36-303 Sampling, Surveys, and Society (additional prerequisite: 36-202 or 36-208 or 36-226 or 36-309 or 36-625 or 70-208 or 73-260)
36-70-208 Regression Analysis
36-309 Experimental Design for Behavioral and Social Sciences

Concentration Area: 36 units

Students must choose one Concentration Area and take four courses in that Area. Courses taken to satisfy the Disciplinary Core requirement cannot also be counted for the Concentration Area requirement. Some of these courses may have additional prerequisites.

Communication Design Area
Complete three courses. Check for course prerequisites.
76-270 Writing in the Professions
76-382 Multimedia Authoring I (prereq: 76-270)
76-487 On-line Information Design (76-488 lab section is optional) (prereqs: 76-270, 76-382)

Plus, complete one course.
76-318 Communication in Global Marketplace
76-319 Environmental Rhetoric
76-373 Argument
76-385 Discourse Analysis
76-386 Language & Culture
76-387 Introduction to Sociolinguistics
76-389 Grammar of Standard Written English
76-390 Style
76-392 Rhetoric & Public Policy
76-395 Science Writing
76-397 Instructional Development & Design
76-451 Topics in Language Study
76-457 Topics in Rhetorical Study
76-470 Advanced Professional & Technical Writing
76-476 Rhetoric of Science
76-479 Corporate Marketing & Communication
76-480 Document Design
76-481 Writing for Multimedia
76-494 Medical Communication
80-291 Issues in Multimedia Authoring

Policy, Organizations, and Technology Area
Complete four courses. Check for course prerequisites.
73-469 Economics of E-commerce
79-230 Technology in American Society
79-342 Technology, Organization, and Information
79-441 Science, Technology, and Business in U.S. History
88-340 Economics of Entrepreneurship in High Tech Industries
88-341 Organizational Communication
88-343 Economics of Technological Change
88-344 Organizational Intelligence in the Information Age
88-345 Rise of Industrial Research and Development
88-347 Complex Technological Systems: Past, Present, and Future
88-354 Economics and Psychology of Organizational Communication
88-385 Managerial Decision Making

Decision Science and Rational Choice Area
Complete four courses. Check for course prerequisites.
19-448 Science, Technology and Ethics
73-325 Experimental Foundations of Equilibrium
73-359 Benefit-Cost Analysis
80-230 Ethical Theory
80-241 Ethical Judgments in Professional Life
80-305 Rational Choice
80-335 Philosophy, Politics, and Economics
80-341 Computers, Society, and Ethics
80-405 Game Theory
88-223 Decision Analysis and Decision Support Systems
88-302 Behavioral Decision Making

Statistics/Data Mining Area
Complete all three courses. Check for course prerequisites.
36-310 Fundamentals of Statistical Modeling
36-315 Graphics and Visualization
36-350 Data Mining
Plus, complete one course.
36-401 Modern Regression
36-46x Topics Courses in Statistics
80-316 Probability and Artificial Intelligence
80-321 Causality in the Social Sciences

Information Systems, B.S.

Sample Junior-Senior Year Curriculum

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Fall</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Concentration Area Course</td>
<td>Elective</td>
<td>Elective</td>
<td>Concentration Area Course</td>
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<td>Elective</td>
<td>Concentration Area Course</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

* If and when possible, it is recommended that this requirement be completed in the sophomore year.

Additional Major and Minor
Information Systems is not available as an additional major nor as a minor.

The Additional Major in International Relations

Faculty Advisor: Kiron K. Skinner
Undergraduate Advisor: Stephanie Wallach
Office: Baker Hall 240

The demise of the cold war had important intellectual effects. They include a redefinition of international relations; a dissolution of disciplinary boundaries, leading to more productive discussions of international relations between social scientists and those in the humanities; a closer investigation of the interaction of politics, culture, and markets; and a focus on the role of non-state actors in international outcomes.

The International Relations Major addresses these scholarly projects by providing a set of core competencies in political science, other types of social science analysis, foreign language, and cultural analysis. Students concentrate in the social science aspects of international relations, gaining knowledge in a range of theories and methodologies, or in the cultural aspects of the field, examining the role of beliefs, culture, religion, and race in interstate and intra-state behavior.

The International Relations Major is currently available exclusively as a second major to be pursued in conjunction with a disciplinary major in H&SS or another college.

The departments of Social and Decision Sciences, History, and Modern Languages jointly offer the International Relations Major.

All students in the program are encouraged to complete one semester of study abroad. Requirements in the major will be adapted accordingly.
Curriculum

The courses listed below are offered with general regularity. Participating departments may subsequently develop and offer other courses that are deemed appropriate for this major. The Undergraduate Advisor should be consulted, especially when the schedule of courses for a given semester becomes available, to identify such additional courses.

Core Courses 18-27 units

Complete 79-231/88-329; 79-350/88-326; and one 200-level course in Modern Languages (unless you fulfill the language requirement via another option listed below).

History (9 units)
79-231/ 88-329 American Foreign Policy, 1945-Present

Social and Decision Sciences (9 units)
88-326/79-350 Theories of International Relations

Modern Languages

Demonstration of basic competency in a foreign language via one of the three options listed below:
1) Complete one (1) Modern Languages course at the 200 level, with a minimum grade of C, or
2) Achieve a score of 4 or higher in one foreign language Advanced Placement examination, or
3) Demonstrate equivalent proficiency to the satisfaction of the department of Modern Languages

Track 1: Social Science 72 units

Complete the course requirements listed below in sections A, B, and C.

Section A (9 units)
88-205 Comparative Politics
Or
88-357 Comparative Foreign Policy: China, Russia, and the US

Section B (18 units)

Complete two (2) of the courses listed below in Business Administration, Economics, History, or Social and Decision Sciences.
70-342 Managing Across Cultures
70-365 International Trade and International Law
70-430 International Management
73-371 International Trade and Economic Development
73-372 International Money and Finance
79-266 Times of Feast/Famine: Populations and Family in History
79-301 Ritual Culture and Identity
79-303 Visual Anthropology
79-309 The Politics and Culture of Memory
79-310 Culture and Power in Europe, 1945-2000
79-330 The American Presidency
79-340 History of Modern Warfare
79-344 The Cold War and Beyond
79-348 Objects of Value
79-364 Art, Anthropology and Empire
79-386 The Global Environment: Historical Perspectives and Policy Dilemmas
79-388 Sociology of Religion
79-440 Rise of Industrial Research and Development
82-406 European Union
88-314 Politics through Film
88-327 Politics of Economic Development
88-352/ 79-346 International Environmental Law and Policy
88-359 Globalization
88-378 International Economics
88-382/ 79-365 Climate Change, Energy Policy and Environmental Protection

Section C (45 units)

Complete five (5) courses in non-U.S. history or international politics in two different regions of the world; minimum of two courses in each region. The aim is to achieve sufficient command of at least two different international settings to make possible well-grounded comparisons.
Africa

79-258 Introduction to African History: 18th Century to Neo-Colonialism
79-267 West African History 1100-1800 (6 units)
79-268 From Local to the Global: Africa in the World (6 units)
79-317 Historical Memory and Historical Sources: Reconstructing Africa's Unwritten Past
79-356 Introduction to African History: Earliest Times to the Origins of the Slave
82-304 The Francophone World
82-404 Francophone Realities: Ousmane Sembene

Asia

79-225 Religions of China
79-237 Cities in History: London and Delhi
79-247 East Asians in Film
79-253 Development of Caribbean Culture
79-254 Pacific Islands: History and Culture
79-270 Chinese Culture and Society
79-271 Modern China
79-272 Modern Japan 1686 to Present
79-276 Japan During WWII (6 units)
79-283 East Asia and WWII
79-289 Society and Culture in South Asia
79-318 World War II in Japanese Memory (6 units)
79-374 Women in Modern India
79-305 Representing Pacific Cultures
82-273 Introduction to the Japanese Language and Culture
82-278 Japanese Literature in Translation
82-333 Introduction to Chinese Language and Culture
82-335 Readings in Chinese
82-433 Topics in Contemporary Culture in China
82-343 Studies in Chinese Tradition
82-474 Topics in Japanese Studies
82-795 Topics in Japanese Studies

Europe

79-205 20th Century Europe
79-207 Development of European Culture
79-221 Religion in European Society
79-237 Cities in History: London and Delhi
79-250 European Revolution: Dynamics of Change in the 19th Century
79-261 Europe after the Black Death
79-263 Riots, Revolutions, and Nations
79-295 Germany and World War II
79-307 The Anthropology of Europe
79-310 Culture and Power in Europe, 1945-2000
79-396 Music and Society in 19th/20th Century Europe and the U.S.
82-303 French Culture
82-323 Germany, Austria and Switzerland in the 20th Century
82-324 Contemporary German, Austria and Switzerland
82-325 Introduction to German Studies
72-342 Spanish Language and Culture
82-345 Hispanic Literary and Cultural Studies
82-396 The Faust Legend at Home and Abroad
82-401 Quebec Society
82-408 Matisse, Chagall, Picasso and Their Contemporaries: Art and Museums on the Riviera
82-410 Advanced Research in French and Francophone Language and Culture
82-415/416 Topics in French and Francophone Studies
82-420 German Classical Literature
82-421 German Literature of the Nineteenth Century
82-422 German Literature of the Early Twentieth Century
82-423 Postwar German Literature
82-424 The New Germany
82-425 Studies in German Literature
82-426 Studies in German Literature and Culture
82-427 Nazi and Resistance Culture
82-428 History of German Film
82-441 Studies in Peninsular Literature and Culture
82-444 Structure of Spanish
82-446 Political Drama of Spain
88-314 Topics in Hispanic Studies

Latin America/Caribbean

79-253 The Development of Caribbean Culture
79-260 Mayan America
79-290 Between Revolutions: the Emergence of Modern Latin America, 1789-1917
79-297 Freedom Bound: Slavery/Emancipation in Brazil and the Caribbean, 1789-1940
79-387 Shaping Modernity's Landscapes: An Environmental History of the Americas
82-342 Spain: Language and Culture
82-343 Latin America: Language and Culture
82-345 Hispanic Literary and Cultural Studies
82-347 Analysis of Spoken Spanish
82-450 Advanced Research in Hispanic Language and Culture
82-451 Studies in Latin American Literature and Culture
82-452 The Latin American Fin de Siglo: Modernity, Modernismo and Underdevelopment
82-453 Voices from Within: The Crisis of Latin American Identity
82-454 The Hispanic Caribbean: Rhyme, Reason and Song
82-455/456 Topics in Hispanic Studies
82-457 Contemporary Latin American Texts: Revision, Rewriting, and Representation

Middle East

79-233 United States and the Middle East Since 1945
79-239 Negotiating Arab-Israeli Peace (6 units)
79-352 The Arab-Israeli Condition: War and Peace
79-397 Religion and Politics in the Middle East

Russia

79-280 Russian History from the First to the Last Tsar
79-281 Modern Soviet History: From Communism to Capitalism
79-284 Gender Relations, the Family, and Women in Russian History: 1861 to Present (6 units)
79-314 Nationalities and the New States of the Former USSR
79-351 Cold War in Documents and Film
79-357 Russia Today
82-397 Russia's Demons
82-491 Literature, Politics and Film in Russia & Eastern Europe Today
82-492 The Historical Imagination in Nineteenth-Century Russian Literature
82-493 Joseph Brodsky in Context

Section C (27 units)

Same selection of courses as in section B above.

Complete three (3) courses in non-U.S. history, international politics, or literature in a country or region of the world other than the one chosen for B. The aim, in concert with B, is to achieve sufficient command of different international settings to make possible well-grounded comparisons.

Courses from other departments may be substituted with prior approval from the Director of International Relations or the Student Advisor.

Students in this track should also consider fulfilling requirements for the Foreign Language and Culture Certificate Program, offered by the Modern Languages Department in coordination with the Office of International Education.

The Major in Russian Studies

Faculty Advisor: Charlene Castellano,
Department of Modern Languages
Main Office: Baker Hall 160

The relationship between Russia and the West has been central to the history of the twentieth century. Beginning with the Russian Revolution in 1917, the West's response to communism has shaped relations between America, Europe, and the Third World. The Treaty of Versailles, the rise of fascism, World War II, the postwar settlement, the Cold War, and the war in Vietnam cannot be understood apart from the West's relationship with the former Soviet Union. Within the past decade, enormous changes have occurred in Russia, once again shaking the global order to its foundations. The disintegration of the USSR, the emergence of more democratic forms of government, and the development of new "free market" economies have led not only to greater openness and stronger ties with the West, but also to a host of new questions in the areas of business, science, technology, national defense and international security. The end of the Cold War allows for exploration of new issues in fascinating ways that were formerly forbidden. The proliferation of exchange programs, the increased accessibility of libraries, archives, and information, and the development of a free press all open untied and exciting possibilities and opportunities for students and scholars.
well as in economic, scientific and technical consulting. The Russian Studies Program aims to give students a solid background in the fields of Russian history, language, culture and politics, by offering a major and minor specialization to interested students.

Russian Studies, a B.A. Program, is jointly administered by the Departments of History and Modern Languages in the College of Humanities and Social Sciences. It is designed for students from all the Carnegie Mellon undergraduate colleges. It may be taken as a primary major, additional major, or minor.

**Russian Studies Major 93 - 96 units**

**The History Curriculum 27 units**

For majors, there is a three-course History requirement comprised of one required course and two courses selected from a list of electives.

1. **Core Course(s) in History** 9 units
   - Complete one course.
   - 79-280 Russian History from the First to the Last Tsar*
   - 79-281 Modern Soviet History from Communism to Capitalism*
   - * Both courses are recommended.

2. **Required Electives in History** 18 units
   - Complete two courses.
   - 79-282 Soviet Union in World War II: Military and Political History
   - 79-357 Russia Today

**The Language and Culture Curriculum 45 units**

Complete the two prerequisite courses, two intermediate courses and one advanced course.

3. **Prerequisite Courses in Modern Languages** 24 units
   - 82-191 Elementary Russian I (or demonstrated equivalent)
   - 82-192 Elementary Russian II (or demonstrated equivalent)

4. **Core Courses in Modern Languages** 27 units
   - 82-291 Intermediate Russian I
   - 82-292 Intermediate Russian II
   - 82-391 Advanced Russian I

Should a student enter the Russian Studies Program with a demonstrated language proficiency at any of these “Intermediate” or “Advanced” levels, the required total of 27 units is reached by selecting from among the advanced language options appearing below in the list of “Required Electives”. Advanced language options include “Advanced Russian II” and “Special Topics: Russian”, as well as subject-oriented language supplements to existing courses (taught in English) in a variety of fields. Thus students can add a language supplement (3 units) to selected 9-unit electives, earning a total of 12 units for the language-supplemented course.

5. **Required Electives** 18 units
   - Complete two courses.
   - History
     - 79-205 20th Century Europe
     - 79-231 American Foreign Policy: 1945-Present
     - 79-280 Russian History from the First to the Last Tsar
     - 79-281 Modern Soviet History from Communism to Capitalism
     - 79-344 The Cold War and Beyond
     - 79-357 Russia Today
   - Modern Languages
     - 82-392 Advanced Russian II
     - 82-396 The Faust Legend at Home and Abroad
     - 82-397 Russia’s Demons
     - 82-399 Special Topics: Russian
     - 82-491 Literature, Politics and Film in Russia & Eastern Europe Today
     - 82-492 The Historical Imagination in Nineteenth-Century Russian Literature
     - 82-493 Joseph Brodsky in Context

New courses will be added as appropriate.

6. **Required Independent Research** 3-6 units
   - Complete one course.

82-599 Russian Studies Thesis

In the senior year, majors are required to undertake an independent research or translation project in which their language skills are applied to Russian-language materials. This project, which earns 3 to 6 units, is conducted in connection with an existing course in Russian history, language, literature or politics. The student works closely with the professor to select a topic requiring the use of Russian sources suitable to the student’s proficiency level. For example, students may choose to prepare a translation of a little-known piece of Russian literature or a debate from a nineteenth-century journal, to compare Soviet and Western newspaper coverage of the Cuban missile crisis, to research Russian opinion of American race relations, or to read and evaluate the reviews of a popular Russian novel.

7. **Study Abroad**

Students in both the major and minor programs are encouraged to spend a semester or summer in Russia via an approved exchange program. Many exchange programs offer instruction in Russian language, history, literature, and culture, in internationally recognized universities. They also offer travel to ancient sites and cities, visits to museums, palaces, exhibitions, and monuments, and the opportunity to live with a Russian host family. Scholarship monies are frequently available.

**Faculty Exchange Program**

In 1993, the College of Humanities and Social Sciences initiated a faculty exchange program with the Russian State University of the Humanities (RGGU), one of the foremost universities in Russia, located in Moscow. Carnegie Mellon has hosted faculty members from RGGU specializing in history, language and philosophy. These professors have joined our College departments for a semester, offering unique courses and perspectives not generally available to our students. In the past, these Russian visitors have offered courses on the Russian Civil War as well as advanced language and literature courses. Several faculty members from Carnegie Mellon have visited Moscow, using the RGGU exchange to pursue archival research and collaborative projects. The exchange offers students an opportunity to study language from native speakers, gain exposure to different perspectives on history and politics, and gather firsthand knowledge about recent developments in Russia. In addition, the exchange can provide important contacts for students interested in pursuing careers abroad.

**Russian Studies, B.A. Sample Curriculum**

This sample curriculum assumes that all prerequisites for 82-291 are fulfilled prior to the Junior year.

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Fall</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td></td>
<td></td>
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<tr>
<td>79-205</td>
<td>20th Century Europe</td>
<td>Intermediate</td>
<td>Russian I</td>
<td>82-291</td>
<td>Advanced</td>
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<tr>
<td>79-231</td>
<td>American Foreign Policy: 1945-Present</td>
<td>Intermediate</td>
<td>Russian II</td>
<td>82-292</td>
<td>Russian Studies Thesis</td>
</tr>
<tr>
<td>79-280</td>
<td>Russian History from the First to the Last Tsar</td>
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<tr>
<td>79-281</td>
<td>Modern Soviet History from Communism to Capitalism</td>
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<tr>
<td>79-344</td>
<td>The Cold War and Beyond</td>
<td>Required</td>
<td>Elective in</td>
<td>History</td>
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</tr>
<tr>
<td>79-357</td>
<td>Russia Today</td>
<td></td>
<td>Elective</td>
<td></td>
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<tr>
<td>Modern Languages</td>
<td></td>
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</tr>
<tr>
<td>82-392</td>
<td>Advanced Russian II</td>
<td>Elective</td>
<td>Elective</td>
<td></td>
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<tr>
<td>82-396</td>
<td>The Faust Legend at Home and Abroad</td>
<td>Elective</td>
<td>Elective</td>
<td></td>
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<tr>
<td>82-397</td>
<td>Russia’s Demons</td>
<td>Elective</td>
<td>Elective</td>
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<tr>
<td>82-399</td>
<td>Special Topics: Russian</td>
<td>Elective</td>
<td>Elective</td>
<td></td>
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<tr>
<td>82-491</td>
<td>Literature, Politics and Film in Russia &amp; Eastern Europe Today</td>
<td>Elective</td>
<td>Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>82-492</td>
<td>The Historical Imagination in Nineteenth-Century Russian Literature</td>
<td>Elective</td>
<td>Elective</td>
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<tr>
<td>82-493</td>
<td>Joseph Brodsky in Context</td>
<td>Elective</td>
<td>Elective</td>
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</tr>
</tbody>
</table>
This is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years, not that it must be. Students may enter their major, and begin major course requirements, as early as the start of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

This plan is an example of the suggested sequence of study for students who have had little or no prior exposure to the language. Such students would need to satisfy the prerequisites (elementary and intermediate language study) during their freshman and sophomore years. Students who arrive at Carnegie Mellon with previous language study and/or who have high AP or CEEB scores will be able to begin taking courses toward the major earlier in their undergraduate program and will also be able, should they so desire, to complete an additional major. In all cases, progress toward the major will be accelerated by study abroad which is strongly recommended for all majors.

Additional Major

All Russian Studies Program requirements for an additional major are the same as those for students obtaining the major in Russian Studies (B. A.).

Student-Defined Major Program

Joseph E. Devine, Associate Dean, H&SS Academic Advisory Center
Office: Baker Hall A57

For H&SS students whose educational goals cannot be as adequately served by the curricula of existing majors. The College provides the opportunity to self-define a major. The procedure for establishing such a major centers on a written proposal, submitted to the College's Dean's Office (c/o the H&SS Advisory Center). This proposal, which is to be built on the College's General Education Program, consists of two parts:

Major Description and Rationale. A description of the components of the proposed program of study; a presentation of the objectives of the program of study, why it represents a coherent and (given available faculty, courses, and other resources) viable course of study, and the reason(s) why these objectives cannot be accomplished within one or more of the College's existing majors.

The Curriculum. Presentation of a complete outline of all courses that will comprise the requirements for the major. These courses should be categorized in two ways: first, according to that component of the major program to which each belongs (e.g., mathematical prerequisites; research methods; theoretical perspectives; etc.) and second, a semester-by-semester outline that indicates when each course is to be taken (or, for any already taken, when taken and grade received). In addition to courses taken at Carnegie Mellon, the major's curriculum may include courses taken (or to be taken) at other schools, related projects or internships, or programs of study abroad. The minimum requirements for graduation is, as with all majors in the College, 350 units of credit.

Proposals and curricula are evaluated for clarity of focus, coherence and depth in related areas, and viability within the content of the College and the university. Proposals should generally be developed no later than the sophomore year, and approved majors begin their program generally no later than the junior year. All Student-Defined Majors must complete the H&SS General Education Program.

Additional details and guidelines for the Student-Defined Major program are available in the College's Academic Advisory Center, Baker Hall A57.
H&S Interdepartmental Minors

H&S interdepartmental minors are programs whose content and components span two or more academic departments in the humanities, behavioral sciences, and social sciences to form coherent patterns of study. A number of interdepartmental minors are offered by H&S, and are, in general, available to all Carnegie Mellon undergraduate students. As well, there are numerous other minors offered by other colleges in the university that are generally available to H&S students. The full list of minors available to Carnegie Mellon students is located in the catalog index under "Minors."

Completion of the requirements for any of these minors is noted on the final transcript and diploma.

To declare an H&S interdepartmental minor, students should contact the H&SS Academic Advisory Center (AAC) and the faculty advisor for that minor. Progress is monitored through the faculty advisor and completion of the minor through the H&SS AAC.

To discuss the possibilities of declaring other non-H&SS minors contact the advisor listed for that particular minor.

In general, unless noted, no course taken to fulfill requirements for these interdepartmental minors may applied toward any other requirements for a major(s) or minor(s).

The Minor in Environmental Studies

Faculty Advisor: Peter Madsen
Office: Baker Hall 150A

Human activities can have large-scale and long-term consequences for environmental quality. The thoughtful analysis of these consequences is required if we desire a sustainable society. The minor in Environmental Studies is designed to provide students with the interdisciplinary background and skills necessary to understand environmental issues. It emphasizes three general areas: humanities, social sciences, and technology and natural science. The humanities emphasis concerns the ethical, legal, and historical basis of environmental concerns. The social science area concentrates on the economic and political nature of environmental problems. The technology and natural science focus includes the exploration of the biological, chemical, and physical nature of the environment and the role of technology in both problem creation and problem solution.

Curriculum

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Prerequisites*</td>
<td>19</td>
</tr>
<tr>
<td>Required Courses</td>
<td>18</td>
</tr>
<tr>
<td>Intermediate (Distributional)</td>
<td>27</td>
</tr>
<tr>
<td>Advanced Course (minimum)</td>
<td>9</td>
</tr>
</tbody>
</table>

The minor in Environmental Studies is offered jointly by the Departments of History and Social and Decision Sciences, with participation by selected departments from the Mellon College of Science and the Carnegie Institute of Technology. The minor requires that students take Biology and Chemistry in the Mellon College of Science or approved environmentally-related science courses at the University of Pittsburgh. In addition, minors are required to complete two required core courses, three intermediate (distributional) courses spread across at least two of the areas of emphasis, and one advanced course. The advanced course requirement includes either pre-approved sections of Policy Analysis III or pre-approved sections of the History and Policy Project Course. It is important for students to work closely with the faculty advisor for the minor in order to select the proper mix of courses to fulfill requirements.

With the exception of the minor's science prerequisites, courses taken to fulfill requirements in other major or minor programs may not be applied to the Environmental Studies minor requirements (and vice versa). In the case of the minor's "Advanced Course" requirement, if one of the two advanced courses is being taken to fulfill a requirement for another program, it cannot also be applied to this minor requirement. If it is not possible to take the other advanced course option, the faculty minor advisor will work with the student to identify an alternative course for this requirement.

NOTE: The courses listed below are offered with at least general regularity. Participating departments may subsequently develop and offer other courses that, while not listed here, are deemed appropriate for this minor. The minor faculty advisor should be consulted (especially when the schedule of courses to be offered for a given semester becomes available) to identify such additional courses.

Science Prerequisites* 19 units

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-121</td>
<td>Modern Biology</td>
</tr>
<tr>
<td>09-105</td>
<td>Modern Chemistry I or approved environmentally-related science courses (equivalent to at least 18 Carnegie Mellon units) at the University of Pittsburgh (see faculty minor advisor)</td>
</tr>
</tbody>
</table>

*These science courses may double count with other major and minor requirements.

Required Courses 18 units

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>66-210</td>
<td>Science and Technology for the Environment</td>
</tr>
<tr>
<td>80-244</td>
<td>Management, Environment, and Ethics</td>
</tr>
</tbody>
</table>

Intermediate (Distributional) Requirements 27 units

To complete three courses in at least two of these areas: Science and Technology, Social Science, and Humanities. Only one of the three courses can be an introductory course (as indicated below by an asterisk).

Science and Technology Area

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-101</td>
<td>Innovation and Design in Civil Engineering*</td>
</tr>
<tr>
<td>12-635</td>
<td>Water Quality Engineering</td>
</tr>
<tr>
<td>12-636</td>
<td>Environmental Engineering: Air Pollution</td>
</tr>
<tr>
<td>19-101</td>
<td>Introduction to Engineering and Public Policy*</td>
</tr>
<tr>
<td>19-321</td>
<td>Law and Technology</td>
</tr>
<tr>
<td>19-420</td>
<td>Chemical Technologies, the Environment, and Society</td>
</tr>
<tr>
<td>19-422</td>
<td>Radiation, Health, and Policy</td>
</tr>
<tr>
<td>19-448</td>
<td>Science, Technology and Ethics</td>
</tr>
<tr>
<td>24-297</td>
<td>Energy-Environmental Systems</td>
</tr>
<tr>
<td>42-604</td>
<td>Biological Transport</td>
</tr>
</tbody>
</table>

Social Sciences Area

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-357</td>
<td>Regulation: Theory &amp; Policy</td>
</tr>
<tr>
<td>73-358</td>
<td>Economics of the Environment and Natural Resources</td>
</tr>
<tr>
<td>73-359</td>
<td>Benefit-Cost Analysis</td>
</tr>
<tr>
<td>88-220</td>
<td>Policy Analysis I</td>
</tr>
<tr>
<td>88-221</td>
<td>Policy Analysis II</td>
</tr>
<tr>
<td>88-425</td>
<td>Politics of Economic Deregulation</td>
</tr>
</tbody>
</table>

Humanities Area

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>76-322</td>
<td>Reading the Built Landscape</td>
</tr>
<tr>
<td>79-345</td>
<td>American Environmental History: Critical History</td>
</tr>
<tr>
<td>79-384</td>
<td>Medicine and Society</td>
</tr>
<tr>
<td>80-340</td>
<td>Environmental Ethics and Decision Processes</td>
</tr>
</tbody>
</table>

Advanced Course (minimum) 9 units

Both courses listed in this category have prerequisites or, as an alternative, require instructor approval for entry.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>88-222</td>
<td>Policy Analysis III (pre-approved sections)</td>
</tr>
<tr>
<td>79-410</td>
<td>History and Policy Project Course (pre-approved sections)</td>
</tr>
</tbody>
</table>

The Minor in European Studies

Faculty Advisor: Beryl Schlossman, Department of Modern Languages
Office: Porter Hall 125A

Europe constitutes a vital part of our cultural heritage and has been a source of both great creativity and massive devastation in the modern era. The European Studies program seeks to enhance students' understanding of the historical evolution and contemporary
dimensions of European society, politics, and culture. It aims as well to train students in an area of growing national need and professional opportunity. It offers an interdepartmental minor that furnishes students with substantive knowledge of western European society through two approaches. First, it provides a solid foundation in one of the continental Western European languages. Second, it encourages comparative inquiry across boundaries of time, nation, and scholarly discipline.

Curriculum

**54 units**

Offered jointly by the Departments of Modern Languages and History.

European Studies minors must take two prerequisite courses (18 units) in the same foreign language (French, Spanish, or German) or demonstrate the equivalent in language ability through the Carnegie Mellon Language Placement Test. The requirements include a minimum of 54 units of core courses. Students are encouraged to take advantage of the Study Abroad Program.

Students are urged to check with the Minor Advisor in selecting courses for this major.

I. Core Courses in Modern Languages **27 units**

Language courses are to be completed in the same language: French, German, or Spanish.

**Complete two courses in a 200-level language sequence** *18 units*

- 82-2xx 200-level language course
- 82-2xx 200-level language course

*Students who place out of 200-level language courses must take at least two 300-level courses or a combination of 300 and 400 level language courses.

**Complete one course in a 300-level language course** *9 units*

- 82-3xx 300-level language course

II. Core Courses in History **27 units**

**Required Course** *9 units*

- 79-207 Development of European Culture

**Pre-20th Century European History** *9 units*

- Complete one 200-level (or above) course in Pre-20th century European history.
- 79-2xx/3xx Pre-20th century European History course

**European History 9 units**

- Complete one 300-level course in European history.
- 79-3xx European History course

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**The Minor in Film and Media Studies**

Faculty Advisor: David Shumway
Office: Baker Hall 259

Film and the electronic media have become a crucial part of contemporary culture and society; they constitute an important tool for understanding social arrangements, historical changes, and play an increasingly important role in the development of aesthetic and cultural theory. The H&SS minor in Film and Media Studies takes an interdisciplinary approach to the study of film and other electronic media. Courses provide techniques for analyzing and criticizing film and other media, for assessing their value as historical, anthropological and social scientific data, and for understanding the aesthetic and philosophical premises of various media texts. In addition, students may take courses in the processes of film-making, offered through special arrangement with the Pittsburgh Filmmakers (a non-profit media arts center, operating since 1971, that provides workshops, seminars, screenings, exhibitions, and training programs in the media and photographic arts).

Courses taken to fulfill requirements for other major or minor programs may not be applied to the Film and Media Studies Minor requirements.

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**Curriculum 54-57 units**

The courses listed below are offered with at least general regularity. Participating departments may subsequently develop and offer other courses that, while not listed here, are deemed appropriate for this minor. The minor faculty advisor should be consulted (especially when the schedule of courses to be offered for a given semester becomes available) to identify such additional courses.

**Introductory Course** *9 Units*

- 76-239 Introduction to Film Studies (prerequisite for 76-439)

**Required Intermediate Course** *9 Units*

- 76-339 Advanced Studies in Film and Media

(May be taken up to three times and counted for additional credit toward Intermediate Courses if topics differ)

**Intermediate Courses 18 Units**

Complete a minimum of 18 units of course work, chosen in any combination from the following three course groups. (All courses are 9 units unless otherwise indicated).

1. **Film and the Study of Society**

- 76-238 Introduction to Media Studies
- 79-247 East Asians in Film
- 82-187 French Cinema

2. **Film and Anthropology**

- 79-210 Picturing Others: Ethnographic Film
- 79-303 Visual Anthropology

3. **Filmmaking**

- 76-269 Study of Forms: Screenwriting
- FM 200 Intermediate Filmmaking (please go to CFA 100 to register for this course)

Other 200 or 300 level courses in English, History, and Modern Languages can be counted in this category when their primary topic is film and media. Please consult the minor faculty advisor.

**Advanced Courses 9 Units**

Complete one advanced course which concentrates on film directly or which uses it as a tool of social or cultural analysis.

- FM 301 Advanced Filmmaking (please go to CFA 100 to register for this course)
- 76-439 Advanced Seminar in Film and Media
- 76-469 Screenwriting Workshop
- 82-491 Literature, Politics and Film in East Europe and Russia Today

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**The Minor in Gender Studies**

Faculty Advisor: Kristina Straub
Office to declare minor: English, Baker Hall 259

The study of gender, with particular focus on women but increasingly with attention to concepts of masculinity as well as femininity, has become a significant area of interdisciplinary research and teaching. The H&SS Minor in Gender Studies combines course work primarily in English, history, and anthropology, but also in economics, psychology and philosophy.

Courses taken to fulfill requirements in other major or minor programs may not be applied to the Gender Studies minor requirements (and vice versa).

**Curriculum** *54-57 units**

The courses listed below are offered with at least general regularity. Participating departments may subsequently develop and offer other courses that, while not listed here, are deemed appropriate for this minor. The minor faculty advisor should be consulted (especially when the schedule of courses to be offered for a given semester becomes available) to identify such additional courses.
The Minor in Health Care Policy and Management

Sponsored by:
H. John Heinz III School of Public Policy and Management
Mellon College of Science
Faculty Advisors: Caroline Acker, Naum Kats, and Stephanie Wallach

The face of health care is changing. The practice of medicine is being fundamentally altered by the forces of change in public policy, health care organizations and in the industry as a whole. The role of individual professionals in this industry is changing as rapidly as the industry itself. Traditional career paths have disappeared over night to be replaced by new opportunities that require new skills. New organizations are placing new demands on their professional and medical staffs. The criteria of efficiency and financial stability are entering the domains of diagnosis and treatment.

This minor is designed to provide students considering a career in the health professions with an understanding of how these changes are likely to affect their careers. Students will become familiar with the critical policy and management issues and will begin to learn to operate effectively in the emerging health care environment. The curriculum combines economic, organizational, managerial, historical and psychological perspectives on these issues to provide a foundation for a deepened understanding of the changing structure of health care organizations and policy.

Curriculum (minimum) 60 units

Six courses (a minimum of 60 units) are required to complete this minor. Entry into the minor requires completion of 73-230, Intermediate Microeconomics or 88-220, Policy Analysis I or the equivalent by approval.

Required Courses

Students are required to take the following courses.

79-384 Medicine and Society
90-650 Introduction to Health Care Policy and Management
90-739 Health Economics

Elective Courses

Complete three courses totaling a minimum of 27 units.

Heinz School Courses (12 units each)

90-721 Non-Profit and Health Marketing
91-830 Financial Management of Health Systems
91-836 Legal Issues in Health Systems Management
91-844 Managing Quality Improvement
91-853 Health Care Information Systems
91-861 Health Policy
91-862 Managed Care

Humanities and Social Sciences Courses (9 units each)

76-494 Medical Communications
79-335 Drug Use and Drug Policy
79-336 Epidemic Disease and Public Health
80-245 Medical Ethics
85-241 Social Psychology
85-442 The Psychology of Health
85-446 The Psychology of Gender
85-451 The Psychology of Purpose
88-373 Mental Health Ideologies

The Minor in International Relations

Faculty Advisor: Kiron K. Skinner; Undergraduate Advisor: Stephanie Wallach Office: Baker Hall 240

The International Relations Minor allows students to explore some of the most important intellectual effects of the demise of the cold war. They include the dissolution of disciplinary boundaries, which facilitates a more productive study of the interaction of politics, culture, and markets, as well as a focus on the role of state and non-state actors in international outcomes. The minor is designed for students with international interests including business and management, culture, history, and political science. The departments of Social and Decision Sciences, History, and Modern Languages jointly offer the International Relations Minor.

Curriculum

The courses listed below are offered with general regularity. Participating departments may subsequently develop and offer other courses that are deemed appropriate for this minor. The Undergraduate Advisor should be consulted, especially when the schedule of courses for a given semester becomes available, to identify such additional courses.

Core Courses 27-36 units

Complete 79-231/88-329; 88-326/79-350; 88-205 OR 88-357; plus one 200-level course in Modern Languages (unless you fulfill the language requirement via another option listed below).

History (9 units)

79-231/88-329 American Foreign Policy, 1945 to Present

Social and Decision Sciences (18 units)

88-326/79-350 Theories of International Relations (required)
AND
88-205 Comparative Politics
OR
88-357 Comparative Foreign Policy: China, Russia, and the US

Modern Languages

Demonstration of basic competency in a foreign language via one of the three options listed below:

1) Complete one (1) Modern Languages course at the 200 level, with a minimum grade of C, or
2) Achieve a score of 4 or higher in one foreign language Advanced Placement examination, or
3) Demonstrate equivalent proficiency to the satisfaction of the Department of Modern Languages
Regional Specialization  

Complete three (3) courses in non-U.S. History, international politics, or literature in a single region of the world from the regions listed below. The aim is to achieve in-depth command of a non-U.S. culture via study of its language, cultural and political history, and cultural products.

Africa
79-258 Introduction to African History: 18th Century to Neo-Colonialism
79-267 Pre-Colonial West African History 1100-1800 (6 units)
79-268 From the Local to the Global: Africa in the World (6 units)
79-317 Historical Memory and Historical Sources: Reconstructing Africa's Unwritten Past
79-356 Introduction to African History: Earliest Times to the Origins of the Slave
82-304 The Francophone World
82-404 Francophone Realities: Ousmane Sembene

Asia
79-225 Religions of China
79-237 Cities in History: London and Delhi
79-247 East Asians in Film
79-254 Pacific Islands: History and Culture
79-253 The Development of Caribbean Culture
79-270 Chinese Culture and Society
79-271 Modern China
79-272 Modern Japan 1868 to Present
79-276 Japan During WWII (6 units)
79-283 East Asia and WWII
79-289 Society and Culture in South Asia
79-305 Representing Pacific Cultures
79-318 World War II in Japanese Memory (6 units)
79-374 Women in Modern India
79-380 U.S.-Japanese Relations: 1853-Present (6 units)
82-273 Introduction to the Japanese Language and Culture
82-278 Japanese Literature in Translation
82-333 Introduction to Chinese Language and Culture
82-335 Readings in Chinese
82-433 Topics in Contemporary Culture of China
82-434 Studying Chinese Traditions
82-474 Topics in Japanese Studies: Images of Japanese Families
82-475 Topics in Japanese Studies

Europe
79-205 20th Century Europe
79-207 Development of European Culture
79-219 The Holocaust in Historical Perspective
79-221 Religion in European Society
79-250 Europe's Two Revolutions: Dynamics of Change in the 19th Century
79-261 Europe after the Black Death
79-263 Riots, Revolts, and Revolutions
79-295 Germany and World War II
79-307 The Anthropology of Europe
79-310 Culture and Power in Europe, 1945-2000
79-396 Music and Society in 19th/20th Century Europe and US
82-303 French Culture
82-323 Germany, Austria and Switzerland in the 20th Century
82-324 Contemporary Germany, Austria and Switzerland
82-325 Introduction to German Studies
82-345 Hispanic Literary and Cultural Studies
82-396 The Faust Legend at Home and Abroad
82-401 Quebec Society
82-406 The European Union
82-407 French Modernism: The Arts in Society
82-408 Matisse, Chagall, Picasso and Their Contemporaries: Art and Museums on the Riviera
82-410 Advanced Research in French and Francophone Language and Culture
82-415/416 Topics in French and Francophone Studies
82-420 German Classical Literature
82-421 German Literature of the Nineteenth Century
82-422 German Literature of the Early Twentieth Century
82-423 Postwar German Literature
82-424 The New Germany
82-425/426 Studies in German Literature and Culture
82-427 Nazi and Resistance Culture
82-428 History of German Film
82-441 Studies in Peninsular Literature and Culture
82-444 The Structure of Spanish
82-446 Political Drama of Spain
88-205 Comparative Politics
88-314 Politics through Film

Latin America/Caribbean
79-253 The Development of Caribbean Culture
79-260 Mayan America
79-288 Bananas, Baseball, and Borders: Latin America and the US from Alamo to Drug Wars
79-290 Between Revolutions: The Emergence of Modern Latin America, 1789-1917
79-297 Freedom Bound: Slavery/Emancipation in Brazil and the Caribbean, 1789-1940
79-387 Shaping Modernity's Landscapes: An Environmental History of the Americas
82-342 Spain: Language and Culture
82-343 Latin America: Language and Culture
82-345 Hispanic Literary and Cultural Studies
82-445 U.S. Latino Literature: Necessity is the Mother of All "Coyotes"
82-450 Advanced Research in Hispanic Language and Culture
82-451 Studies in Latin American Literature and Culture
82-452 The Latin American Fin de Sieglo: Modernity, Modernismo and Underdevelopment
82-453 Voices from Within: The Crisis of Latin American Identity
82-454 The Hispanic Caribbean: Rhyme, Reason and Song
82-455/456 Topics in Hispanic Studies
82-493 Contemporary Latin American Texts: Revision, Rewriting, and Representation

Middle East
79-233 The United States and the Middle East Since 1945
79-349 Negotiating Arab-Israeli Peace (6 units)
79-352 Arab-Israeli Condition: War and Peace
79-391 Religion and Politics in the Middle East

Russia
79-280 Russian History from the First to the Last Tsar
79-281 Modern Soviet History: From Communism to Capitalism
79-284 Gender Relations, the Family, and Women in Russian History: 1861-Present (6 units)
79-314 Nationalities and the New States of the Former USSR
79-351 The Cold War in Documents and Film
79-357 Russia Today
82-397 Russian's Demons
82-491 Literature, Politics and Film in Russia & Eastern Europe Today
82-492 The Historical Imagination in Nineteenth-Century Russian Literature
82-494 Joseph Brodsky in Context

The Minor in Linguistics

Faculty advisor: Mandy Simons
Office: Baker Hall 155E

Linguistics is the study of human language. It aims not merely to describe particular languages, but to characterize and account for the nature of language and for the human ability to learn and use it. Linguists address the phenomenon of language from a variety of perspectives. Some are concerned with the cognitive aspects of language learning, production and comprehension; some are concerned with language as a social and cultural phenomenon; others engage in the analysis of linguistic structure, some from a functional and others from a formal perspective. Some linguists are concerned with computational implementations of linguistic theory for both practical and theoretical purposes. In all cases, a central question for linguists is to understand not only the wonderful variety of the world's languages but also what these languages have in common: what it is that makes a human language human. The study of language thus contributes vitally to our understanding of human society, human culture, and human minds.

The interdepartmental Minor in Linguistics is sponsored by the departments of English, Modern Languages, Philosophy and Psychology and the Language Technologies Institute. It synthesizes the linguistics related offerings in these departments and provides students with an academic experience that reflects both the interdisciplinary character of the subject and its cross-departmental representation at CMU.
Curriculum 54 units

The requirements for the Minor consist of 6 courses. Of the six, three must be selected from the four core courses, which give all students a basic introduction to linguistics, and some more in-depth exposure to both structural and functional approaches to language. The remaining three courses may be selected from among any of the linguistics-related courses taught in the four H&SS departments or the LTI.

Students in the minor may choose to take advantage of the full range of approaches to the study of language represented here, or may choose to focus on a particular aspect of language study. Some sample curricula are offered below, but these are intended merely as indications of the many options. Note, however, that some of the elective courses have particular core courses as prerequisites. Students should take this into account when they select their core courses.

Core Courses
80-280 Linguistic Analysis
82-383 Second Language Acquisition
85-421 Language and Thought
11-582 Language Technologies

Electives
76-385 Introduction to Discourse Analysis
76-387 Introduction to Sociolinguistics
76-451 Topics in Language Study
80-181 Language and Thought (Philosophy)
80-380 Philosophy of Language
80-481 Introduction to Formal Semantics
82-280 Learning about Language Learning
82-442 Analysis of Spoken Spanish
82-480 Social and Cognitive Aspects of Bilingualism
11-511 Algorithms for Natural Language Processing
11-521 Grammars and Lexicons
11-541 Machine Translation
11-552 Speech: Phonetics, Prosody, Perception and Synthesis

Sample Curricula

Example 1: Courses selected to maximize breadth

Core Courses
80-280 Linguistic Analysis
85-421 Language and Thought
11-582 Language Technologies

Electives
76-385 Introduction to Discourse Analysis
82-480 Social and Cognitive Aspects of Bilingualism
80-380 Philosophy of Language

Example 2: Focus on second language acquisition

Core Courses
80-280 Linguistic Analysis
82-280 Learning about Language Learning
85-421 Language and Thought

Electives
82-383 Second Language Acquisition
82-480 Social and Cognitive Aspects of Bilingualism
76-451 Topics in Language Study

Example 3: Focus on language technologies

Core courses
80-280 Linguistic Analysis
85-421 Language and Thought
11-582 Language Technologies

Electives
80-481 Introduction to Formal and Computational Semantics
11-511 Algorithms for Natural Language Processing
11-521 Grammars and Lexicons

The Minor in Minority Studies

Faculty Advisor: Joe Trotter, Undergraduate Advisors: Naum Kats, Stephanie Wallach Office: Baker Hall 240

The word “minority” suggests issues of cultural, racial, ethnic, and linguistic diversity within a broad geographical and historical context. The term points to the problems of inequality and discrimination which are part of the experience of many minority groups in the United States, in other industrialized nations, and in the Third World. The situations that minority groups face vary with time and place; nevertheless, there are problems of power and powerlessness, and access to political and economic resources that are common to all such groups. Courses organized around the concept of “minority” emphasize issues of historical, political, theoretical, and pragmatic kinds which should be central to the definition of knowledge at a modern university campus. These issues constitute the central intellectual matter of this minor.

Courses included in the minor have as their primary focus the examination of minority-group culture, history, political strategies, and linguistic distinctiveness. Methodological and theoretical courses indicate ways in which a concern with minority groups and minority status impinge upon method and theory in a discipline or a research endeavor. Courses in the minor include primary readings that examine the experiences of one or more minority groups in an historical or contemporary context. Student assignments include written analysis of some facet of minority experience, based on appropriate use of source material and of conceptual frameworks.

NOTE: Courses taken to fulfill requirements in other major or minor programs may not be applied to the Minority Studies minor requirements (and vice versa).

Curriculum 54 units

Every student will be required to take the core course 79-113, Culture and Identity in American Society. This course is offered one semester each year, and introduces the themes, approaches and methods that are crucial for this minor. This course is followed by a selection of intermediate courses, and by an advanced seminar in which advanced techniques can be applied to a minority issue. At the intermediate level, the minor requires that at least 9 of the 36 units focus on issues of race in America. The advanced course will allow students to develop their own interest in minority studies, using the content, arguments, and methods that have been part of preceding courses.

The courses listed below are offered with at least general regularity. Participating departments, including departments in the College of Fine Arts, may subsequently develop and offer other courses that, while not listed here, are deemed appropriate for this minor. The minor faculty advisor should be consulted (especially when the schedule of courses to be offered for a given semester becomes available) to identify such additional courses.

Core Course
9 units
79-113 Culture and Identity in American Society
or
79-201 Introduction to Anthropology

Intermediate Courses 36 units

Intermediate courses are divided into four groups (a., b., c., and d.). Students must select at least one course from group a., and the remaining three courses in any combination from groups a. through d.
a. Minority groups in the United States.

These courses look at minority groups in the United States, in terms of their own histories, encounters with the more powerful surrounding society, and strategies for maintaining a distinct cultural identity within a pluralistic society.

79-112 Race, Nationality, and Culture in American Society
79-113 Culture and Identity in American Society*
79-204 Introduction to Anthropology*
79-241 African-American History I*
79-242 African-American History II*
79-258 Introduction to African History: 18th Century to Neo-Colonialism
79-297 Freedom Bound: Slavery/Emancipation in Brazil & the Caribbean, 1789-1940
79-356 Introduction to African History: Earliest Times to the Origins of the Slave Trade

* Unless chosen for another course category

b. Social problems, social structures, and minority groups.

These courses focus on issues of conflict and controversy that arise from differentials of power and position among minority groups and the dominant, surrounding society. Different approaches to such conflicts are presented and critically assessed.

73-340 Labor Economics
79-253 The Development of Caribbean Culture
79-254 The Pacific Islands: History and Culture
79-290 Between Revolutions: The Emergence of Modern Latin America, 1789-1917*
80-136 Social Structure, Public Policy and Ethical Dilemmas
85-241 Social Psychology

*unless chosen for another course category

c. Presentations, portrayals, and self-representations.

These courses consider minority groups from the point of view of how they present themselves, how they are portrayed by others, and the implications of such portrayals for social action and change.

76-339 Advanced Studies in Film
79-201 Introduction to Anthropology*
79-210 Picturing Others: Ethnographic Film
79-303 Visual Anthropology

*unless chosen for another course category

d. Minority groups in comparative geographical perspective.

This cluster of courses considers the problems of minority groups in specific social and cultural areas, noting the historical developments and processes of change in those areas. A comparative perspective is presented as well.

79-241 African-American History I*
79-242 African-American History II*
79-290 Between Revolutions: The Emergence of Modern Latin America, 1789-1917*

*unless chosen for another course category

Advanced Course

76-4xx*

*Consult the faculty minor advisor regarding other appropriate advanced course options.

The Minor in Multimedia Production

Faculty Advisor: Robert Cavalier
Office: Baker Hall 155 C

Computers are increasingly being used to present information in non-traditional forms. Of special note is the use of computers for multimedia presentations in which text, graphics, video, and sound are combined, often in interactive formats.

Multimedia applications are expanding as information providers attempt to deliver their message via computers - educators and software developers develop video and graphics applications to supplement and enhance more traditional textual materials, businesses allow browsing and on-line ordering of their products, libraries allow the searching and perusal of their holdings, and organizations promote themselves on the Internet. In fact, multimedia applications on the Internet are so prevalent that World Wide Web addresses can be found throughout the traditional forms of communication - including print, television, and film - directing their audiences to additional, and presumably "enhanced," multimedia materials.

This Minor is specifically designed for undergraduate Liberal Arts majors (including BHA Majors). Its objective is to introduce students in these areas of study to the philosophical and technical aspects of Multimedia Authoring. The three core courses of the Minor will provide Liberal Arts students with the major issues and basic skills necessary to understand and appreciate this new aspect of communication. Students interested in pursuing this minor must consult the faculty advisor for this minor prior to registering for any of the core courses.

Curriculum 59 units

Required Courses 45 units

15-111 Introductory Intermediate Programming (10 units)
76-270 Writing in the Professions (9 units)
76-382 Multimedia Authoring I (9 units)
76-383 Multimedia Authoring II (9 units)
80-291 Issues in Multimedia Authoring (9 units)

Elective Courses 18 units

In general, relevant electives for the Minor in Multimedia Production will be similar to the core courses and electives of the following University Programs:

- The Human-Computer Interaction Major
- The Communication and Design Core of the Information Systems Major
- The GSIA track in Graphic Communications Management
- The Graduate Program in Entertainment Technology

With the advice and approval of the minor faculty advisor, students may propose courses other than those listed, provided they can show that these courses will enhance their knowledge of issues relating to multimedia production.

The Minor in Religious Studies

Faculty Advisor: David Miller, Undergraduate Advisors: Naum Kats, Stephanie Wallach Office: Baker Hall 240

The Religious Studies minor provides the student with a range of intellectual tools with which to think about religious ideas, behaviors and institutions. A further objective is to enable the student to build a base of knowledge which extends beyond any one particular religious tradition. The minor consists of six courses, totaling at least 54 units.

No more than 9 units of courses in the minor can be counted to also fulfill requirements for any other minor or major.

Curriculum 54 units

In addition to the general education requirements of the student’s college and the requirements of the student’s major, Religious Studies minors must satisfy the requirements as outlined below.

The “required” course listed below is offered regularly; the “distribution” and “elective” courses are offered with at least general regularity. Participating departments may subsequently develop and offer other courses that, while not listed here, are deemed appropriate for this minor. The minor faculty advisor should be consulted (especially when the schedule of courses to be offered for a given semester becomes available) to identify such additional courses.

Core Course 9 units

This required course introduces a variety of methods of religious inquiry such as philosophy of religion, sociological and behavioral approaches to religion, historical analysis of religious subject matter, literary and critical analysis of religious texts, theological modes of thought, and anthropological treatments of religion.

66-250 Introduction to Religion

Distribution Requirements 18 units

Complete two courses that are not from the same disciplinary "Approaches" listed below. Each of the courses that may be chosen to fulfill this requirement takes a specific disciplinary approach to religion and deals with subject matter which is not specific to one religious tradition.
The major events and issues in Russian history and policy. Sophomore and junior years. They provide a substantive overview of the intermediate-level History courses are generally taken in the Carnegie Mellon undergraduate colleges. It may be taken as either a primary major, additional major, or minor. For minors, there is a two course History requirement comprised of the History Curriculum. The History Curriculum: 18 units

1. Core Course(s) in History 9 units
   Complete one course.
   79-280 Russian History from the First to the Last Tsar*
   79-281 Modern Soviet History: From Communism to Capitalism
   * Both courses are recommended.

2. Required Electives in History 9 units
   Complete one course.
   79-282 Soviet Union in World War II: Military and Political History
   79-357 Russia Today

The Language and Culture Curriculum 42 units
   Complete the two prerequisite courses and two intermediate courses.

3. Prerequisite Courses in Modern Languages 24 units
   82-191 Elementary Russian I (or demonstrated equivalent)
   82-192 Elementary Russian II (or demonstrated equivalent)

4. Core Courses in Modern Languages 18 units
   82-291 Intermediate Russian I
   82-292 Intermediate Russian II

Should a student enter the Russian Studies Program with a demonstrated language proficiency at any of these "Intermediate" levels, the required total of 18 units is reached by selecting from among the advanced language options appearing below in the list of "Required Electives". Advanced language options include "Advanced Russian I", "Advanced Russian II" and "Special Topics: Russian", as well as subject-oriented language supplements to existing courses (taught in English) in a variety of fields. Thus students can add a language supplement (3 units) to selected 9-unit electives, earning a total of 12 units for the language-supplemented course.

5. Required Electives 18 units
   Complete two courses.
   History
   79-205 20th Century Europe: Collapse and Renewal
   79-231 American Foreign Policy: 1945-Present
   79-280 Russian History from the First to the Last Tsar*
   79-281 Modern Soviet History: From Communism to Capitalism
   79-282 Soviet Union in World War II: Military and Political History
   79-344 The Cold War and Beyond
   79-357 Russia Today

Modern Languages
   82-392 Advanced Russian II
   82-396 The Faust Legend at Home and Abroad
   82-397 Russia's Demons
   82-399 Special Topics: Russian
   82-491 Literature, Politics and Film in Russia & Eastern Europe Today
   82-492 The Historical Imagination in Nineteenth-Century Russian Literature
   82-493 Joseph Brodsky in Context

New courses will be added as appropriate.

6. Study Abroad
   Students in both the major and minor programs are encouraged to spend a semester or summer in Russia via an approved exchange program. Many exchange programs offer instruction in Russian language, history, literature, and culture, in internationally recognized universities. They also offer travel to ancient sites and cities, visits to museums, palaces, exhibitions, and monuments, and the opportunity to live with a Russian host family. Scholarship monies are frequently available.

The Minor in Science, Technology and Society
   Faculty Advisor: David Hounshell, Undergraduate Advisors: Naum Kats, Stephanie Wallach
   Office: Baker Hall 240

This minor provides varied perspectives on the development and meaning of science and technology. Principal course categories allow exploration of the philosophical underpinnings, cultural contexts and historical, organizational or economics assessment of technology's Western and post-Soviet developments.

**Historical Approaches**

- 79-221 Religion and European Society
- 79-222 Religion and American Society
- 79-225 Religions of China
- 79-397 Religion and Politics in the Middle East

**Anthropological Approaches**

- 79-301 Ritual, Cultural and Identity

**Sociological Approaches**

- 79-388 Sociology of Religion

**Philosophical Approaches**

- 80-151 God in the West
- 80-276 Philosophy of Religion

**Textual Approaches**

- 79-325 Art and Religion
- 76-330 Medieval Literary and Cultural Studies
- 76-332 Renaissance and Literary and Cultural Studies

**Elective Courses (minimum) 27 units**

Complete courses totaling at least 27 units. In addition to the Carnegie Mellon courses listed below, electives may be chosen from among any of the courses listed above under "Distribution requirements" that were not used to fulfill that requirement.

- 66-301 Science and Christianity
- 79-219 The Holocaust in Historical Perspective
- 79-220 Early Christianity

Students may cross-register for relevant electives at other Pittsburgh institutions with the permission of the faculty advisor for the religious studies minor.

**The Minor in Russian Studies**

Faculty Advisor: Charlene Castellano, Department of Modern Languages Program Office: Baker Hall 160

The relationship between Russia and the West has been central to the history of the twentieth century. Beginning with the Russian Revolution in 1917, the West's response to communism has shaped relations between America, Europe, and the Third World. The Treaty of Versailles, the rise of fascism, World War II, the postwar settlement, the Cold War, and the war in Vietnam cannot be understood apart from the West's relationship with the former Soviet Union. Within the past decade, enormous changes have occurred in Russia, once again shaking the global order to its foundations. The disintegration of the USSR, the emergence of more democratic forms of government, and the development of new "free market" economies have led not only to greater openness and stronger ties with the West, but also to a host of new questions in the areas of business, science, technology, national defense and international security. The end of the Cold War allows for exploration of new issues in fascinating ways that were formerly forbidden. The proliferation of exchange programs, the increased accessibility of libraries, archives, and information, and the development of a free press all open untapped and exciting possibilities and opportunities for students and scholars.

Young, talented people with a broadly-based knowledge of Russian history, language and culture are needed to fill jobs in international business, diplomacy, business, journalism and computing, as well as in economic, scientific and technical consulting. The Russian Studies Program aims to give students a solid background in the fields of Russian history, language, culture and politics, by offering a major and minor specialization to interested students.

Russian Studies, a B.A. Program, is jointly administered by the Departments of History and Modern Languages in the College of Humanities and Social Sciences. It is designed for students from all the Carnegie Mellon undergraduate colleges. It may be taken as either a primary major, additional major, or minor.

**Russian Studies Minor 78 units**

The History Curriculum 18 units

For minors, there is a two course History requirement comprised of one required course and one course selected from a list of electives. The intermediate-level History courses are generally taken in the sophomore and junior years. They provide a substantive overview of the major events and issues in Russian history and policy.
meaning and impact. Elective courses further the consideration of these approaches and also permit examination of medicine, scientific writing and other topics.

Courses taken to fulfill requirements in other major or minor programs may not be applied to this minor and vice versa.

Curriculum 54 units

The courses listed are offered regularly. Departments may subsequently develop and offer other courses not listed here that may be appropriate for this minor. Contact the faculty advisor for possible additional courses.

Required Courses 27 units

Complete one course from each of Areas 1, 2, and 3.

Area 1. Language, Culture and Science
76-419 Technology and Writing
76-476 The Rhetoric of Science

Area 2. History and Philosophy of Science
79-212 History of Modern Science
80-120 Reflections on Science
80-220 Philosophy of Science

Area 3. History of Technology
79-230 Technology in American Society
79-358/88-347 Complex Technological Systems: Past, Present and Future

Advanced Courses 9 units

Complete one course from Area 4 after completing one course from Area 3. If possible, complete in this sequence.

Area 4. Historical/Social Scientific Assessment
79-256 Biology and Society
79-333 History of Biomedical Research
79-340 History of Modern Warfare
79-440 The Rise of Industrial Research and Development
88-343 Economics of Technological Change

Electives 18 units

Complete two courses. Courses listed in Areas 1, 2, 3, and 4 may also be taken as electives if not already completed for an Area requirements.

Curriculum 54 units

In addition to the general education requirements of the student’s college and the requirements of the student’s major, Sociology minors must satisfy the following requirements. The Core courses comprise 18 units of the minor. One course is taken from the Organizations cluster, and one course is taken from the Methodology cluster. The Elective courses comprise 36 units of the minor. Sociology minors should consult with the program advisor to plan a course schedule prior to registration.

NOTE: The core courses are offered regularly; the elective courses are offered with at least general regularity. Participating departments may subsequently develop and offer other courses that, while not listed here, are deemed appropriate for this minor. The program advisor should be consulted (especially when the schedule of courses to be offered for a given semester becomes available) to identify such additional courses.

Core Courses 18 units

a. Organizations
Complete one course.
70-311 Organizational Behavior
88-260 Organizations

b. Methodology
Complete one course.
36-202 Statistical Methods
70-208 Regression Analysis
85-340 Research Methods in Social Psychology
88-251 Empirical Research Methods

Elective Courses 36 units

Complete four courses from the following list. Two courses (18 units) must be taken from one category to complete the depth requirement. One course (9 units) must be taken from the other category. The remaining course (9 units) may be taken from either category. Appropriate courses offered by the Department of Sociology at the University of Pittsburgh (available during the academic year through cross-registration) may also be included as part of this option. Contact the Sociology faculty advisor for more information.

1. Sociology of Gender, Family, and Culture

66-250 Introduction to Religion
70-342 Managing Across Cultures
79-270 Chinese Culture and Society
79-329 Sex Population and Birth Control
79-338 Childhood, Education and Social Reform in American History
79-359 History of African-American Families
79-374 Women in Modern India
79-376 Children In America
79-379 Women in American History
79-382 African-American Women is US History
79-394 Medicine & Society
79-392 The Family
80-230 Ethical Theory
80-245 Medical Ethics
80-342 Ethics and Oppression
85-241 Social Psychology
85-375 Cross-Cultural Psychology
85-446 Psychology of Gender
88-356 Rational Choice

*open only to qualified juniors and seniors

The Minor in Sociology

Faculty Advisor, Roberto Weber
Program Advisor, Connie Angermeier
Office: Porter Hall 208A
2. Sociology of Work, Organizations, and Technology

- 70-332 Business, Society, and Ethics
- 70-414 Technology-Based Entrepreneurship
- 79-230 Technology in American Society
- 80-300 Minds, Machines, and Knowledge
- 88-222 Policy Analysis III
- 88-305 Philosophy of Social Science
- 88-341 Organizational Communication
- 88-347 Complex Technological Systems

Note: Some courses have additional prerequisites.
Undergraduate Economics Program

Dennis Epple, Program Head
http://econ.gsia.cmu.edu/undergrad

In our fast changing world, economists are called upon to analyze and develop useful solutions to a wide range of important and interesting problems. Although economics is often simply described as the study of the allocation of scarce resources within a society, fully understanding such a broad topic requires thoughtful consideration of a wide range of issues. Economists must examine how both individuals and groups of individuals (consumers, firms, government agencies, universities, etc.) determine their actions in light of their incentives and decision constraints. Economists then proceed to examine how particular market structures determine prices and influence the allocation of goods and services through their effect on the decision makers' incentives and constraints. Economic and political factors, including taxation, labor market policies, and government activities influence these market structures and consequently affect economy-wide employment, inflation levels, energy production and pollution concerns, as well as levels of economic growth and innovation. Furthermore, economists are active participants in the economic and political processes which influence these issues. They are often called upon to help organizations make better economic decisions in the face of very complex incentives and constraints. Economists also assist in the development of market strategies, regulatory structures and policy, and increasingly in the design of markets themselves.

The Undergraduate Economics Program, jointly administered with the Tepper School of Business, has been carefully designed to prepare students for careers as economic analysts in either the private or public sector, for advanced professional studies in business, law and public policy, as well as for entry into Ph.D. programs in economics, finance, and related fields. To these ends, the program’s academic requirements provide a solid understanding of the central ideas of economics, while retaining the flexibility necessary to accommodate students’ wide variety of goals and interests. Essential skills are provided through the mathematics, statistics, computer programming and writing requirements. In addition, the H&SS general education requirements provide a broad introduction to the ideas of the humanities, arts, and sciences necessary for putting economic issues in context. The economics core courses provide the solid foundation in the field necessary for all students. Advanced electives provide students the opportunity to customize their course of studies, culminating in the students’ exploration of their special interests in their senior projects.

For students who are majors in other departments, the program offers both a second major and a minor in economics. Additionally, qualified students may seek to enter the Tepper School of Business’ accelerated master’s degree program, which offers the opportunity to earn both a bachelors degree and a Masters of Science in Quantitative Economics in only five years. Students interested in these programs are invited to contact the Economics Department’s advisors for further information.

B.S. in Economics

To receive a Bachelor of Science degree in Economics, students must complete mathematics, programming, statistics and writing prerequisites, the economics core sequence, advanced economics/ focus area electives, and a senior project.

<table>
<thead>
<tr>
<th>Mathematics Prerequisites</th>
<th>29 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-122 Integration, Differential Equations, and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>21-256 Multivariate Analysis and Approximation</td>
<td>9</td>
</tr>
</tbody>
</table>

*Although 21-120 is strongly recommended, an approved alternative is the two semester sequence 21-111/112.

Students may also meet this requirement by taking 21-259, Calculus in Three Dimensions.

<table>
<thead>
<tr>
<th>Programming Prerequisite</th>
<th>10 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistics Prerequisite</th>
<th>9 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose one *:</td>
<td></td>
</tr>
<tr>
<td>36-217 Probability Theory and Random Processes</td>
<td>9</td>
</tr>
<tr>
<td>36-225 Introduction to Probability and Statistics</td>
<td>9</td>
</tr>
</tbody>
</table>

* These courses do not replace the statistical reasoning requirement of the H&SS General Education Program (which is fulfilled by 36-201).

<table>
<thead>
<tr>
<th>Writing Prerequisite</th>
<th>9 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose one:</td>
<td></td>
</tr>
<tr>
<td>73-270 Professional Writing for Economists</td>
<td>9</td>
</tr>
<tr>
<td>76-270 Writing in the Professions</td>
<td>9</td>
</tr>
<tr>
<td>76-271 Introduction to Professional and Technical Writing</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Economics Core Requirements</th>
<th>45 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete all of following:</td>
<td></td>
</tr>
<tr>
<td>73-100 Principles of Economics</td>
<td>9</td>
</tr>
<tr>
<td>73-200 Macroeconomics</td>
<td>9</td>
</tr>
<tr>
<td>73-226 Quantitative Economic Analysis</td>
<td>9</td>
</tr>
<tr>
<td>73-251 Economic Theory</td>
<td>9</td>
</tr>
<tr>
<td>73-261 Econometrics</td>
<td>9</td>
</tr>
</tbody>
</table>

* Students may also satisfy this requirement by taking 88-220 (Policy Analysis I).

<table>
<thead>
<tr>
<th>Advanced Electives</th>
<th>36 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>This requirement is satisfied by completing a program approved track in a selected focus area. Each such track consists of a menu of courses from which the student must complete four. Since course offerings vary over time, focus area tracks are periodically updated and revised. Students should contact the Undergraduate Economics Program or check the Economics website (<a href="http://econ.gsia.cmu.edu/undergrad">http://econ.gsia.cmu.edu/undergrad</a>) for current information. Students must consult with their economics advisor for approval of their focus area selection. Presently, the Undergraduate Economics Program offers the following focus areas:</td>
<td></td>
</tr>
<tr>
<td>Business Economics</td>
<td>9</td>
</tr>
<tr>
<td>Financial Markets</td>
<td>9</td>
</tr>
<tr>
<td>Quantitative Economics</td>
<td>9</td>
</tr>
<tr>
<td>Public Economics</td>
<td>9</td>
</tr>
<tr>
<td>Behavioral Economics</td>
<td>9</td>
</tr>
</tbody>
</table>

Additionally, students may work with their advisor to structure alternative tracks based on their particular interests and course availability.

<table>
<thead>
<tr>
<th>Senior Project</th>
<th>9 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-497 Senior Project</td>
<td>9</td>
</tr>
</tbody>
</table>

Sample Course Schedule

What follows is a sample four-year course schedule for economics students. As there are many different ways of completing the requirements, several sample schedules can be found on the Undergraduate Economics Program website (http://econ.gsia.cmu.edu/undergrad). Students are strongly encouraged to meet with an economics advisor to tailor their coursework to suit their own particular needs. It is the responsibility of the student to ensure that he or she understands all program requirements and meets the
conditions for graduation. When planning course schedules, students must give consideration to all prerequisite and corequisite requirements. Course descriptions, prerequisites, and corequisites can be found at the back of this catalog.

First Year

**Fall**  49 Units
21-120  Differential and Integral Calculus  10
36-201  Statistical Reasoning  9
73-100  Principles of Economics  9
99-101  Computing Skills Workshop  3
xx-xxx  elective  9
xx-xxx  elective  9

**Spring**  47 Units
21-122  Integration, Differential Equations, and Approximation  10
73-101  1st Year Seminar in Economics  9
15-100  Introductory/Intermediate Programming  10
xx-xxx  elective  9
xx-xxx  elective  9

* Although not a requirement for the degree, students considering an economics major are strongly encouraged to meet their H&SS Freshman Seminar requirement by taking the 1st Year Seminar in Economics.

Second Year

**Fall**  45 Units
21-256  Multivariate Analysis and Approximation  9
36-225  Introduction to Probability and Statistics I  9
73-200  Macroeconomics  9
xx-xxx  elective  9
xx-xxx  elective  9

**Spring**  45 Units
73-226  Quantitative Economic Analysis  9
73-251  Economic Theory  9
xx-xxx  elective  9
xx-xxx  elective  9
xx-xxx  elective  9

Third Year

**Fall**  45 Units
73-261  Econometrics  9
73-270  Writing for Economists  9
xx-xxx  Advanced Economics Focus Area Elective  9
xx-xxx  elective  9
xx-xxx  elective  9

**Spring**  45 Units
xx-xxx  Advanced Economics Focus Area Elective  9
xx-xxx  elective  9
xx-xxx  elective  9
xx-xxx  elective  9

Fourth Year

**Fall**  45 Units
73-497  Senior Project  9
xx-xxx  Advanced Economics Focus Area Elective  9
xx-xxx  elective  9
xx-xxx  elective  9

**Spring**  45 Units
xx-xxx  Advanced Economics Focus Area Elective  9
xx-xxx  elective  9
xx-xxx  elective  9
xx-xxx  elective  9

Additional Major in Economics

The requirements for an additional major in Economics are the same as those for the B.S. in Economics, except that the H&SS general education requirements are waived. Interested students must meet with an economics advisor prior to submitting an application.

Minor in Economics

The requirements for a minor in Economics consist of mathematics requirements, a statistics requirement, and six economics courses, as follows:

<table>
<thead>
<tr>
<th>Mathematics Requirements</th>
<th>19 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120  Differential and Integral Calculus *</td>
<td>10</td>
</tr>
<tr>
<td>Choose one:</td>
<td></td>
</tr>
<tr>
<td>21-256  Multivariate Analysis and Approximation</td>
<td>9</td>
</tr>
<tr>
<td>21-259  Calculus in Three Dimensions</td>
<td>9</td>
</tr>
</tbody>
</table>

* The two courses 21-111 and 21-112 may be substituted for the 21-120 requirement.

Statistics Requirements  18 Units

Choose one:
36-201  Introduction to Statistical Methods  9
36-207  Probability and Statistics for Business Applications  9
36-220  Engineering Statistics and Quality Control  9

or any course from the statistics requirement for B.S. in Economics.

Choose one:
36-208  Regression Analysis  9
36-226  Introduction to Probability and Statistics II  9
73-226  Quantitative Economic Analysis  9
88-250  Regression Methods in the Social Sciences  9

* 36-207 is equivalent to 70-207.
* 36-208 is equivalent to 70-208.
* Only open to students who met their statistics requirement by taking 36-226.

Economics Requirements  54 Units

Complete all of following:
73-100  Principles of Economics  9
73-200  Macroeconomics  9
73-251  Economic Theory  9
xx-xxx  Advanced Economics Elective  9
xx-xxx  Advanced Economics Elective  9
xx-xxx  Advanced Economics Elective  9

* Students may also satisfy this requirement by taking 88-220 (Policy Analysis I).
* See the Undergraduate Economics Program or check the Economics website (http://econ.gswa.cmu.edu/undergrad) for a list of approved courses.

Dual Degree in Economics

A student pursuing a primary degree outside of the Economics Program may obtain a dual degree in economics by completing all of the requirements for a B.S. in Economics (including the H&SS general education requirements). In addition, the student’s total units completed must be at least 90 units in excess of the requirement for the student’s other degree(s) or at least 450 units, whichever is more. Interested students must meet with an economics advisor prior to submitting an application.

The Honors Program

The Honors Program in the College of Humanities and Social Sciences provides recognition of outstanding H&SS students, including the Economics majors. Students accepted to the program have the opportunity to apply and further develop their skills in economic analysis, as well as qualify for graduation with "College Honors". During their senior year, students complete an honors thesis through their enrollment in 66-501/502 (18 units). Completion of an honors thesis also satisfies the students’ senior project requirement. To qualify for the Honors Program, students must maintain at least a 3.5 Q.P.A. in their economics core and elective courses, as well as a minimum 3.25 overall Q.P.A.

Accelerated Master’s Degree Programs

The Masters of Science in Quantitative Economics (M.S.Q.E.) is the Tepper School of Business’ professional degree in economics. Exceptional students may qualify for admission into an accelerated program, earning both a B.S. in Economics and an M.S. in Quantitative Economics by remaining one additional year at Carnegie Mellon. For the most recent information, see http://econ.gswa.cmu.edu/mse. In addition, the H. J. Heinz III School of Public Policy and Management offers an Accelerated Master’s Program
for students attracted to advanced education focused on issues of public interest. For additional information, please see the Heinz section of this catalog.

Faculty

DANIELLE COEN-PIRANI, Assistant Professor of Economics — Ph.D., University of Rochester; Carnegie Mellon, 2000—.
W. ROBERT DALTON, Associate Teaching Professor in Economics — Ph.D., University of Missouri; Carnegie Mellon, 1985—.
ROBERT M. DAMMON, Professor of Financial Economics — Ph.D., University of Wisconsin; Carnegie Mellon, 1984—.
DENNIS N. EPPELE, Thomas Lord Professor of Economics; Head, Economics Programs — Ph.D., Princeton University; Carnegie Mellon, 1974—.
MARIA FERREYRA, Assistant Professor of Economics — Ph.D., University of Wisconsin; Carnegie Mellon, 2002—.
GEORGE-LEVI GAYLE, Assistant Professor of Economics — Ph.D., University of Pittsburgh; Carnegie Mellon, 2003—.
RONALD L. GOETTLER, Assistant Professor of Economics — Ph.D., Yale University; Carnegie Mellon, 1997—.
LIMOR GOLAN, Assistant Professor of Economics — Ph.D., University of Wisconsin-Madison; Carnegie Mellon, 2002—.
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BURTON HOLLIFIELD, Associate Professor of Financial Economics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1999—.
STEVEN KLEPPER, Arthur Arton Hamerschlag Professor of Economics and Social Science — Ph.D., Cornell University; Carnegie Mellon, 1980—.
FINN KYDLAND, Professor of Economics — Ph.D., University of Wisconsin-Madison; Carnegie Mellon, 1977—.
LESTER B. LAVE, Harry B. and James H. Higgins Professor of Economics and University Professor; Director, Carnegie Mellon Green Design Initiative; Co-Director, Carnegie Mellon Electricity Industry Center — Ph.D., Harvard University; Carnegie Mellon, 1963—.
MARK D. MANUSZAK, Assistant Professor of Economics — Ph.D., Northwestern University; Carnegie Mellon, 2000—.
BENNETT T. MCCALLUM, H. J. Heinz Professor of Economics — Ph.D., Rice University; Carnegie Mellon, 1981—.
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JOHN R. O'BRIEN, Associate Professor of Accounting and Experimental Economics — Ph.D., University of Minnesota; Carnegie Mellon, 1984—.
DUANE J. SEPPI, Professor of Financial Economics — Ph.D., University of Chicago; Carnegie Mellon, 1986—.
HOLGER SIEG, Professor of Economics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2001—.
PATRICK SILEO, Associate Teaching Professor of Economics; Director, Undergraduate Economics Program; Director, Master of Science in Quantitative Economics Program— Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000—.
FALLOW B. SOWELL, Associate Professor of Economics — Ph.D., Duke University; Carnegie Mellon, 1988—.
STEPHEN E. SPEAR, Professor of Economics — Ph.D., University of Pennsylvania; Carnegie Mellon, 1982—.
SANJAY SRIVASTAVA, Associate Dean - Intellectual Strategy; and Alumni Professor of Economics and Finance; Director, FAST Program — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1982—.
CHRIS I. TELMER, Associate Professor of Financial Economics — Ph.D., Queen's University (Canada); Carnegie Mellon, 1992—.
STANLEY E. ZIN The Richard M. Cyert and Morris H. DeGroot Professor of Economics and Statistics; Professor of Economics and Finance, — Ph.D., University of Toronto; Carnegie Mellon, 1988—.
The Department of English at Carnegie Mellon involves students in the important study of reading and writing as they are embedded in historical, cultural, professional, technological, and literary practices. Working with faculty who are themselves writers, scholars, and researchers in these areas, students become effective writers and analysts of various kinds of texts in a range of media. We hold strongly to our traditional interest in print documents but extend the idea of text to include other media such as film, multimedia, and online texts. The types of texts that students and faculty work with include academic writing, criticism, fiction and non-fiction, professional and technical writing, argument and public advocacy, poetry, film, and even screenwriting. The English Department faculty have particular strengths in Creative Writing, in Literary and Cultural Studies, and in Rhetoric. Specialists in each area use distinctive methods of studying texts, but all share a deep commitment to working in small and intense workshops and seminars to help students learn to become experts in analyzing existing texts, and in producing original and distinctive work of their own.

The English Department offers a B.A. in English, a B.A. in Creative Writing, a B.A. in Professional Writing, and a B.S. in Technical Writing and Communication. All four majors involve the relationship of texts to contexts, and all four are structured to allow students to balance liberal and professional interests. Students in the English B.A. focus on the production and interpretation of print texts and other media in their social and cultural contexts. Students in the Creative Writing B.A. focus on analyzing and learning to produce poetic and narrative forms. Students in the Professional Writing B.A. focus on analyzing and producing non-fiction for a variety of professional contexts. Students in the Technical Writing B.S. focus on integrating writing with technical expertise in a chosen area of concentration. In addition to the four majors, the department offers a minor in English and strongly encourages non-majors in the campus community to join us in English courses, beginning with offerings at the 200-level.

English faculty and students represent a diverse but close community with a shared interest in understanding how texts are produced and understood. This interest is the foundation for the formal curriculum and also the inspiration for a range of complementary activities, including a reading series of distinguished writers of fiction and non-fiction. English majors also have multiple opportunities to gain experience in publishing, editing, and marketing through involvement with The Oakland Review and The Carnegie Mellon University Press. Many of our students hold writing and editorial positions on the student newspaper, The Tartan, and other campus publications. We also offer a strong internship program that places student writers in media, non-profit, arts, corporate, and technical internships before they graduate. The end of every year culminates in a gala event to celebrate our students and their writing achievements in literary, academic, and professional writing. For this event, known as the Pauline Adamson Awards, we invite a well-known writer to do a public reading and then present and celebrate student writing awards in over a dozen categories, all judged anonymously by writing professionals from outside the university. Nationally prominent speakers who have participated in this event include Michael Cunningham, Jamaica Kincaid, Michael Ondaatje, Tobias Wolff, Stanley Kunitz and Dennis Lehane.

Undergraduate students also have the opportunity to apply to the various Masters level graduate programs sponsored by the department. Students interested in communications careers in both the public and private sectors may receive advanced training in our Masters in Professional Writing (MAPW) program. Students who have interests in visual as well as verbal communication apply to the Masters in Design in Communication Planning and Information Design (jointly administered with the School of Design). Students with academic interests looking toward doctoral work can apply to our Masters programs in Rhetoric and in Literary and Cultural Studies to acquaint themselves with and to prepare for academic careers. The best of our Masters candidates may request consideration for the department’s Ph.D. programs in Rhetoric or in Literary and Cultural Studies and will be, in any case, well prepared for graduate work no matter where they chose to go. Upper level undergraduates interested in graduate level work should contact the English Department directly for further information and for advice on planning their junior and senior years to prepare for graduate study.

Majoring in English:

The Four English Degree Options
All students who major in English choose one of the four majors offered by the department as the main focus of their studies:
- The B.A. in English
- The B.A. in Creative Writing
- The B.A. in Professional Writing
- The B.S. in Technical Writing & Communication

Other Options for English Majors
Students who wish to broaden their experience with English courses may do so by taking more than the minimum requirements for each major or by combining two of the majors within the department for a double major in English. Common combinations include Professional Writing and Creative Writing, Creative Writing and the B.A. in English, or the B.A. in English and Professional Writing. Students who are already majoring in one of the English degrees can generally add a second English major by completing 5 to 7 additional courses. Consult the English Department and the section below on “Completing an Additional Major in English” for further detail.

All of the English majors may also be combined with majors and minors from other Carnegie Mellon departments and colleges. English Department advisors can help you to explore the available options and to choose a major or combination of programs that is appropriate for your interests and goals.

How the Curriculum is Structured
In addition to H&SS requirements, English majors complete 11 to 12 courses (99 to 114 units) specifically related to their chosen major within English and structured as indicated below. Please note that courses taken to fulfill requirements in other major or minor programs may not be applied to requirements for any of the English Department majors or minors.

English Department Core:
2 courses, 18 units
Complete both courses. 76-26x Survey of Forms (Fiction, Poetry, or Screenwriting) 76-294 Interpretive Practices

The English Department Core is designed to introduce students to various genres of writing, to the fundamental concepts and techniques of fiction and non-fiction, and to a conceptual understanding of how texts are produced and interpreted. In the Survey of Forms courses, students learn how to use language to express experience through poetic and narrative forms. In Interpretive Practices, students are introduced to basic concepts, methods, and practices of literary and rhetorical approaches to texts and their social and cultural contexts.

Core Requirements for the Specific Major:
5 to 7 courses, 45 to 63 units
Complete five to seven courses. The Core Requirements differ for each major and are designed explicitly to provide both breadth and depth within the specific major the student has chosen.

English Electives:
3 to 4 courses, 27 to 36 units
Complete three to four elective courses.

Elective Courses for the major are designed to add breadth to each
student’s study within English and to provide experience with the range of approaches to reading and writing available within the department. Students in all English majors are encouraged to sample widely from the Department’s offerings.

The B.A. in English

An important role of English departments has been to create interpretations of the literature of various historical periods, including the present. The B.A. in English (EBA) at Carnegie Mellon builds on, and also extends, this tradition by teaching texts as part of a traditional web of historical conditions and relationships; by teaching both major literary texts and public and non-fiction documents; and by teaching film, television, and other storytelling media alongside more conventional texts.

The B.A. in English is distinctive in drawing from the artistic and research strengths of the Department’s faculty in Literary and Cultural Studies, Rhetoric, and Creative Writing. Rhetoric focuses on the way texts are formally constructed and how they function in historical and contemporary contexts. Creative Writing helps students focus on language as a tool to explore and depict experience. Rhetoric focuses on the principles through which writers construct texts and readers respond to them. Drawing from all of these perspectives, students in the B.A. in English learn the research skills and writing strategies to enable them to analyze the language and texts of other writers and to report their research in effective texts of their own. Such training can prepare students for graduate study, work in culture, studies, or rhetoric, and also for careers in law, business, or government, which require similar skills in interpretation, research, and writing.

The 200-level core courses are designed to introduce students to writing in a variety of genres, to a knowledge of literary and other media forms, and to a basic theoretical knowledge of how texts are produced and interpreted. In the Interpretive Practices course, students are introduced to basic concepts, methods, and practices of literary and rhetorical approaches to texts. In the Survey of Forms course, students learn how to use language to express experience through poetic and narrative forms.

Beyond these English Department core courses, students take at least one course in rhetoric, two 300-level EBA core courses, and two 400-level seminars designed to introduce them to the functioning of texts within specific cultural and rhetorical contexts. Two of 300- and 400-level courses must feature a specific historical period, and one of these “period” courses must have a pre-1900 focus. Period study introduces students to a range of historical and cultural texts and to a range of methods for analyzing these texts in their original context and across contexts. Courses that fulfill the Rhetoric Requirement focus explicitly on language and discourse as objects of study and emphasize the relationships of language, text structure, and meaning within specific contexts.

Research in English Studies (76-394) is also required of students in the B.A. in English. This course offers training in gathering information systematically and in building arguments based on that information. Students will hone their skills in reading texts, using critical commentary, assessing print and electronic materials, and conducting interviews and surveys. They will learn how to test the hypothesis against alternatives and present their research to audiences within the discipline of English. The historical or thematic content of this course will vary from one semester to another. 76-394 should be taken in the fall of the student’s junior year as it is a pre- and co-requisite for a number of the 400-level seminars.

At the advanced level, students are required to take two 400-level capstone seminars for which 76-294 Interpretive Practices is a prerequisite and 76-394 Research in English Studies is a pre- and co-requisite. One of the seminars (76-450) will be a designated “Senior Seminar” reserved only for seniors in the English B.A. and normally taken in the spring semester of the senior year. The content of that course will vary from year to year, but, like other 400-level courses, it will deal with an author, period, or genre in depth. Students will contribute to the seminar discussion, design and complete research projects, and serve as correspondents for each others’ work. EBA majors also complete three English Electives, one at the 200 or above level and two at the 300 or 400 level. Electives at the 200 level allow students to sample introductory courses in special topics — such as gender and media studies — within rhetorical, literary, and cultural studies, or genre courses in the novel or comedy. Electives at the 300 and 400 level encourage students to explore more advanced study in the various offerings within the department. In choosing their electives, EBA students are encouraged to sample courses from across the department.

Curriculum

In addition to satisfying all of the H&SS degree requirements for B.A. candidates, English B.A. majors must complete 11 courses in the following areas:

**English Department Core:** 2 courses, 18 units

Complete both courses:
- 76-26x Survey of Forms (Fiction, Poetry, or Screenwriting)
- 76-294 Interpretive Practices

**EBA Core Requirements:** 6 courses, 54 units

Complete six required courses.

**Research Course**

- 76-394 Research in English Studies

**Rhetoric Requirement**

Complete one course from a set of varied offerings in Rhetoric as designated each term by the English Department. Rhetoric courses focus explicitly on language and discourse as objects of study and emphasize the relationships of language, text structure, and meaning within specific contexts.

**Two 300-level Courses**

Complete two 300-level courses that investigate the production and interpretation of texts and other media from a variety of periods and theoretical and methodological perspectives. Course offerings that meet these requirements are advertised on a semester-by-semester basis. For EBA majors, 76-294: Interpretive Practices is a prerequisite for these courses. Course options include but are not limited to the following:
- 76-330 Medieval Literary and Cultural Studies
- 76-331 Renaissance Literary and Cultural Studies
- 76-332 African American Studies
- 76-334 Narratives of Profession
- 76-335 20th Century Literary and Cultural Studies
- 76-339 Advanced Studies in Media
- 76-347 American Literary & Cultural Studies
- 76-353 Advanced Gender Studies
- 76-386 Language and Culture
- 76-387 Sociolinguistics
- 76-392 Rhetoric and Public Policy
- 76-393 Rhetorical Traditions

**“Period” Course Requirement**

The period course requirement is not a separate course requirement per se but one that needs to be met through the selection of the required 300- and 400-level courses. At least two of these four required courses must be “period” courses, that is, courses that focus on texts that are connected in time and place or through common social concerns. One of these two courses must focus on a historical period prior to 1900. Courses in this category will vary from year to year and be advertised on a semester-by-semester basis. Such courses may be at either the 300 or 400 level.

**Two 400-level Seminar Courses**

Complete two 400-level seminar courses, including one Senior Seminar (76-450), generally taken in the spring of the senior year, which investigate a specific topic in depth and allow students to work on a major research-based paper. Courses in this category will be advertised on a semester-by-semester basis. For EBA majors, 76-294: Interpretive Practices is a prerequisite and 76-394: Research in English Studies is pre- or co-requisites. Among current course offerings, examples include but are not limited to the following:
- 76-431 Advanced Seminar in British Literary and Cultural Studies
- 76-433 Postcolonial Literature and Theory
- 76-441 Chaucer
- 76-444 Enlightenment Sexualities
- 76-445 Topics in Language Studies
- 76-451 Literature and Theory
- 76-476 Rhetoric of Science
Creative Writing majors take four workshops in fiction, introductory courses (receive a grade of A or B). In their junior and non-fiction texts.

practice in the careful reading, writing and understanding of literary backgrounds and encourage their analytical abilities. English courses

major.

in the introductory classes will not be encouraged to continue in the CW program, based on a conservatory model, is made up of faculty

writing fiction, poetry, and other imaginative forms. While studying

must be taken in a specific genre. A student who receives a grade of C in a Survey of

courses offered by the English Department with the exception of 76-201, 76-205, and 76-206, all of which are designed for non-majors. Some semester

from Modern Languages or History.

English B.A. Sample Curriculum

This plan is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years not that it should or must be. In fact, as a department, we recommend beginning the major in the sophomore year if possible. Students in H&SS may declare a major as early as mid-semester of the spring of their first year and begin major requirements the following fall. 76-294 Interpretive Practices should generally be taken in the sophomore year and before 76-394.

**English Electives: 3 courses, 27 units**

Complete three courses from the English Department’s offerings. One may be at the 200-level or above; the remaining two must be at the 300 or 400 level. Electives may include any courses offered by the English Department with the exception of 76-201, 76-205, and 76-206, all of which are designed for non-majors. Some semester offerings may include cross-listed courses from Modern Languages or History.

The B.A. in Creative Writing

Carnegie Mellon is one of a small number of English departments in the country where undergraduates can major in Creative Writing. In the Creative Writing major (CW), students develop their talents in writing fiction, poetry, and other imaginative forms. While studying with faculty members who are practicing poets and prose writers, Creative Writing majors read widely in literature, explore the resources of their imaginations, sharpen their critical and verbal skills, and develop a professional attitude toward their writing. Students also have the opportunity to work with other nationally known poets and fiction writers through the department’s Visiting Writers series. The CW program, based on a conservatory model, is made up of faculty and students who have an intense commitment to their work. Students who do not exhibit a high level of commitment and promise in the introductory classes will not be encouraged to continue in the major.

Beginning with the H&SS requirements, the curriculum for Creative Writing majors is designed to broaden the students’ intellectual backgrounds and encourage their analytical abilities. English courses beyond the Creative Writing core requirements provide additional practice in the careful reading, writing and understanding of literary and non-fiction texts.

Students in the Creative Writing major are required to take two of the introductory Survey of Forms courses, ideally in their sophomore year. Choices include Poetry (76-265), Fiction (76-260), and Screenwriting (76-269). In order to proceed into the upper level courses in the major (and in each of the genres), students must do well in these introductory courses (receive a grade of A or B). In their junior and senior years, Creative Writing majors take four workshops in fiction,

poetry, screenwriting, or non-fiction. At least two of the workshops must be taken in a single genre. In the writing workshops, students develop their critical and verbal abilities through close reading and analysis of poems, stories, and other literary forms. Their work is critiqued and evaluated by peers and the faculty. Students may write a Senior Project or Honors Thesis under the supervision of a faculty member during their senior year.

Carnegie Mellon also offers Creative Writing majors various extracurricular opportunities for professional development. For example, they may work as interns with the Carnegie Mellon University Press, which is housed in the English Department. The Press publishes scholarly works, and books of poetry and short stories by both new and established American writers. Students may submit their work for publication to The Oakland Review, a Carnegie Mellon University-sponsored annual journal, and The Tartan (the weekly student newspaper where they often serve in editorial positions). Students also have opportunities to read their works in a series of readings by student writers held in the Gladys Schmitt Creative Writing Center and to hear nationally known authors as part of the Carnegie Mellon Visiting Writers series. Additionally, the English Department (in cooperation with the Carnegie Mellon University Press) offers prizes for students each year in the writing of fiction, non-fiction, poetry and screenwriting. These include the Pauline Adamson Awards, the Academy of American Poets Prize, and the Carnegie Mellon University Press Prizes in poetry and fiction. In addition, the Gladys Schmitt Scholarship Fund and the Gladys Schmitt Student Enhancement Fund provide support for creative writing majors.

Because the Creative Writing program provides a disciplined atmosphere in which to study and write, it appeals especially to students who are as concerned with their personal growth as with vocational goals. Nevertheless, the extracurricular writing activities and a variety of writing internships available on and off campus can provide Creative Writing majors with valuable experiences for planning their future. After graduation, most Creative Writing majors have gone on to graduate writing programs and to careers in teaching, publishing, public relations, advertising, TV and film, or freelance writing and editing.

Curriculum

In addition to satisfying all of the H&SS degree requirements for B.A. candidates, Creative Writing majors must complete 11 courses in the following areas:

**English Department Core: 2 courses, 18 units**

Complete both courses.

76-26x Survey of Forms (Fiction, Poetry, or Screenwriting) * 76-294 Interpretive Practices

* A student must receive a grade of A or B in the Survey of Forms class in a specific genre in order to be eligible to enroll in a workshop of that genre. A student who receives a grade of C in a Survey of Forms course may enroll in a related workshop only with the permission of the workshop professor. A student who receives a D or R in Survey of Forms may not take a workshop in that genre.

**Creative Writing Core: 5 courses, 45 units**

A Second Survey of Forms Course * Complete one of the following courses in addition to the 76-26x course completed for the English Department Core requirement.


Four Creative Writing Workshops Complete four Creative Writing workshops, at least two in a single genre. Workshops in all genres may be taken more than once for credit.

76-365 Beginning Poetry Workshop 76-460 Beginning Fiction Workshop 76-461 Personal Essay

76-462 Advanced Fiction Workshop 76-465 Advanced Poetry Workshop 76-469 Screenwriting Workshop 76-4xx Elective Workshops (various forms)
English Electives: 4 courses, 36 units

Complete four additional courses from the English Department’s offerings. Two of the four English Electives must be courses that are designated as fulfilling the literature requirement and focus on close reading of literary texts. Please consult the list of courses published each semester by the Department for current offerings. English Electives may include any course offered by the Department with the exception of 76-201, 76-205, and 76-206, which are designed primarily for non-majors. Additionally, English Electives can include no more than one course at the 200 level. The remaining English Electives must be at the 300 or 400 level. In choosing Electives, students are encouraged to sample courses from across the Department.

Creative Writing B.A.

Sample Curriculum

This plan is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years not that it should or must be. In fact, as a department, we recommend beginning the major in the sophomore year if possible. Students in H&SS may declare a major as early as mid-semester of the spring of their first year and begin major requirements the following fall.

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The B.A. in Professional Writing

Professional Writing combines liberal and professional education with a strong foundation in rhetorical studies. While based firmly in the liberal arts tradition, the major has a strong career orientation and is specifically designed to prepare students for successful careers as writers and communications specialists in a range of fields: publishing, government, journalism, law, community advocacy, the non-profit sector, education, corporate communications, and the arts. The major is designed to develop articulate and reflective writing professionals with both the professional skills needed to negotiate current work contexts (including writing for the web and for multimedia), and the analytic and problem-solving skills needed to understand and keep pace with cultural and technological change.

Professional Writing majors take the English Department Core and then a cluster of advanced rhetoric, language studies, and writing courses designed to integrate theory with practice. Through special topics courses—journalism, on-line information design, advocacy writing, document design, science writing, corporate communications, writing for multimedia—students have the opportunity to study with faculty who are experts and practicing professionals in these fields. They also gain experience in working on client-based projects and develop a portfolio of polished writing samples that they can use in applying for internships and employment. Through courses in Rhetoric, Creative Writing, and Literary and Cultural Studies, students gain additional practice in the careful reading, writing, and analysis of literary and non-fictional texts and important insights into how texts function in their historical and contemporary contexts.

While the major appeals to students with strong professional interests, elective requirements encourage writers to develop the broad intellectual background one expects from a university education. In choosing their elective courses beyond Department requirements, Professional Writing majors are encouraged to explore courses from across the university, keeping in mind the very important point that to be effective, writers must have both strong writing skills and in-depth knowledge of their subjects. While there is no formal requirement for these elective courses, students are encouraged to think about what courses will complement their interest in Professional Writing. Students interested in journalism, for example, are encouraged to take courses in history and political science, while those interested in writing for health-related fields are pointed toward courses in biology, chemistry, and healthcare policy. Other possible elective areas include business, organizational behavior, graphic design, the arts, psychology, economics, modern languages, and computer programming. Because the major in Professional Writing is deliberately structured to allow a broad range of options, majors in Professional Writing should consult closely with their English Department advisors on choosing both elective and required courses and in planning for internships and summer employment.

Various opportunities for writers to gain professional experience and accumulate material for their writing portfolios are available through campus publications, department-sponsored internships for academic credit, and writing-related employment on and off campus. Professional Writing majors frequently write for The Tartan, the student-run campus weekly newspaper, and have served as editor-in-chief, section editors, and reporters. Professional Writing majors can also serve on the editorial staff of The Oakland Review, a Carnegie Mellon journal that publishes work by undergraduate writers from across the U.S. These publications provide opportunities for students to publish their own written work and to gain experience in skills ranging from editing, to layout, to production, to selling ads or managing business affairs. Students can also write for the faculty and staff newspaper, Focus, under the guidance of the editor, or take a course in editing and publishing with the Carnegie Mellon University Press. Additionally, the English Department offers student awards in Professional Writing each year. The awards are judged by professionals outside the university and include the Pauline Adamson Awards in non-fiction, The Alan and Gloria Wingel Awards in Professional Writing, and the Dawe Memorial Award to encourage creativity and innovation in publishing. The Dawe Award provides a junior in the department with a $2000 grant to plan, produce, and publish an innovative magazine, newspaper, or other periodical publication.

Professional Writing majors also have the option of taking writing internships for academic credit during their junior or senior years. Available internships in advertising, newspaper and magazine writing, medical communication, publishing, technical writing, public service organizations, web design, and public relations illustrate both internship possibilities and the kinds of employment that Professional Writing majors have taken after graduation. In addition to providing approximately 120 hours of professional experience, these internships help students establish contacts outside the university and add professional publications to their portfolios. Recent internships have included organizations such as The Pittsburgh Ballet Theatre, The Pittsburgh Mediation Center, WQED Magazine, KDKA Television, WPXI Television, Pittsburgh Children’s Museum, Pittsburgh Post Gazette, Creative Non-Fiction (a professional journal), the Heinz Family Foundation, the Silver Eye Photography Studio, and Bayer Polymers.

Seniors also have the opportunity to complete a Senior Project or Honors Thesis in Rhetoric or Professional Writing under the direction of a faculty member. Ideas and guidance for choosing internship courses, summer employment, and possible career paths are provided through a 3-unit course, 76-300 Professional Seminar, which meets once a week during the fall term and provides majors with the opportunity to meet and network with practicing professionals in a range of communications fields.

Curriculum

In addition to satisfying all of the H&SS degree requirements for B.A. candidates, Professional Writing majors must fulfill 12 requirements in the following areas:

**English Department Core:** 2 courses, 18 units

Complete both courses.

- 76-26x Survey of Forms (Fiction, Poetry, or Screenwriting)
- 76-294 Interpretive Practices

234 Department of English
Professional Writing Core: 7 courses, 63 units

Complete seven courses.

**Foundations Courses**

- 76-271 Introduction to Professional & Technical Writing
- 76-373 Argument
- 76-390 Style

**Rhetoric Requirement**

Complete one course from designated Rhetoric courses offered and advertised each semester by the Department. Rhetoric courses focus on language and discourse as explicit objects of study and emphasize the relationships among language, text structure, and meaning within specific contexts. These courses provide explicit techniques for understanding readers, texts (with an emphasis on non-fiction), and contexts that are extremely useful to all writers.

**Three Advanced Writing / Rhetoric Courses**

Complete three courses at the 300- or 400-level. Options for these courses include but are not limited to the following:

- 76-318 Communicating in the Global Marketplace *
- 76-372 Contemporary Journalism
- 76-375 Magazine Writing *
- 76-378 Community Literacy & Intercultural Communication
- 76-385 Introduction to Discourse Analysis
- 76-386 Language and Culture
- 76-387 Sociolinguistics
- 76-389 Grammar of Standard Written English
- 76-392 Rhetoric and Public Policy
- 76-395 Science Writing *
- 76-396 Writing in the Public Interest *
- 76-397 Instructional Development & Design *
- 76-451 Topics in Language Study
- 76-457 Topics in Rhetorical Study
- 76-460 Literary Journalism *
- 76-470 Advanced Professional and Technical Writing *
- 76-472 Advanced Journalism *
- 76-476 Rhetoric of Science
- 76-479 Corporate Marketing and Communications *
- 76-480 Document Design *
- 76-481 Writing for Multimedia *
- 76-482 Comparative Rhetoric
- 76-487 On-line Information Design *
- 76-494 Medical Communications *
- 39-605/6 Product Design

* Courses that have prerequisites. Check course descriptions for specific details.

**English Electives:** 3 courses, 27 units

Complete three additional courses from the English Department's offerings. Two of the three Electives must be courses that are designated as fulfilling the literature requirement and focus on the relationships between texts and their cultural and historical contexts. Please consult the list of courses published each semester by the Department for current offerings in this category. English Electives may include any course offered by the Department with the exception of 76-201, 76-205, and 76-206, all of which are designed primarily for non-majors. Additionally, Electives can include no more than one course at the 200 level. The remaining Electives must be at the 300 or 400 level. In choosing Electives, students are encouraged to sample courses from across the Department.

**Professional Writing B.A.**

**Sample Curriculum**

This plan is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years not that it should or must be. In fact, as a department, we recommend beginning the major in the sophomore year if possible. Students in H&SS may declare a major as early as mid-semester of the spring of their first year and begin major requirements the following fall.

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**The B.S. in Technical Writing & Communication**

The B.S. in Technical Writing & Communication (TWC) is one of the oldest undergraduate technical communication degrees in the country, and still one of the few that is a B.S., rather than a B.A. The program is specifically designed to prepare students for successful careers involving scientific, technical, and computer-related communication.

The B.S. in Technical Writing reflects changes taking place in the technical communication field. At one time in the not too distant past, technical writers worked primarily with print documents and within a relatively narrow range of fields that included the software industry and various organizations concerned primarily with scientific or technological subjects. The recent explosion of information technologies has radically changed that situation. Today’s technical communicators are professional specialists with strong backgrounds in the technology, communication, and design skills needed to enter a broad range of information-based fields. The work that technical writers now do goes well beyond writing documents for print distribution. The expanding range of options includes positions that involve organizing, managing, communicating, and facilitating the use of both technical and non-technical information in a range of fields and media.

Some of the many things that technical communicators do include developing and designing web sites, explaining science and technology to the public, developing print and multimedia materials, developing information management systems, designing and delivering corporate training, and developing support systems for consumer products ranging from software for word processing or personal finance to complex data management systems.

The B.S. in Technical Writing recognizes the important changes taking place in communication-based careers and includes two distinctive “tracks,” one in Technical Communication (TC) and one in Scientific and Medical Communication (SMC). Both tracks begin with a common core of foundation courses in print and on-line communication as well as a shared set of prerequisites in math, statistics, and computer programming. The two tracks differ in the set of theory/specialization courses beyond the core, with each track including a specialized set appropriate to its focus.

In both the TC and SMC tracks, TWC students work on real projects for actual clients, learn group interaction and management skills, and develop a flexible repertoire of skills and strategies to keep up with the rapid advances in software and technology. Above all else, they focus on developing structures and information strategies to solve a broad range of communication and information design problems.

Students majoring in Technical Writing & Communication are able to draw on exceptional resources on and off campus to enhance their education. Most obvious are the course offerings of Carnegie Institute of Technology, the Mellon College of Science, and the School of Computer Science. Additional course offerings in business, organizational behavior, policy and management, psychology, history, and design are also encouraged.
Students have the options of doing internships for academic credit during their junior or senior year. These internships provide a minimum of 120 hours of professional experience as well as exposure to the broad range of career possibilities that technical writers can pursue after graduation. Both coursework and internships also provide writing samples for students’ professional portfolios. Recent students have done internships at various on- and off-campus sites including Rockwell Automation, Duquesne Systems, the Carnegie Mellon Robotics Institute, Claritech, Janus Technologies, and the Carnegie Mellon Software Engineering Institute (SEI). Placement patterns after graduation are similarly diverse. Graduates of the Technical Writing program have been hired by organizations nationwide. Firms recruiting and hiring Technical Writing graduates include Microsoft, Intel, AT&T, Digital Equipment, IBM, Data General, NCR Corporation, Cisco Systems, and Mellon Financial.

**The Technical Communication, or TC Track**

The Technical Communication track (TC) prepares students for careers in the rapidly changing areas of computer-based communication. Students learn the fundamentals of visual, verbal, and on-line communication as well as the technical skills needed to design, communicate, and evaluate complex communication systems and to manage the interdisciplinary teams needed to develop them. Students become fluent in both print-based and electronic media across a variety of information genres and learn to design information for a range of specialist and non-expert audiences. The TWC/TC major can be pursued as a primary major within H&SS or as a secondary major for students in other Colleges with an interest in combining their specialized subject matter knowledge with strong writing and communication skills. Graduates of this track are likely to follow in the footsteps of previous Technical Writing students from Carnegie Mellon who are currently employed as web designers, information specialists, technical writers, and information consultants in a range of technology and communication-based organizations including IBM, Microsoft, Apple, and Intel, all of whom actively recruit on the Carnegie Mellon campus.

**The Scientific and Medical Communication, or SMC Track**

The Scientific and Medical Communication track (SMC) is designed for students who seek careers that focus on communication and information design problems in these specialized areas. It should appeal to students with interests in the health care professions, science and public policy, patient education, scientific journalism and related fields. Like the TC track, the SMC track is designed to provide both the technical and the communication skills needed to analyze and solve complex communication problems. Students learn the fundamentals of verbal, visual, and on-line communication as well as the technical skills needed to design, communicate, and evaluate complex information systems and to manage the interdisciplinary teams needed to develop them. Students become fluent in both print-based and electronic media across a variety of information genres and learn to design information for a range of specialist and non-expert audiences. The TWC/SMC major can be pursued as a primary major within H&SS or as a secondary major for students in other Colleges, such as MCS, with an interest in science or medicine.

**Curriculum for the TWC degree**

All Technical Writing & Communication majors must satisfy the H&SS requirements for the B.S. degree, and a set of 3 to 4 prerequisite courses in calculus, statistics, and computer science. All prerequisites should be completed by the beginning of the fall semester, junior year. Prerequisites may double count toward H&SS Requirements or requirements for other majors or minors.

**Mathematics Prerequisite:**

1 course, 9-10 units

Complete one of the following:

- 21-111 Calculus I
- 21-120 Differential and Integral Calculus

**Statistics Prerequisite:**

1 course, 9 units

Complete one course

- 36-201 Statistical Reasoning

**Computer Science Prerequisites:**

1-2 courses, 10-19 units

Complete either:

15-100 Introductory/Intermediate Programming (10 units) and 15-200 Advanced Programming/Practicum (9 units) or 15-111 Intermediate/Advanced Programming (10 units) *

* The 15-100 + 15-200 sequence is specifically designed and paced for students in the Technical Communication and similar degrees who are not majoring in Computer Science or planning to pursue advanced courses in programming. Students who anticipate taking courses in Computer Science beyond this level should take 15-111, which is the prerequisite for most advanced programming courses, in place of the 15-100 + 15-200 sequence. Please consult your English Department advisor for help in making this decision.

Beyond these prerequisites, students in both TC and SMC tracks of the Technical Writing and Communication degree take the 2 English Core Courses required of all English majors and a common set of 4 Core Requirements in writing, communication, and information design. To complement these foundation courses, TWC students take a set of 3 theory/specialization courses specific to either TC or SMC. In addition, students in the SMC track take a series of 3 courses in the natural sciences or engineering relevant to their areas of interest, while TC students take 3 electives in management, technology, and social issues.

**Technical Communication Track**

**English Department Core:**

2 courses, 18 units

Complete both courses.

- 76-26x Survey of Forms (Fiction, Poetry, or Screenwriting)
- 76-294 Interpretive Practices

**TWC Core Requirements:**

4 courses, 42 units

Complete all 4 courses.

- 76-271 Introduction to Professional & Technical Writing
- 76-470 Advanced Professional & Technical Writing *
- 76-480 Document Design *
- 76-487 On-Line Information Design **

* prerequisite = 76-271 ** prerequisite = 76-271 + 76-480

**Theory/Specialization Courses:**

3 courses, 27 units

Complete 3 advisor-approved courses chosen from these options. Additional options may be advertised on a semester-by-semester basis.

- 76-318 Communicating in the Global Marketplace *
- 76-383 Multimedia Authoring 2 *
- 76-392 Rhetoric & Public Policy *
- 76-397 Instructional Development and Design *
- 76-476 Rhetoric of Science *
- 76-481 Writing for Multi Media *
- 76-385 Introduction to Discourse Analysis
- 76-386 Language & Culture
- 76-387 Sociolinguistics
- 76-389 Grammar of Standard English
- 76-390 Style
- 76-451 Topics in Language Study
- 76-457 Topics in Rhetorical Study
- 39-505 Product Design

* Courses with prerequisites. Check course descriptions for details.

**Technical Communication Electives:**

3 courses, 27 units

Complete 3 advisor-approved electives in management, technology, and social issues, chosen from the following options. Additional options may be advertised on a semester-by-semester basis. Note that at least some of these courses may have prerequisites. Please check course listings for details and plan accordingly. Courses in this category may double count for both the TWC degree and a major or minor in another department.
05-410 Introduction to Human Computer Interaction Methods
05-413 Human Factors
15-xxx Computer Science courses beyond the 2 required
19-402 Telecommunications, Technology Policy & Management
19-448 Science, Technology, and Ethics
36-309 Experimental Design for Behavioral and Social Sciences
36-315 Statistical Graphics and Visualization
36-325 Probability and Mathematical Statistics 1
36-350 Data Mining
51-261 or 2 Communication Design Fundamentals
51-263 or 4 Industrial Design Fundamentals
51-421 Visual Interface Design
70-311 Organizational Behavior
70-332 Business and Society
70-342 Managing Across Cultures
70-209 Theory and Practice in Anthropology
70-230 Technology in American Society
70-358 Complex Technological Systems: Past, Present, Future
80-220 Philosophy of Science
80-221 Philosophy of Social Science
80-241 Professional Ethics
80-244 Management, Environment, and Ethics
80-300 Minds, Machines, and Knowledge
80-340 Environmental Ethics and Decision Processes
85-211 Cognitive Psychology
85-213 Human Information Processing and Artificial Intelligence
85-241 Social Psychology
85-370 Perception
85-392 Human Expertise
85-411 Cognitive Processes and Problem
85-413 Human Factors
88-260 Organizations
88-341 Organizational Communication
88-343 Economics of Technological Change
88-344 Organizational Intelligence in the Information Age
88-366 Social Issues in Computing
88-368 Introduction to Human Computer Interaction
88-452 Organizational Theory
88-467 Computers in Organizations

Scientific & Medical Communication Track

English Department Core:
2 courses, 18 units

Complete both courses.

76-26x Survey of Forms (Fiction, Poetry, or Screenwriting)
76-294 Interpretive Practices

Core Requirements for TWC:
4 courses, 42 units

Complete all 4 courses.

76-271 Introduction to Professional & Technical Writing
76-470 Advanced Professional & Technical Writing *
76-480 Document Design *
76-487 On-Line Information Design **

* prerequisite = 76-271
** prerequisite = 76-271 + 76-480

Theory/ Specialization Courses:
3 courses, 27 units

Complete 3 advisor-approved courses chosen from these options:

76-318 Communicating in the Global Marketplace *
76-395 Science Writing *
76-494 Medical Communication *
76-397 Instructional Design *
76-385 Introduction to Discourse Analysis
76-392 Rhetoric & Public Policy
76-476 Rhetoric of Science
76-386 Language & Culture
76-396 Writing in the Public Interest *
76-472 Journalism Workshop
76-481 Writing for Multi Media *
76-389 Grammar of Standard Written English
76-390 Style
36-203 Sampling, Surveys, and Society
36-309 Experimental Design for Behavioral and Social Sciences
36-315 Statistical Graphics and Visualization
79-230 Technology in American Society
79-334 Health Policy: Historical Perspectives
79-335 Drug Use and Drug Policy
79-358 Complex Technological Systems: Past, Present, Future
79-384 Medicine and Society
79-385 History of Biomedical Research
80-220 Philosophy of Science
80-244 Management, Environment, and Ethics
80-245 Medical Ethics

* English Department courses that have prerequisites. Course options in other departments may also have prerequisites. Please check appropriate departmental course listings for details.

Natural Sciences & Engineering:
3 courses, 27 units

Complete 3 advisor-approved courses that contribute to the student’s chosen focus. The courses may be all in one area such as biology, or spread across areas. The basic courses in biology, chemistry, and physics are listed below. Additional options include advanced courses in any of these areas, statistics, or engineering. Consult your English Department advisor on the appropriateness of specific courses for your interests.

03-124 Modern Biology Lab
09-105 Modern Chemistry I
09-106 Modern Chemistry II
33-xxx Physics I for Science Students
33-xxx Physics II for Science Students
42-101 Introduction to Biomedical and Health Engineering
42-301 Physiology
42-377 Rehabilitation Engineering

TWC / TC Track

Sample Curriculum

This plan is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years not that it should or must be. In fact, as a department, we recommend beginning the major in the sophomore year if possible. Students in H&S may declare a major as early as mid-semester of the spring of their first year and begin major requirements the following fall.

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Fall</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Fall</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>Intro to Professional &amp; Technical Writing 76-271</td>
<td>Survey of Forms 76-26x</td>
<td>Document Design* 76-480</td>
<td>Advanced Professional &amp; Technical Writing 76-470</td>
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</tr>
<tr>
<td>Interpretive Practices 76-294</td>
<td>Theory/ Specialization Course</td>
<td>Theory/ Specialization Course</td>
<td>On-Line Information Design* 76-487</td>
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<tr>
<td>TC Elective</td>
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</tbody>
</table>

* Because of prerequisites and course scheduling, it is critical that these course be taken in this order and in the semester (fall or spring) indicated in order to complete the degree in two years.
TWC / SMC Track

Sample Curriculum

This plan is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years not that it should or must be. In fact, as a department, we recommend beginning the major in the sophomore year if possible. Students in H&SS may declare a major as early as mid-semester of the spring of their first year and begin major requirements the following fall.

<table>
<thead>
<tr>
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<td></td>
</tr>
<tr>
<td>Interpretive Practices 76-294</td>
<td>TC Elective</td>
<td>Natural Science/ Engineering Course</td>
<td>On-Line Information Design* 76-487</td>
<td></td>
</tr>
<tr>
<td>Natural Science/ Engineering Course</td>
<td>TC Elective</td>
<td>TC Elective</td>
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</tbody>
</table>

* Because of prerequisites and course scheduling, it is critical that these course be taken in this order and in the semester (fall or spring) indicated in order to complete the degree in two years.

Completing an Additional Major in English

Students with interests that include more than one of the department’s degrees have the option of completing a double major within the department. Students may double major in any combination of the B.A. degrees or combine the B.S. in Technical Writing and Communication with either the B.A. in English or the B.A. in Creative Writing. Students may not combine the B.A. in Professional Writing and the B.S. in Technical Writing for a double major because so many of the courses overlap.

Students majoring in two or more English department degrees must fulfill the Core Requirements for the Major for both programs. The two courses of the English Department Core — Interpretive Practices and Survey of Forms — need to be taken only once to count toward both majors. Similarly, the English Electives need to be taken only once and can count toward both majors with the understanding that a student must complete the number of English Electives required by the program with the higher number of Electives. For example, a student double-majoring in the B.A. in English and the B.A. in Creative Writing would take the 4 English Electives required for Creative Writing.

Because the two English Department Core courses and the English Electives are allowed to double count toward both majors, students who are already majoring in one of the English degrees can generally add a second English major by completing 5 to 6 additional courses. For example, a student who has fulfilled all 11 requirements for the BA in English can complete the BA in Creative Writing by adding the 5 courses of the Creative Writing Core: one additional Survey of Forms course plus 4 Writing Workshops. Because sequencing of courses can become an issue when doing multiple majors, students are strongly advised to consult closely with their English Department advisors about the sequence of their courses.

Completing a Secondary Major in English

Students in other departments who wish to complete a secondary major in the English Department should contact the Academic Coordinator in the English Department Office to file an additional major application form and be assigned to an English Department advisor. Secondary majors in the four English degrees are required to complete all requirements for the chosen major. Additionally, courses taken to fulfill requirements within the primary major may not double count for requirements within the chosen English Department degree. The only exceptions to this rule are the TC electives for the TWC/TC degree and the Natural Science and Engineering requirements for the TWC/SMC degree. In planning schedules for an additional major, it is critically important that students consult with both departments in which they are majoring to be sure that all requirements for graduation can be met.

Minor in English

The English Department also offers a minor in English, with concentrations in Creative Writing, English Studies, Professional Writing, and Technical Writing. The minor requires a minimum of five courses (45 units), plus completion of (or credit for) 76-101 or an equivalent requirement. The minor in English is available to all undergraduate students except English majors, who may not both major and minor in English.

Courses taken to fulfill requirements in other major or minor programs may not be applied to English minor requirements (and vice versa).

Courses that meet the various requirements are advertised on a semester-by-semester basis. Full descriptions are available each semester from the English Department main office. We also publish a document titled “What Counts for What for Minors,” which indicates which courses offered in a given term fulfill specific requirements in each of the minor concentrations.

English Studies Concentration

Complete 6 courses, including 76-101 as a prerequisite.

- 76-101 Interpretation & Argument (or credit for equivalent course)
- 76-294 Interpretive Practices (prerequisite for 300- and 400-level courses)
- 76-3xx Two 300-level courses in Literature, Cultural Studies or Rhetoric
- 76-3xx/4xx One additional 300-level course or a 400-level seminar in Literature, Cultural Studies, or Rhetoric *
- 76-xxx One 200-level or above English Elective **

* Note that at least some 400-level seminars have 76-394: Research in English Studies as a pre- or co-requisite. Students planning to take a 400-level seminar to fulfill this requirement should plan to take 76-394 as one of their 300-level courses.

** The English Elective may be any course offered by the English Department except 76-201, 76-205, and 76-206, all of which are designed primarily for non-majors.

Creative Writing Concentration

Complete 6 courses, including 76-101 as a prerequisite.

- 76-101 Interpretation & Argument (or credit for equivalent course)
- 76-260/265 Survey of Forms: Fiction* or Poetry *
- 76-36x/46x Two Fiction or Poetry Workshop courses
- 76-xxx One 200-level or above Literature Course
- 76-xxx One 200-level or above English Elective **

* A student must receive a grade of A or B in the Survey of Forms class in order to be eligible to enroll in a workshop of that genre. A student who receives a grade of C in a Survey of Forms course may enroll in a related workshop only with the permission of his or her workshop professor. A student who receives a D or R in Survey of Forms may not take a workshop in that genre.

** The English Elective may be any course offered by the English Department except 76-201, 76-205, and 76-206, all of which are designed primarily for non-majors.
Professional Writing Concentration
Complete 6 courses, including 76-101 as a prerequisite.
76-101 Interpretation & Argument (or credit for equivalent course)
76-270 Writing in the Professions
or
76-271 Introduction to Professional & Technical Writing
76-3xx/4xx Two 300- or 400-level Writing courses *
76-3xx/4xx One Rhetoric/Language Studies course
76-xxx One 200-level or above English elective**

* 76-270 or 76-271 is generally the prerequisite for these 300- and 400-level courses. Options include 76-318, 76-319, 76-372, 76-375, 76-389, 76-390, 76-395, 76-396, 76-397, 76-461, 76-470, 76-472, 76-479, 76-480, 76-481, 76-487, 76-494, and other options advertised on a semester-by-semester basis.

** The English Elective may be any course offered by the English Department except 76-201, 76-205, and 76-206, all of which are designed primarily for non-majors.

Technical Writing Concentration
Complete 6 courses, including 76-101 as a prerequisite.
76-101 Interpretation & Argument (or credit for equivalent course)
76-271 Introduction to Professional & Technical Writing
76-3xx/4xx Two 300- or 400-level courses* from these options:

76-318 Communications in the Global Marketplace
76-383 Multimedia Authoring II
76-385 Introduction to Discourse Analysis
76-390 Style
76-397 Instructional Design
76-392 Rhetoric and Public Policy
76-470 Advanced Professional and Technical Writing
76-480 Document Design
76-487 On-Line Information Design
76-476 Rhetoric of Science
76-481 Writing for Multimedia
76-494 Medical Communication
76-3xx/4xx One Rhetoric/Language Studies course
76-xxx One 200-level or above English elective**

* 76-271 is a prerequisite for these courses. Additionally, 76-480 is a prerequisite for 76-487.

** The English Elective may be any course offered by the English Department except 76-201, 76-205 and 76-206, all of which are designed primarily for non-majors.

Senior Honors Thesis
Seniors in all four majors in the English Department who meet the necessary requirements are invited by the College of Humanities and Social Sciences (H&SS) to propose and complete a Senior Honors Thesis during their final year of study. The thesis may focus on research and/or original production in any of the areas offered as a major within the Department. To qualify for the H&SS Honors Program, students must have a cumulative Quality Point Average of at least 3.50 in their major and 3.25 overall at the end of their junior year and be invited by H&SS to participate. Students then choose a thesis advisor within the Department and propose and get approval from H&SS for a Senior Honors Thesis. The Honors Thesis is completed over the two semesters of the senior year (9 units each semester) under the direction of the chosen advisor. By successfully completing the thesis, students earn 18 units of credit and qualify for graduation with "College Honors.

Internship Program
Qualified students in all four of the Department’s degree programs have the option of doing one or more professional internships for academic credit during their junior or senior years. These opportunities help students explore possible writing-related careers as well as gain workplace experience. Each internship is arranged, approved, and overseen by the Department’s Internship Coordinator. Particular attention is given to matching students to internship sites of specific interest to them. Students have interned in a wide variety of communications-related positions including placements at local radio, television, and print publications; museums, theaters, and cultural organizations; non-profit and public service organizations; public relations, advertising, and marketing firms; software and technology companies; and hospitals and medical communication concerns.

To be eligible for an internship, students must have a Quality Point Average of 3.0 or better and credit for at least one writing course (including Survey of Forms) beyond 76-101. Internships generally carry 3-9 units of credit. A 9-unit internship is the standard and requires a minimum of 120 hours (8-10 hours per week) of work at the internship site during the term. In addition, interns complete a reflective journal and a series of short research and writing assignments relevant to the specific internship. Students doing an internship for credit must be registered for the internship during the term (including summer) when they are working at the internship site.

The MAPW 4+1 Program
Undergraduate majors in any of the department’s four programs may apply for admission to the Master of Arts in Professional Writing (MAPW) during their junior or senior year. Students in any of the undergraduate majors in English who have taken undergraduate courses in Rhetoric and Professional or Technical Writing that match requirements in the MAPW program may, upon evaluation of their undergraduate courses by the Director of the MAPW program, receive credit for up to four courses, or one full semester of work, toward the M.A. requirements. Such credit will reduce the coursework requirements for the MAPW program from the usual three semesters to two (plus the summer internship required of all MAPW students).

Students, including Bachelor of Humanities and Arts (BHA) students with concentrations in English, who are interested in applying to the program should consult the Director of the MAPW program early in their junior year for further details and advice on shaping undergraduate coursework to qualify for this option.

Faculty
MARIAN AGUIAR, Assistant Professor of English and Literary and Cultural Studies — Ph.D., University of Massachusetts; Carnegie Mellon, 2002 —.
STEPHANIE BATISTE, Assistant Professor of English and Literary and Cultural Studies — Ph.D., The George Washington University; Carnegie Mellon, 2003 —.
JANE BERNSTEIN, Associate Professor of English and Creative Writing — M.F.A., Columbia University; Carnegie Mellon, 1991 —.
ANTHONY BUTTS, Assistant Professor of English and Creative Writing — Ph.D., University of Missouri-Columbia; Carnegie Mellon, 2001 —.
GERALD P. COSTANZO, Professor of English and Creative Writing — M.A., M.A.T., Johns Hopkins University; Carnegie Mellon, 1970 —.
JAMES DANIELS, Thomas S. Baker Professor of English and Creative Writing — M.F.A., Bowling Green State University; Carnegie Mellon, 1981 —.
SHARON DILWORTH, Associate Professor of English and Creative Writing — M.F.A., University of Michigan; Carnegie Mellon, 1989 —.
LINDA FLOWER, Professor of English and Rhetoric — Ph.D., Rutgers University; Carnegie Mellon, 1980 —.
TERRANCE HAYES, Associate Professor of Creative Writing — M.F.A., University of Pittsburgh; Carnegie Mellon, 2001 —.
PAUL HOPPER, Paul Mellon Distinguished Professor of the Humanities, Rhetoric and Linguistics — Ph.D., University of Texas; Carnegie Mellon, 1990 —.
SUGURU ISHIZAKI, Associate Professor of Rhetoric and Visual Design — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2005 —.
BARBARA JOHNSTONE, Professor of Rhetoric and Linguistics — Ph.D., University of Michigan; Carnegie Mellon, 1997—.

DAVID S. KAUFER, Professor of English and Rhetoric; Head of the English Department — Ph.D., University of Wisconsin; Carnegie Mellon, 1980—.

ALAN KENNEDY, Professor of English — Ph.D., University of Edinburgh; Carnegie Mellon, 1989—.

JON KLANCHER, Associate Professor of English — Ph.D., University of California at Los Angeles; Carnegie Mellon, 1999—.

PEGGY A. KNAPP, Professor of English — Ph.D., University of Pittsburgh; Carnegie Mellon, 1970—.

HILARY MASTERS, Professor of English and Creative Writing — A.B., Brown University; Carnegie Mellon, 1983—.

JANE McCAFFERTY, Associate Professor of English and Creative Writing — M.F.A., University of Pittsburgh; Carnegie Mellon, 1997—.

CHRISTINE NEUWIRTH, Professor of English and Human Computer Interaction — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1983—.

KATHLEEN NEWMAN, Associate Professor of English and Literary and Cultural Studies — Ph.D. Yale University; Carnegie Mellon, 1997—.

ANDREEA RITIVOI, Assistant Professor of Rhetoric — Ph.D., University of Minnesota; Carnegie Mellon, 2001—.

KAREN SCHNACKENBERG, Associate Teaching Professor in Rhetoric and Professional Writing — Ph.D. Carnegie Mellon University; Carnegie Mellon, 1995 —.

DAVID R. SHUMWAY, Professor of English and Literary and Cultural Studies — Ph.D., Indiana University; Carnegie Mellon, 1985—.

ERWIN R. STEINBERG, Professor of English and Rhetoric — Ph.D., New York University; Carnegie Mellon, 1946—.

KRISTINA STRAUB, Professor of English and Associate Head of the English Department — Ph.D., Emory University; Carnegie Mellon, 1987—.

JEFFREY WILLIAMS, Professor of English and Literary and Cultural Studies — Ph.D. SUNY— Stoneybrook; Carnegie Mellon, 2004 —.

MICHAEL WITMORE, Associate Professor of English and Literary and Cultural Studies — Ph.D., University of California—Berkeley; Carnegie Mellon, 1999—.
Undergraduate programs in History focus on new ways to understand the past and new ways to use what we know. The programs all deal with connections between past and present and the ways historical understanding facilitates the assessment of social, cultural, and policy change. The programs emphasize analysis and empirical methods in developing conceptual understanding. In addition, specific research skills relevant to many types of jobs as well as to further professional training are taught. The Department's mission also includes courses introducing students to various societal settings and diverse types of controversial public issues, thus contributing actively to students' liberal and professional development.

Each of the History programs combines a structured sequence, training in research methods and relevant theory, and a considerable array of electives. Each program stems from the teaching and research strengths of a department that has led in the formulation of a number of innovative approaches to the study of social and policy change. Carnegie Mellon's Department of History is nationally known for its strength in three broad areas: Social and Cultural History, History and Policy, and Anthropology and History. Social and Cultural History is the effort to understand the past as it was experienced and shaped by people at various levels, from lower class to elite. Social historians do research in such areas as how families and communities developed, how people's work lives were organized and how they used their leisure time, what they believed and felt, and how they related to the authority of the state and other sources of power in their particular society. History and Policy uses historical explanation and analysis to inform the interpretation and formulation of policy in both the public and private sectors. Policy historians bring to contemporary social issues a perspective on change and innovation that others (for example, legislators or operations researchers) often lack. Anthropology and History takes advantage of the fruitful interaction between theories and methodologies elaborated in both disciplines to provide a more profound analysis of social processes or cultures of the people that they study.

The History Department supports several research centers to coordinate sponsored research by faculty and graduate students. The research centers include the Center for History and Policy (Caroline Acker, Director); the Center for Business, Technology, and the Environment (Joel A. Tarr, Director; David A. Hounshell, Associate Director); and the Center for African American Urban Studies and the Economy (CAUSE) (Joe W. Trotter, Director; Tera Hunter, Associate Director). The department also supports The Center for Arts and Society (Judith Schachter, Director); and the Center for Historical Information Systems and Analysis (CHISA) (David Miller, Director).

The Department of History offers B. A. and B. S. degrees in Social and Cultural History, History and Policy, and Anthropology and History. Each of these majors is described below.

The Majors in History

The study of history involves not only the mastery of a body of subject matter, but also the development of a range of skills which are broadly applicable in modern society. Exploration of patterns in the past aids in understanding the workings of human society, while historical research and study promote abilities in handling and interpreting data that have a variety of uses. The Carnegie Mellon History programs are devoted to innovative approaches to history and to the development of key skills.

History provides a springboard to a number of career options. There is, of course, a profession of history, composed largely, but not exclusively, of historians who teach and conduct research in colleges and universities. The normal way to enter that profession is to complete a Ph.D. in the history department of a major university, and several undergraduate students with a major in the History Department go on to do just that. Most students who complete a major in the History Department, however, do not become professional historians in the sense that this term is normally used. History as a major is often chosen by students who plan to enter a profession which will require training in a post-baccalaureate professional school, such as law, business administration, public policy, urban planning, librarianship, journalism, the ministry, or social work. Most schools in these fields prefer students who have used their undergraduate years to acquire a strong liberal education and a broad perspective on human problems such as one gained by majoring in History, rather than students with narrowly specialized programs and skills.

History is also excellent preparation for certain specific careers which can be entered immediately upon graduation. The U. S. Foreign Service is one traditional avenue for History majors, especially those who have also acquired language skills, and there are a number of other government agencies that recruit History and other liberal arts graduates. Because History courses emphasize research and writing skills plus analysis of social and policy trends, journalism and editorial work are also natural careers for History majors.

The horizons for a student with a major in the History Department include business careers as well. Most majors in the History Department, at Carnegie Mellon and elsewhere, take jobs in business, and research shows that History majors have better than average career success in management. Because they have been trained to analyze subtle and complex issues, because they develop breadth of understanding, because they are accustomed to digging out information and making sense of it, and because they have learned to present their findings effectively, students with a major in the History Department do extremely well in many different types of organizations, both public and private, throughout their careers. A major in History provides the general skills and sense of perspective that continue to be of value as one advances to positions of greater responsibility in an organization. At the same time, Carnegie Mellon History majors are encouraged to take full advantage of complementary areas of study in the College and the University that offer other specific skills and perspectives that are an important professional addition to a major in History. Some students combine History with work in another specialty such as Business, Economics, Professional Writing, Statistics, Philosophy, Political Science, or Modern Languages.

The Department also offers a minor in History. Several other minors, described throughout this catalog, can be linked with any of the History majors to provide additional depth. These include H&S S minors in such fields as Gender Studies; Film and Media Studies; International Relations; Religious Studies; Minority Studies; Environmental Studies; Policy and Management; and Russian Studies. Additional examples include minors offered in the arts, engineering, science, mathematics, business, and computer science.

History is also a central component of four interdepartmental majors described elsewhere in this catalog: Ethics, History, and Public Policy; European Studies; Russian Studies; and International Relations.

The Major in Anthropology and History

Students who major in Anthropology and History learn to use both disciplines in analyzing pattern and change in human societies. The major examines the ways in which anthropological theories and methods can enrich an understanding of historical processes and events. The major also points to the ways historical method can strengthen the cross-cultural and ethnographic approaches central to anthropology. Throughout, the value of interdisciplinary work is emphasized.

In two preliminary courses, students are exposed to the basic concepts and perspectives of each discipline. At the intermediate level they select from two sets of courses combining historical and anthropological analysis: thematic courses that relate culture and symbols to institutions, daily life, and social change; and regional courses that allow students to study an evolving culture and society in its own terms as well as ours. In the senior year, students undertake original research which may combine field work and archival work.
Besides supplying a solid preparation for graduate work in history or anthropology, the major offers a gateway to careers in journalism, law, government, and business, especially as these address matters of multicultural or international concern. Its training in comparative and historical thinking will also be valuable in such professions as teaching, design, and medicine.

**Curriculum**

Students majoring in Anthropology and History normally are awarded a B.A. degree. Students should consult with departmental advisors about their course of study when declaring their major. The B.S. degree requires 36-201, Statistical Reasoning, and is awarded when it is deemed appropriate after review of a student's overall undergraduate record including second majors, minors, and elective courses.

**Prerequisite Course**

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<tr>
<th>Course</th>
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<tr>
<td>79-104 Introduction to World History</td>
<td>9</td>
</tr>
<tr>
<td>79-201 Introduction to Anthropology</td>
<td>9</td>
</tr>
<tr>
<td>79-200 Historical Evidence and Interpretation</td>
<td>12</td>
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</tbody>
</table>

This course focuses on a single critical event in history (e.g., the French Revolution, the Cuban missile crisis). Materials in the course will include examples of various types of explanation as well as primary sources. The course is a common experience for students in this major and in the History and Policy and the Social and Cultural History majors.

**Theory and Practice in Anthropology (1)**

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<thead>
<tr>
<th>Course</th>
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</tr>
</thead>
<tbody>
<tr>
<td>79-209 Theory and Practice in Anthropology</td>
<td>9</td>
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</tbody>
</table>

**Regional Courses (3)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>79-207 Development of European Culture</td>
<td></td>
</tr>
<tr>
<td>79-253 Development of Caribbean Culture</td>
<td></td>
</tr>
<tr>
<td>79-254 The Pacific Islands: History and Culture</td>
<td></td>
</tr>
<tr>
<td>79-255 Irish History</td>
<td></td>
</tr>
<tr>
<td>79-258 Introduction to African History: 18th Century to Neo-Colonialism</td>
<td></td>
</tr>
<tr>
<td>79-260 Mayan America</td>
<td></td>
</tr>
<tr>
<td>79-267 Pre Colonial West African History 1100 to 1800</td>
<td></td>
</tr>
<tr>
<td>79-268 From the Local to the Global: Africa in the World</td>
<td></td>
</tr>
<tr>
<td>79-270 Chinese Culture and Society</td>
<td></td>
</tr>
<tr>
<td>79-271 Modern China</td>
<td></td>
</tr>
<tr>
<td>79-288 Bananas, Baseball, and Borders: Latin America and the US from Alamo to Drug War</td>
<td></td>
</tr>
<tr>
<td>79-289 Society and Culture in South Asia</td>
<td></td>
</tr>
<tr>
<td>79-290 Between Revolutions: The Emergence of Modern Latin America, 1789-1917</td>
<td></td>
</tr>
<tr>
<td>79-297 Freedom Bound: Slavery/Emancipation in Brazil &amp; the Caribbean, 1789-1940</td>
<td></td>
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<tr>
<td>79-305 Representing Pacific Cultures</td>
<td></td>
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<tr>
<td>79-307 The Anthropology of Europe</td>
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<tr>
<td>79-310 Culture and Power in Europe, 1945-2000</td>
<td></td>
</tr>
<tr>
<td>79-356 Introduction to African History: Earliest Times to the Origins of the Slave Trade</td>
<td></td>
</tr>
<tr>
<td>79-374 Women in Modern India</td>
<td></td>
</tr>
</tbody>
</table>

**Thematic Courses (2)**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>79-210 Picturing Others: A Course on Ethnographic Film</td>
<td></td>
</tr>
<tr>
<td>79-301 Ritual, Culture and Identity</td>
<td></td>
</tr>
<tr>
<td>79-303 Visual Anthropology</td>
<td></td>
</tr>
<tr>
<td>79-308 The Politics and Culture of Memory</td>
<td></td>
</tr>
<tr>
<td>79-348 Objects of Value</td>
<td></td>
</tr>
<tr>
<td>79-364 Art, Anthropology, and Empire</td>
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</tr>
</tbody>
</table>

**Advanced Studies in Anthropology and History (1)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>79-400 Advanced Studies in Anthropology and History</td>
<td></td>
</tr>
</tbody>
</table>

*prerequisites: 79-200, 79-201 and 79-209

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## Anthropology and History, B.A. and B.S.

### Sample Curriculum

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Fall</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Anthropology 79-201</td>
<td>Theory &amp; Practice 79-209</td>
<td>Intermediate Regional Course 79-xxx</td>
<td>Intermediate Regional Course 79-xxx</td>
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</tr>
<tr>
<td>Intermediate Thematic Course 79-xxx</td>
<td>Intermediate Regional Course 79-xxx</td>
<td>Advanced Studies in Anthropology and History 79-400</td>
<td>Elective</td>
<td></td>
</tr>
<tr>
<td>Historical Evidence &amp; Interpretation 79-200</td>
<td>Intermediate Thematic Course 79-xxx</td>
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<td>Elective</td>
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<tr>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
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</tbody>
</table>

This is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years; not that it must be. Students may enter their major, and begin major course requirements, as early as the start of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

### Additional Major

Anthropology and History may be scheduled as an additional major in consultation with the departmental heads concerned.

### The Major in History and Policy

The History and Policy major is designed to develop a special kind of policy analyst who applies the skills and interests of historians to current problems of policy in government and business. Besides providing a thorough grounding in historical analysis, the History and Policy major includes courses on theories of public policy and the role of the state. Other courses focus on specific policy areas such as urban planning, business development and regulation, the environment, public health, criminal justice, foreign policy, education, and social welfare. The major culminates with the History and Policy Project Course, in which students act as a team of consultants who apply historical research to a contemporary policy problem and present the results to a client organization in the community. The major will strengthen a student’s qualifications for a variety of positions in research, management, policy analysis, and policy development.

Historical perspective enriches policy analysis in several ways. Majors in History and Policy use historical analysis and archival research to investigate the ways in which decisions have been made in societies in the past, with the goal of bringing historical understanding to bear on the making of decisions in the present and on projects for the future. History and Policy prepares students to use comparisons with past policy effectively so that experience can properly contribute to recommendations and decision-making in the present. It develops an ability to assess social trends, in order to establish both continuities and discontinuities as the context for determining appropriate policy.

Students also apply tools from other disciplines such as the social sciences to evaluate policy problems and to study how problems have been recognized, formulated, and assessed.

Carnegie Mellon has pioneered in the systematic application of historical perspective to policy issues. The History and Policy major prepares students for work in a number of policy areas while also serving as excellent preparation for graduate work in public policy, management, law, public health, journalism, social work, and business administration. At the same time, students are broadly prepared for intelligent participation in decision making in the leading problem areas of contemporary society.
Curriculum

Students majoring in History and Policy normally are awarded a B.A. degree. Students should consult with departmental advisors about their course of study when declaring their major. The B.S. degree requires 36-201, Statistical Reasoning, and is awarded when it is deemed appropriate after a review of a student’s overall undergraduate record including second majors, minors, and elective courses.

Prerequisite Course 9 units
79-104 Introduction to World History

Survey Course 9 units
Choose one survey course from among the following:
79-206 Development of American Culture
79-207 Development of European Culture
79-253 Development of Caribbean Culture
79-258 Introduction to African History: 18th Century to Neo-Colonialism
79-270 Chinese Culture and Society
79-281 Modern Soviet History: From Communism to Capitalism
79-290 Between Revolutions: The Emergence of Modern Latin America, 1789-1917
79-356 Introduction to African History: From the Earliest Times to the Origins of the Slave Trade

Historical Evidence and Interpretation (1) 12 Units
79-200 Historical Evidence and Interpretation

This course focuses on a single critical event in history (e.g., the French Revolution, the Cuban missile crisis). Materials in the course will include examples of various types of explanation as well as primary sources. The course is a common experience for students in this major and in the Anthropology and History and the Social and Cultural History majors.

History and Policy Introductory Courses (2) 18 units
79-202 The History of Public Policy in the United States
79-208 Theory and Practice in History and Policy*
* Prerequisite: 79-202; Open only to declared majors in History and Policy

Public Agenda History Courses (4)* 36 units
Choose four courses from among the following; at least one of the four courses must have an international orientation.
79-230 Technology in American Society
79-231 American Foreign Policy: 1945 to the Present
79-232 Vietnam: America's Lost War
79-233 The United States and the Middle East Since 1945
79-242 African-American History II
79-244 Pittsburgh and the Transformation of Modern Urban America
79-256 Biology and Society
79-282 The Soviet Union in World War II: Military, Political and Social History
79-288 Bananas, Baseball, and Borders: Latin America and the US from Alamo to Drug Wars
79-289 Society and Culture in South Asia
79-304 Government Response to Market Failures
79-330 The American Presidency
79-331 Crime and Punishment in American History
79-332 Juvenile Delinquency: Images, Realities and Shaping of Public Policy 1800-1960
79-335 Drug Use and Drug Policy
79-336 Epidemic Disease and Public Health
79-337 Educational Policy: Historical Perspectives
79-344 The Cold War and Beyond
79-345 American Environmental History: Critical Issues
79-354 Stalin and Stalinism
79-358 Complex Technological Systems: Past, Present, and Future
79-368 Poverty, Charity and Welfare in Historical Perspective
79-386 The Global Environment: Historical Perspectives and Policy Dilemmas
79-397 Religion and Politics in the Middle East
79-440 The Rise of Industrial Research and Development

* With advance approval by the Undergraduate Advisor, students may substitute one social science course from another department or school (e.g., SDS, EPP, Philosophy, Statistics, Heinz School) that adds depth to specific policy history interests.

History and Policy Project Courses (2) 18 units
79-409 History and Policy Project Course Mini*
79-410 History and Policy Project Course**
* Prerequisites: 79-200, 79-202, 79-208
** Prerequisites: 79-200, 79-202, 79-208, 79-409

History and Policy, B.A. and B.S.

Sample Curriculum

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Senior Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>Survey Course 79-xxx</td>
<td>Public Agenda Course 79-xxx</td>
</tr>
<tr>
<td>Historical Evidence &amp; Interpretation 79-200</td>
<td>Theory and Practice in History and Policy 79-208</td>
</tr>
<tr>
<td>The History of Public Policy in the U.S. 79-202</td>
<td>History and Policy Project Course Mini 79-409</td>
</tr>
<tr>
<td>Elective</td>
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<tr>
<td>Elective</td>
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</tr>
</tbody>
</table>

This is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years, not that it must be. Students may enter their major and begin major course requirements, as early as the start of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

Additional Major

History and Policy may be scheduled as an additional major in consultation with the departments concerned.

The Major in Social and Cultural History

The Department has a national reputation in Social and Cultural History. Social and Cultural History can best be understood as the effort to understand the past as it was experienced and shaped by people at various social levels, from lower classes to elite. The Social and Cultural History major involves courses in labor, immigration, race, gender, politics and leisure, as well as in the history of culture. The Social and Cultural History major is also explicitly comparative in nature, reflecting a multi-cultural approach to the study of history. The major, finally, allows a wide range of choice in electives.

The Social and Cultural History major provides a good background for a wide variety of careers. It is excellent preparation for professional studies, such as law, but also for management programs and the ministry. Many Social and Cultural History majors also find employment in government, business, and with public action groups, or in any field that prizes the ability to analyze materials and to write and think clearly.
Curriculum

Students majoring in Social and Cultural History normally are awarded a B.A. degree. Students should consult with departmental advisors about their course of study when declaring their major. The B.S. degree requires 36-201, Statistical Reasoning, and is awarded when it is deemed appropriate after a review of a student's overall undergraduate record including second majors, minors, and elective courses.

Prerequisite Course

- 9 units
- 79-104 Introduction to World History

Survey Courses (2)

- Development of American Culture
- Development of European Culture

- 18 units

Historical Evidence and Interpretation (1)

- Historical Evidence and Interpretation
- 12 Units

This course focuses on a single critical event in history (e.g., the French Revolution, the Cuban missile crisis). Materials in the course will include examples of various types of explanation as well as primary sources. The course is a common experience for students in this major and in the Anthropology and History and the History and Policy majors.

Social & Cultural History

Distribution Requirements (5)

Five history courses at the 200/300 level. Of these five courses:
- one must be on African, Asian, Latin American/Caribbean, or Russian history,
- one must be substantially devoted to the period before 1900,
- two must deal with the same major geographic region (e.g. U.S., Europe, Russia, Latin America/Caribbean, East Asia).
- one additional course
- No Double-Counting

Advanced Studies in Social and Cultural History (1)

- Advanced Studies in Social and Cultural History
- 12 units

*prerequisite: 79-200

** Majors in Social and Cultural History are also encouraged to consult with faculty about opportunities for undertaking their own research projects by enrolling in 79-421, Social and Cultural History Research Seminar and/or completing a Senior Thesis.

Advanced Courses (4)

- 36 units

Internship Program

The History Department offers internships (or supervised off-campus work experiences) designed for qualified junior and senior majors in History, International Relations or Ethics, History, and Public Policy. In general, a QPA of 3.0 or better is required. Internships carry 3-9 units. Internships are available on a pass/fail basis only. Each internship is arranged, approved, and overseen by the Department's Internship Director. Students have been placed at a wide variety of internship sites including: Carnegie Museums, WQED, The Juvenile Court Project, ACLU, Senator John Heinz Pittsburgh Regional History Center, and The Urban League.

Undergraduate Research Fellow

Highly qualified history majors with prior research experience may apply to serve in their senior year as research fellows in one of the department's several research centers. Permission of Department Head is required.
Senior Thesis
Seniors may write a thesis with permission of the Director of Undergraduate Studies and a designated faculty member who will supervise its completion. By completing the thesis, the student earns 18 units of credit.

Senior Honors Thesis
The Honors Program provides recognition of outstanding performance by students in Social and Cultural History, History and Policy, and Anthropology and History. By completing the thesis, the student earns 18 units of credit and qualifies for graduation with College Honors. To qualify for the Honors Program, the student must maintain a QPA of at least 3.50 in the major and 3.25 overall, and be invited to become a participant.

Faculty
CAROLINE ACKER, Associate Professor of History – Ph.D., University of California, San Francisco; Carnegie Mellon, 1993–.
SUSAN AMBROSE, Teaching Professor of History; Director, The Eberly Center for Teaching Excellence – D.A., Carnegie Mellon University; Carnegie Mellon, 1986–.
JAY D. ARONSON, Assistant Professor of History - Ph.D., University of Minnesota; Carnegie Mellon, 2004–.
PAUL EISS, Assistant Professor of Anthropology and History – Ph.D. University of Michigan; Carnegie Mellon, 2000–.
EDDA FIELDS-BLACK, Assistant Professor of History – Ph.D., University of Pennsylvania, Carnegie Mellon, 2001–.
WENDY Z. GOLDMAN, Professor of History – Ph.D., University of Pennsylvania; Carnegie Mellon, 1988–.
DONNA HARSCH, Associate Professor of History – Ph.D., Yale University; Carnegie Mellon, 1990–.
DAVID A. HOUSHEL, Roderick Professor of Technology and Social Change – Ph.D., University of Delaware; Carnegie Mellon, 1991–.
TERA W. HUNTER, Associate Professor of History – Ph.D., Yale University; Carnegie Mellon, 1996–.
KATHERINE A. LYNN, Professor of History – Ph.D., Harvard University; Carnegie Mellon, 2008–.
RICHARD MADDOX, Professor of Anthropology and History – Ph.D., Stanford University; Carnegie Mellon, 1993–.
DAVID W. MILLER, Professor of History – Ph.D., University of Chicago; Carnegie Mellon, 1967–.
SCOTT SANDAGE, Associate Professor of History – Ph.D. Rutgers University; Carnegie Mellon, 1995–.
JUDITH SCHACHTER, Professor of Anthropology and History; Director, Center for the Arts in Society – Ph.D., University of Minnesota; Carnegie Mellon, 1984–.
STEVEN SCHLOSSMAN, Professor of History – Ph.D. Columbia University; Carnegie Mellon 1988–.
JAYEETA SHARMA, Assistant Professor of History - Ph.D., St. Catharine’s College in the University of Cambridge; Carnegie Mellon, 2003–.
KIRON SKINNER, Assistant Professor of History and Political Science – Ph.D. Harvard University; Carnegie Mellon, 1999–.
JOHN SOLURI, Associate Professor of History – Ph.D. University of Michigan; Carnegie Mellon, 1999–.
DONALD S. SUTTON, Professor of History and Anthropology – Ph.D., Cambridge University, England; Carnegie Mellon, 1969–.
JOEL A. TARR, Richard S. Caliguiri University Professor – Ph.D., Northwestern University; Carnegie Mellon, 1967–.
JOE WILLIAM TROTTER, Mellon Professor of History; Head, Department of History – Ph.D., University of Minnesota; Carnegie Mellon, 1985–.

Adjunct Faculty
JOSEPH E. DEVINE, Adjunct Professor of History; Associate Dean, College of Humanities and Social Sciences – D.A., Carnegie Mellon University; Carnegie Mellon, 1979–.
LAURIE Z. EISENBERG, Adjunct Professor of History - Ph.D., University of Michigan; Carnegie Mellon University, 1992–.
NAUM KATS, Adjunct Professor of History - Ph.D., University of Saint Petersburg; Carnegie Mellon, 1990–.
ROBERT W. KIGER, Adjunct Professor of History; Director, Hunt Institute for Botanical Documentation – Ph.D., University of Maryland; Carnegie Mellon, 1974–.
Department of Modern Languages

The study of a foreign language is not only desirable but essential for successful integration into our current multinational, pluralistic world. If the United States is to achieve and maintain its respected leadership position in the world, it is incumbent upon us to educate citizens who will be sensitive to other cultures and capable of communicating in other languages. Proficiency in a foreign language by itself, or combined with other professional training, may lead to a variety of rewarding careers. Moreover, the personal experience of mastering another language is enriching and gratifying.

The Majors in French & Francophone Studies, German, Japanese and Hispanic Studies

Modern Languages majors are available in French & Francophone Studies, German, Japanese, and Hispanic Studies as well as in English as a Second Language (ESL), European Studies and Russian Studies. These majors are designed to lead to acquisition of communicative language proficiency and substantive knowledge of other cultures.

Drawing on the unique interdisciplinary climate of the Carnegie Mellon campus, the undergraduate major in Modern Languages encourages the acquisition of multiple skills by students with varied backgrounds, talents and interests. An important resource in support of these goals is the Modern Language Resource Center, which is a state-of-the-art facility that provides students with access to authentic foreign language materials such as original television broadcasts, interactive video projects and computerized assessment tools.

Students majoring in a modern language are also encouraged to enroll, preferably during their junior year, in a study-abroad program or to spend a summer abroad at a language institute or in an internship. Semester or year-long programs are available in China, France, Germany, Japan, Russia, Spain and Latin America. The Department also sponsors summer language courses in China, France, Germany, Japan, Russia and Spain (see course offerings). Foreign film series, informal conversation tables, native-speaker conversation partners, writing assistants, and Student Advisory Committee cultural events are some of the activities organized by the Department of Modern Languages to increase students' ability in their chosen languages.

The major in Modern Languages is designed to permit students to acquire communicative language proficiency in their language of specialization. Courses in literature, culture and civilization offer students a solid introduction to the main currents in national literatures as well as artistic and social movements. These courses also provide close study of specific movements, genres, national or regional histories, literatures and cultures while continuing to promote skill development in reading, writing, and aural/oral communication. In addition, the student who majors in Modern Languages will develop a perspective on the learning and use of second languages, from both a social and cognitive point of view, within contemporary American society and in an increasingly global community. Working closely with their advisor, language majors are guided to develop personal interests by taking courses in other disciplines such as fine arts, history, psychology, philosophy and English which often include readings, discussions and papers in the foreign language. The rich technological environment of the campus (computers, videodisks and satellite linkups) strongly enhances all fields of language study.

Second language proficiency is seen as an asset which enhances the study of other fields and which will provide students with practical as well as theoretical bases for a variety of paths after graduation. Students will be prepared to pursue graduate studies in second language-related fields (e.g., linguistics, literature, second language acquisition) or they may use their undergraduate background as a complement to careers in fields such as the arts, government or public service, business and management, law and other areas in which proficiency in a second language is an asset.

Curriculum

Seven specializations are available to Modern Languages majors:

- French
- German
- Japanese
- Spanish
- European Studies
- Russian Studies
- Hispanic Studies

Language-specific faculty advisors for these specializations are:

<table>
<thead>
<tr>
<th>Faculty Advisors</th>
<th>For Students in Majors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beryl Schlossman, Professor of French</td>
<td>French</td>
</tr>
<tr>
<td>Stephen Brockmann, Associate Professor of German</td>
<td>German</td>
</tr>
<tr>
<td>Keiko Kodá, Associate Professor of Japanese</td>
<td>Japanese</td>
</tr>
<tr>
<td>Kenya C. Dworkin y Mendez, Associate Professor of Spanish</td>
<td>Spanish</td>
</tr>
<tr>
<td>Barbara Freed, Professor of French</td>
<td></td>
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<tr>
<td>and Second Language Acquisition</td>
<td>English as a Second Language</td>
</tr>
<tr>
<td>Beryl Schlossman, Professor of French</td>
<td>European Studies</td>
</tr>
<tr>
<td>Charlene Castellano, Senior Lecturer in Russian</td>
<td>Russian Studies</td>
</tr>
</tbody>
</table>

The majors in European Studies and Russian Studies are interdisciplinary majors jointly with the Department of History. These majors are described in the H&SS Interdepartmental majors section of the catalog.

The Major in French and Francophone Studies

Students who arrive at Carnegie Mellon with previous language study and/or have high Advanced Placement, International Baccalaureate or internal placement exam scores will be able to begin taking courses toward the major earlier in their undergraduate program and will also be able, should they so desire, to complete an additional major. In all cases, progress toward the major will be accelerated by study abroad which is strongly recommended for all majors.

Prerequisites

- 0 - 42 units

Intermediate level proficiency in the appropriate language. This is equivalent to the completion of four courses (two at the 100-level and two at the 200-level) or exemption based on Advanced Placement, International Baccalaureate or Carnegie Mellon internal placement test scores.

1. Core Courses in French and Francophone Studies

| 12 units |
| Complete all three courses. |
| 82-303 | French Culture |
| 82-304 | The Francophone World |
| 82-305 | French in its Social Contexts* |
| * A 400-level course may be substituted with an advisor's approval. |

2. Core Courses in Modern Languages

| 12 units |
| (Complete one 9 unit course* plus the Senior Seminar) |
| 82-280 | Learning about Language Learning |
| 82-281 | Tutoring for Community Outreach |
| 82-383 | Introduction to Second Language Acquisition |
| 82-580 | Senior Seminar (3 units) |
| *In consultation with the Major Advisor, students may substitute a course related to language analysis from the listings in French or from another department. Examples: 80-180 Nature of Language, 80-181 Language and Thought, 85-421 Language and Thought. |

3. French and Francophone Interdisciplinary Electives

Complete 45 units from List A and 9 units from List B.

**List A. French and Francophone Electives**

| 82-401 | Québec Culture |
| 82-403 | The French at War |
| 82-404 | Francophone Realities |
French and Francophone (B.A.)

Sample Curriculum

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Senior Year</th>
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<tbody>
<tr>
<td><strong>Fall</strong></td>
<td><strong>Spring</strong></td>
</tr>
<tr>
<td>French Culture 82-303</td>
<td>French Elective List A</td>
</tr>
<tr>
<td>French in its Social Contexts 82-305</td>
<td>French Elective List A</td>
</tr>
<tr>
<td><strong>Fall</strong></td>
<td><strong>Spring</strong></td>
</tr>
<tr>
<td>The Francophone World 82-304</td>
<td>French Elective List A</td>
</tr>
<tr>
<td>French Elective List A</td>
<td>French Elective List A</td>
</tr>
<tr>
<td><strong>Fall</strong></td>
<td><strong>Spring</strong></td>
</tr>
<tr>
<td>Interdisciplinary Elective List B</td>
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<td>French Elective List A</td>
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This is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years, not that it must be. Students may enter their major, and begin major course requirements, as early as the start of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

The Major in German 93 units

Students who arrive at Carnegie Mellon with previous language study and/or who have high Advanced Placement, International Baccalaureate or internal placement exam scores will be able to begin taking courses toward the major earlier in their undergraduate program and will also be able, should they so desire, to complete an additional major. In all cases, progress toward the major will be accelerated by study abroad which is strongly recommended for all majors.

**Prerequisites**

0 - 42 units

Intermediate level proficiency in the appropriate language. This is equivalent to the completion of four courses (two at the 100-level and two at the 200-level) or exemption based on Advanced Placement, International Baccalaureate or Carnegie Mellon internal placement test scores.

1. Core Courses in German 27 units

Complete all three courses.

82-323 Germany, Austria, and Switzerland in the 20th Century
82-324 Contemporary Germany, Austria and Switzerland
82-325 Introduction to German Studies

* A 400-level course may be substituted with an advisor's approval.

2. Core Courses in Modern Languages 12 units

(Complete one 9 unit course* plus the Senior Seminar)

82-280 Learning about Language Learning
82-281 Tutoring for Community Outreach
82-383 Introduction to Second Language Acquisition
82-580 Senior Seminar (3 units)

*In consultation with the Major Advisor, students may substitute a course related to language analysis from the listings in German or from another department. Examples: 80-180 Nature of Language, 80-181 Language and Thought, 85-421 Language and Thought.

3. German and Interdisciplinary Electives 54 units

Complete 45 units from List A and 9 units from List B or 36 units from List A and 18 units from List B.
**List A: German Electives**

- 82-420 German Classical Literature
- 82-421 German Literature of the Nineteenth Century
- 82-422 German Literature of the Early Twentieth Century
- 82-423 Postwar German Literature
- 82-424 The New Germany
- 82-425/426 Studies in German Literature and Culture
- 82-427 Nazi and Resistance Culture
- 82-428 History of German Film
- 82-429 German Reading and Translation Workshop
- 82-521/522 Special Topics: German
- 82-787 Film Festival (When offered by German Professor with German Topics)

**List B: Interdisciplinary Electives**

An additional elective(s), chosen in consultation with the Major Advisor, will be required of all students. The student may complete part of the course work in German (readings and written papers) with agreement of instructor.

**History**

- 79-205 20th Century Europe: Collapse and Renewal 79-219 The Holocaust in Historical Perspective
- 79-221 Religion and Society: The European Experience
- 79-250 Two Revolutions: Dynamics of Change in Nineteenth Century Europe
- 79-251 European Cities
- 79-307 The Anthropology of Europe

**Philosophy**

- 80-280 Linguistic Analysis
- 80-136 Social Structure, Public Policy and Ethical Dilemmas
- 80-151 God and the West
- 80-251 Modern Philosophy
- 80-252 19th Century Philosophy
- 80-253 Continental Philosophy
- 80-256 Modern Moral Philosophy
- 80-260 Philosophy of Art
- 80-275 Metaphysics
- 80-279 Philosophy of Religion

**Psychology**

- 85-375 Cross Cultural Psychology
- 85-421 Language and Thought

**Modern Languages**

- 82-383 Introduction to Second Language Acquisition
- 82-480 Social and Cognitive Aspects of Bilingualism
- 82-787 Film Festival (When offered by German Professor with German Topics)

**English**

- 76-239 Introduction to Film Studies
- 76-354 Contemporary Literary and Cultural Theory
- 76-386 Language and Culture
- 76-387 Introduction to Sociolinguistics
- 76-483 Cross Cultural Rhetoric

**Music**

- 57-203 Medieval, Renaissance, and Baroque Music History
- 57-204 Eighteenth and Nineteenth Century Music History
- 57-205 Twentieth Century Music History
- 57-306 World Music
- 57-321 Music and the Literary Imagination
- 57-323 Poetry and Music
- 57-324 Music and Dance
- 57-325 Music and Film
- 57-396 Introduction to Interdisciplinary Studies
- 57-397 European and American Cultural Studies
- 57-398 Global Heartbeat: A Cross Cultural Appreciation of Art, Song and Politics
- 58-399 Music, Cinema, Culture

Additional courses from other departments may be added to list as information becomes available.

**4. Additional Requirement: Oral Proficiency Interview**

Complete an oral proficiency interview. This test should be taken by the end of the first semester of the senior year; students are strongly encouraged to take it by the end of the junior year. Students are permitted to retake the test.

**Study Abroad**

A semester or year of study abroad or internship is strongly recommended.

**German (B.A.)**

**Sample Curriculum**

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Senior Year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall</strong></td>
<td><strong>Spring</strong></td>
</tr>
<tr>
<td>Germany, Austria, and Switzerland in the 20th Century</td>
<td>Contemporary Germany, Austria and Switzerland</td>
</tr>
<tr>
<td>Core History Course</td>
<td>Introduction to German Studies</td>
</tr>
<tr>
<td>Learning about Language Learning 82-280</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is presented as a two-year plan (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years, not that it must be. Students may enter their major, and begin major course requirements, as early as the start of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

This plan is an example of the suggested sequence of study for students who have had little or no prior exposure to the language. Such students would need to satisfy the prerequisites (elementary and intermediate language study) during their freshman and sophomore years.

**The Major in Japanese** **93-105 units**

Students who arrive at Carnegie Mellon with previous language study and/or who have high Advanced Placement, International Baccalaureate or internal placement exam scores will be able to begin taking courses toward the major earlier in their undergraduate program and will also be able, should they so desire, to complete an additional major. In all cases, progress toward the major will be accelerated by study abroad which is strongly recommended for all majors.

**Prerequisites 0 - 42 units**

Low-intermediate level proficiency in Japanese. This is equivalent to the completion of three courses (two at the 100-level and one at the 200-level) or exemption based on internal placement test scores.

1. **Core Courses in Japanese** **27 - 39 units**

Complete all four courses.

- 82-272 Intermediate Japanese II*
- 82-273 Introduction to Japanese Language and Culture
- 82-371 Advanced Japanese I
- 82-372 Advanced Japanese II

*Placement out of 82-272 is possible. For students who place out of 82-272, a minimum of 12 additional units must be taken from category 2 below.
2. Core Courses in Modern Languages 12 units
   (Complete one 9 unit course* plus the Senior Seminar)
   82-280 Learning about Language Learning
   82-281 Tutoring for Community Outreach
   82-383 Introduction to Second Language Acquisition
   82-580 Senior Seminar (3 units)

3. Core Course(s) in History*(minimum) 9 units
   Complete one of the following History courses after consultation with
   the Major Advisor and the designated History or Modern Languages
   professor.
   79-263 Riots, Revolts, and Revolutions
   79-265 Ethnicity in Modern America
   79-269 Japan's Social History Since 1945
   79-272 Modern Japan, 1868 to the Present
   79-325 Art and Religion
   79-381 Male and Female in Japan

*Majors are encouraged to complete at least one more History course
from the list above in fulfillment of the major requirements, as well as
additional courses from this list as electives. This list will evolve
according to the current offerings of the Departments of History and
Modern Languages.

4. Japanese and Interdisciplinary Electives (minimum)
   45 units

List A: Japanese Electives
   82-474* Topics in Japanese Studies: Images of Japanese Families
   82-475* Topics in Japanese Studies: Aspects of Daily Life in
     a Buddhist Perspective
   82-477 Topics in Japanese Studies: Japanese Conversation
     Analysis
   82-47x Topics in Japanese Studies: Social Issues in
     Contemporary Japan
   82-47x Topics in Japanese Studies: Contemporary Japanese
     Literature
   82-47x Topics in Japanese Studies: Japanese Education
   82-47x Topics in Japanese Studies: Japanese Reading and
     Translation
   84-47x Topics in Japanese Studies: Japanese Sociolinguistics
   82-47x Topics in Japanese Studies: Current Issues and Trends in
     Japan
   82-571/572 Special Topics: Japanese

*Students may repeat with new topics.

Note: x-numbered courses will be added over the next two to four
years within the current teaching capacity. Additional courses from
other departments will be added to the list of "core" courses or
elective courses as they become available.

List B: Interdisciplinary Electives
   An additional elective(s), chosen in consultation with the Major
   Advisor, will be required of all students. The student may be required
to complete part of the course work in Japanese.

History
   79-265 Ethnicity in Modern America
   79-269 Japan's Social History Since 1945
   79-272 Modern Japan, 1868 to the Present
   79-381 Male and Female in Japan

Philosophy
   80-280 Linguistic Analysis

Psychology
   85-375 Cross Cultural Psychology
   85-421 Language and Thought

Modern Languages
   82-278 Japanese Literature in Translation
   82-373 Structure of the Japanese Language
   82-374 Technical Japanese
   82-383 Introduction to Second Language Acquisition
   82-480 Social and Cognitive Aspects of Bilingualism
   82-487 On Writing in a Second Language

English
   76-239 Introduction to Film Studies
   76-354 Contemporary Literary and Cultural Theory
   76-386 Language and Culture
   76-387 Introduction to Sociolinguistics
   76-483 Cross Cultural Rhetoric

Music
   57-203 Medieval, Renaissance, and Baroque Music History
   57-204 Eighteenth and Nineteenth Century Music History
   57-205 Twentieth Century Music History
   57-306 World Music
   57-321 Music and Literary Imagination
   57-323 Poetry and Music
   57-324 Music and Dance
   57-325 Music and Film
   57-396 Introduction to Interdisciplinary Studies
   57-397 European and American Cultural Studies
   57-398 Global Heartbeat: A Cross-Cultural Appreciation of Art,
     Song and Politics
   58-399 Music, Cinema, Culture

New courses will be added as appropriate.

4. Additional Requirement

Oral Proficiency Interview

Complete an oral proficiency interview. This test should be taken by
the end of the first semester of the senior year; students are strongly
encouraged to take it by the end of the junior year. Students are
permitted to retake the test.

Study Abroad

A semester or year of study abroad or internship is strongly
recommended.

Japanese (B.A.)

Sample Curriculum

This sample curriculum assumes that all prerequisites for 82-371 are
fulfilled prior to the Junior year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Junior</td>
<td>Introduction to Japanese Language and</td>
<td>Core History Course</td>
</tr>
<tr>
<td></td>
<td>Culture 82-273</td>
<td>Required Elective List A</td>
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<tr>
<td></td>
<td></td>
<td>Required Elective List A</td>
</tr>
<tr>
<td></td>
<td>Advanced Japanese I 82-371</td>
<td>Advanced Japanese II 82-372</td>
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<tr>
<td></td>
<td></td>
<td>Required Elective List A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Required Elective List B</td>
</tr>
<tr>
<td></td>
<td>Learning about Language Learning</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td>82-280</td>
<td>Elective/Required Elective List B</td>
</tr>
<tr>
<td></td>
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<td>Elective</td>
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<td>Elective</td>
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<tr>
<td>Senior</td>
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</tbody>
</table>

This is presented as a two-year (junior-senior) plan for completing
major requirements. Its purpose is to show that this program can be
completed in as few as two years, not that it must be. Students may
enter their major, and begin major course requirements, as early as
the start of the sophomore year, and in some instances in the first
year. Students should consult their advisor when planning their
program.

This plan is an example of the suggested sequence of study for
students who have had little or no prior exposure to the language.
Such students would need to satisfy the prerequisites (elementary
and intermediate language study) during their freshman and
sophomore years.
The Major in Hispanic Studies 93 units

Students who arrive at Carnegie Mellon with previous language study and/or who have high Advanced Placement, International Baccalaureate or internal placement exam scores will be able to begin taking courses toward the major earlier in their undergraduate program and will also be able, should they so desire, to complete an additional major. In all cases, progress toward the major will be accelerated by study abroad which is strongly recommended for all majors.

Prerequisites 0 - 42 units

Intermediate level proficiency in the appropriate language. This is equivalent to the completion of four courses (two at the 100-level and two at the 200-level) or exemption based on Advanced Placement, International Baccalaureate or Carnegie Mellon internal placement test scores.

1. Core Courses in Hispanic Studies 27 units

(Complete two courses.)

82-342 Spain: Language and Culture
82-343 Latin America*: Language and Culture
82-344 U.S. Latinos: Language and Culture

Complete required course.
82-345 Introduction to Hispanic Literary and Cultural Studies

2. Core Courses in Modern Languages 12 units

(Complete one 9 unit course* plus the Senior Seminar)

82-280 Learning about Language Learning
82-281 Tutoring for Community Outreach
82-383 Introduction to Second Language Acquisition
82-580 Senior Seminar (3 units)

*In consultation with the Major Advisor, students may substitute a course related to language analysis from the listings in Spanish or from another department. Examples: 80-180 Nature of Language, 80-181 Language and Thought, 85-421 Language and Thought.

3. Hispanic Studies and Interdisciplinary Electives 54 units

Spanish (B.A.)

Complete 45 units from List A and 9 units from List B.

Sample Curriculum

List A: Hispanic Studies Electives

82-441 Studies in Peninsular Literature and Culture*
82-442 Analysis of Spoken Spanish
82-443 Spanish Reading and Translation Workshop
82-444 The Structure of Spanish
82-445 U.S. Latino Literature: Necessity is the Mother of All "Coyotes"
82-446 Political Drama of Spain
82-451 Studies in Latin American Literature and Culture*
82-452 The Latin American Fin de Siglo: Modernity, Modernisms and Underdevelopment
82-454 The Hispanic Caribbean: Rhyme, Reason and Song
82-455/456 Topics in Hispanic Studies*
82-457 Contemporary Latin American Texts: "Back to the Future" Revision, Rewriting, and Representation
82-541/542 Special Topics: Spanish

*Students may repeat these courses with new topics.

List B. Interdisciplinary Electives

From possibilities such as but not limited to the following, students should consult with the Major Advisor to identify an interdisciplinary elective to complement their program.

History
79-221 Religion in European Society
79-250 Two Revolutions: Dynamics of Change in Nineteenth Century Europe
79-251 European Cities
79-263 Riots, Revolts and Revolutions
79-265 Ethnicity in Modern America
79-290 Modern Latin America, 1789 to the Present
79-292/293 The Latin America Fin de Siglo: Modernity, Modernisms and Underdevelopment
79-294 Cultures of South America
79-307 The Anthropology of Europe
79-325 Art and Religion

Philosophy
80-280 Linguistic Analysis

Psychology
85-375 Cross Cultural Psychology
85-421 Language and Thought

Modern Languages
82-383 Introduction to Second Language Acquisition
82-480 Social and Cognitive Aspects of Bilingualism

English
76-239 Introduction to Film Studies
76-354 Contemporary Literary and Cultural Theory
76-386 Language and Culture
76-387 Introduction to Sociolinguistics
76-483 Cross Cultural Rhetoric

Music
57-203 Medieval, Renaissance, and Baroque Music History
57-204 Eighteenth and Nineteenth Century Music History
57-205 Twentieth Century Music History
57-206 Music and the Literary Imagination
57-321 World Music
57-323 Poetry and Music
57-324 Music and Dance
57-325 Music and Film
57-396 Introduction to Interdisciplinary Studies
57-397 European and American Cultural Studies
57-398 Global Heartbeat: A Cross Cultural Appreciation of Art, Songs and Politics
58-399 Music, Cinema, Culture

4. Additional Requirement

Oral Proficiency Interview

Complete the oral proficiency interview. This test should be taken by the end of the first semester of the senior year; students are strongly encouraged to take it by the end of the junior year. Students are permitted to retake the test.

Study Abroad

A semester or year of study abroad or internship is strongly suggested.

Hispanic Studies (B.A.)

Sample Curriculum

This sample curriculum assumes that all prerequisites for 82-371 are fulfilled prior to the Junior year.

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Senior</td>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>*Spain Language and Culture 38-342</td>
<td>Introduction to Hispanic Literary and Cultural 82-345</td>
<td>Spanish Elective List A</td>
<td>Spanish Elective List A</td>
</tr>
<tr>
<td>Latin America Or U.S. Latinos Language and Culture 82-343/82-344</td>
<td>Interdisciplinary Elective List B</td>
<td>Spanish Elective List A</td>
<td>Spanish Elective List A</td>
</tr>
<tr>
<td>Learning about Language Learning 82-280</td>
<td>Elective</td>
<td>Spanish or Interdisciplinary Elective List A or List B</td>
<td>Senior Seminar 82-580</td>
</tr>
<tr>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>
This is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years, not that it must be. Students may enter their major, and begin major course requirements, as early as the start of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

This plan is an example of the suggested sequence of study for students who have had little or no prior exposure to the language. Such students would need to satisfy the prerequisites (elementary and intermediate language study) during their freshman and sophomore years.

**Additional Major**

H&SS students as well as students from other colleges may complete an additional major in French, German, Japanese or Spanish by completing the major requirements as outlined above in addition to the requirements for their primary major. Non-H&SS students interested in an additional major in Modern Languages need to fulfill only the requirements for the chosen Modern Languages major but not the H&SS General Education program requirements.

**The Major in Modern Languages with a Concentration in English as a Second Language (ESL)**

**Prerequisites 0 - 42 units**

Four semesters (or the equivalent) of college instruction in at least one foreign language or demonstrable proficiency in a second language acquired in another context. Study abroad strongly encouraged.

1. Core Courses in Modern Languages 39 units
2. Core Courses in English 18 units
3. Core Course in Philosophy 9 units
4. Required Electives (minimum) 27 units

Complete three courses from the following courses

**English**

76-387 Introduction to Sociolinguistics

**History**

79-390 History of Immigration: Asian Americans in the United States

**Philosophy**

80-180 The Nature of Language

**Modern Languages**

82-480 Social and Cognitive Aspects of Bilingualism
82-481 Research Methods in Second Language Acquisition
82-487 On Writing in a Second Language

**Psychology**

85-211 Cognitive Psychology
85-221 Principles of Child Development
85-300 Human Memory
85-421 Language and Thought

New courses will be added as appropriate.

**Modern Languages with a Concentration in ESL (B.A.)**

**Sample Curriculum**

<table>
<thead>
<tr>
<th>Junior Year</th>
<th></th>
<th>Senior Year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall</strong></td>
<td><strong>Spring</strong></td>
<td><strong>Fall</strong></td>
</tr>
<tr>
<td>Linguistic Analysis 80-280</td>
<td>Tutoring for Community Outreach 82-281</td>
<td>ESL Practicum 82-485</td>
</tr>
<tr>
<td>82-280 Learning About Language Learning</td>
<td>82-281 Tutoring for Community Outreach</td>
<td></td>
</tr>
<tr>
<td>82-383 Introduction to Second Language Acquisition</td>
<td>76-385 Introduction to Discourse Analysis</td>
<td></td>
</tr>
<tr>
<td>82-485 ESL Practicum</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General Course</strong></td>
<td>3 units</td>
<td></td>
</tr>
<tr>
<td>Complete one course.</td>
<td></td>
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</tr>
<tr>
<td>82-580 Senior Seminar (3 units)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. Core Courses in English</strong></td>
<td>18 units</td>
<td></td>
</tr>
<tr>
<td>Complete both courses.</td>
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<tr>
<td>76-385 Introduction to Discourse Analysis</td>
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</tr>
<tr>
<td>76-389 Grammar of Standard Written English</td>
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</tr>
<tr>
<td><strong>3. Core Course in Philosophy</strong></td>
<td>9 units</td>
<td></td>
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<tr>
<td>Complete one course.</td>
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<td></td>
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<tr>
<td>80-280 Linguistic Analysis</td>
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<tr>
<td>58-399 Music, Cinema, Culture</td>
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</tr>
<tr>
<td><strong>4. Required Electives (minimum) 27 units</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete three courses from the following courses.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>English</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>76-387 Introduction to Sociolinguistics</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>History</strong></td>
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<tr>
<td>79-390 History of Immigration: Asian Americans in the United States</td>
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<tr>
<td><strong>Philosophy</strong></td>
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<tr>
<td>80-180 The Nature of Language</td>
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<tr>
<td>80-380 Philosophy of Language</td>
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<tr>
<td>80-480 Linguistic Theory</td>
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<tr>
<td>80-481 Formal Semantics</td>
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</tr>
</tbody>
</table>

**Minors in the Department of Modern Languages**

In addition to the majors in the Department of Modern Languages with specializations in English as a Second Language (ESL), European Studies, French, German, Japanese, Russian Studies or Spanish, it is also possible to minor in Chinese, European Studies, French, German, Japanese, Russian Studies and Spanish as well as in English as a Second Language (ESL) or Second Language Acquisition (SLA).

For the student who has chosen to major in another discipline, a minor in one of these languages is an asset which enhances almost any other field of study. The minor in Modern Languages permits students to acquire similar levels of communicative language proficiency as do students who major in the language but requires fewer courses in complementary areas.

Language-specific faculty advisors for these specializations are:

<table>
<thead>
<tr>
<th>Faculty Advisors</th>
<th>For Students in Majors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yueming Yu, Lecturer</td>
<td>Chinese</td>
</tr>
<tr>
<td>Bonnie Youngs, Senior Lecturer</td>
<td>French &amp; Francophone Studies</td>
</tr>
<tr>
<td>Anne Green, Senior Lecturer</td>
<td>German</td>
</tr>
<tr>
<td>Sono Takano Hayes, Senior Lecturer</td>
<td>Japanese</td>
</tr>
<tr>
<td>Therese Tardio, Lecturer</td>
<td>Hispanic Studies</td>
</tr>
<tr>
<td>Barbara Freed, Professor of French and Second Language Acquisition</td>
<td>English as a Second Language</td>
</tr>
<tr>
<td>Keiko Koda, Associate Professor</td>
<td>Second Language Acquisition</td>
</tr>
<tr>
<td>Beryl Schlossman, Professor of French &amp; Francophone Studies</td>
<td>European Studies</td>
</tr>
<tr>
<td>Charlene Castellano, Senior Lecturer in Russian</td>
<td>Russian Studies</td>
</tr>
</tbody>
</table>
The minors in European Studies and Russian Studies are interdepartmental minors offered jointly with the Department of History. These minors are described in the H&SS Interdepartmental minors section of the catalog.

**Curricula**

The minimum requirement for the minor in French, German or Spanish is 54 units (not including any 100- or 200-level prerequisite work in the chosen language), as outlined below. The minimum requirement for the minor in Chinese or Japanese is 57 units, as outlined.

### The Minor in Chinese 57 units

**Prerequisites 0 - 36 units**

Completion of Elementary Chinese I and II and Intermediate Chinese I at Carnegie Mellon University (with a minimum grade of "B") or equivalent (based on a placement test).

1. **Core Courses in Chinese** 39 units

   Complete four courses.
   82-232 *Intermediate Chinese II*
   82-331 Advanced Chinese I
   82-332 Advanced Chinese II
   82-333 Chinese Language and Culture
   *82-235 Intensive Intermediate Chinese may be substituted for 82-232.

2. **Chinese and Interdisciplinary Electives** 9 units

   **List A. Chinese Electives**
   Complete one course after consultation with the Minor Advisor.
   79-225 Religions of Asia
   79-270 Chinese Culture and Society
   79-271 Modern China
   79-275 The Chinese Cultural Revolution (mini course)
   79-306 East Asians in Film
   79-380 Women in Late Imperial and Modern China
   82-280 Learning about Language Learning
   82-387 The Film Festival**
   0401 Modern East Asian Civilization*
   0525 Religion and Culture in East Asia*
   1047 Chinese and Western Poetry*
   1084 Masterpieces of Chinese Literature and Film*
   1089 The World of China: 20th Century Chinese Art*
   1334 Government & Politics in Contemporary China*
   1476 Chinese Religious Traditions*
   1630 Economic Development of China*
   1739 Cultures of East Asia*

   **List B. Interdisciplinary Elective (minimum) 9 units**

   Complete one course. Students may select another course in this category to substitute for the Core Elective.
   82-334 Structure of Chinese
   82-335 Selected Readings in Chinese
   82-336 Mandarin Chinese for Oral Communication I
   82-338 Mandarin Chinese for Oral Communication II
   82-433 Topics in Contemporary Culture of China
   82-434 Studies in Chinese Traditions
   82-4xx Advanced Readings in Chinese
   82-4xx Business Chinese
   82-5xx Classical Chinese Readings
   1040 Literary Chinese 1 Classical*

   * University of Pittsburgh Course
   ** This course is counted only when it has a China-related topic

### The Minor in French and Francophone Studies 54 units

**Prerequisites 0 - 42 units**

Intermediate level proficiency in the French language. Students who arrive at Carnegie Mellon with previous language study and/or who have high Advanced Placement, International Baccalaureate or internal placement exam scores will be able to begin taking courses toward the minor earlier in their undergraduate. Study abroad is strongly recommended.

1. **Core Courses in French and Francophone Studies** 27 units

   Complete three courses.
   82-303 French Culture
   82-304 The Francophone World
   82-305 French in its Social Contexts*

   * A 400 level course may be substituted with an advisor's approval.

2. **French and Francophone Studies and Interdisciplinary Electives** 27 units

   Complete 27 units from List A or 18 units from List A and 9 units from List B, with advisor's approval.

   **List A. French Electives**
   82-401 Québec Culture
   82-403 The French at War
   82-404 Francophone Realities
   82-405 Image of Modernity: Baudelaire and the Painting of Modern Life
   82-406 The European Union
   82-407 French Modernism: The Arts in Society
   82-408 Matisse, Chagall, Picasso and their Contemporaries: Art and Museums on the Riviera
   82-415/416 Topics in French and Francophone Studies
   82-501/502 Special Topics: French

   **List B. Interdisciplinary Electives**

   **History**
   79-205 20th Century Europe: Collapse and Renewal
   79-307 The Anthropology of Europe
   79-321 Picasso and 20th Century Art
   79-324 Modernism and Painting, 1880-1945
   79-325 Art and Religion

   **Philosophy**
   80-280 Linguistic Analysis

   **Psychology**
   85-375 Cross Cultural Psychology
   85-421 Language and Thought

   **Modern Languages**
   82-303 Introduction to Second Language Acquisition
   82-480 Social and Cognitive Aspects of Bilingualism

   **English**
   76-239 Introduction to Film Studies
   76-354 Contemporary Literary and Cultural Theory
   76-386 Language and Culture
   76-387 Introduction to Sociolinguistics
   76-483 Cross Cultural Rhetoric

   **Music**
   57-203 Medieval, Renaissance, and Baroque Music History
   57-204 Eighteenth and Nineteenth Century Music History
   57-205 Twentieth Century Music History
   57-306 World Music
   57-321 Music and the Literary Imagination
   57-323 Poetry and Music
   57-324 Music and Dance
   57-325 Music and Film
   57-396 Introduction to Interdisciplinary Studies
   57-397 European and American Cultural Studies
   57-398 Global Heartbeat: A Cross Cultural Appreciation of Art, Song and Politics
   58-399 Music, Cinema, Culture

   * New courses will be added as appropriate
The Minor in German 54 units

Prerequisites 0 - 42 units

Intermediate level proficiency in the German language. Students who arrive at Carnegie Mellon with previous language study and/or who have high Advanced Placement, International Baccalaureate or internal placement exam scores will be able to begin taking courses toward the minor earlier in their undergraduate program. Study abroad is strongly recommended.

1. Core Courses in German 27 units

Complete three courses.

82-323 Contemporary German Culture: Print Media*
82-324 Contemporary German Culture: Spoken Media*
82-325 Introduction to German Studies

* A 400-level course may be substituted with an advisor’s approval.

2. German & Interdisciplinary Electives 27 units

Complete 27 units from List A, (400 level German courses) or 18 units from List A and 9 units from List B, with advisors approval.

List A. German Electives

82-420 German Classical Literature
82-421 German Literature of the Nineteenth Century
82-422 German Literature of the Early Twentieth Century
82-423 Postwar German Literature
82-424 The New Germany
82-425/426 Studies in German Literature and Culture
82-427 Nazi and Resistance Culture
82-428 History of German Film
82-429 German Reading and Translation Workshop
82-521/522 Special Topics: German Film Festival (When offered by German Professor with German Topics)

List B. Interdisciplinary Electives

An additional elective(s), chosen in consultation with the Major Advisor, will be required of all students. The student completes part of the course work in German. (Readings and or written papers in German with agreement of instructor.)

History
79-205 20th Century Europe: Collapse and Renewal
79-219 The Holocaust in Historical Perspective
79-221 Religion and Society: The European Experience
79-250 Two Revolutions: Dynamics of Change in Nineteenth Century Europe
79-251 European Cities
79-307 The Anthropology of Europe

Philosophy
80-280 Linguistic Analysis
80-136 Social Structures, Public Policy and Ethical Dilemmas
80-151 God and the West
80-251 Modern Philosophy
80-252 19th Century Philosophy
80-253 Continental Philosophy
80-256 Modern Moral Philosophy
80-260 Philosophy of Art
80-275 Metaphysics
80-279 Philosophy of Religion

Psychology
85-375 Cross Cultural Psychology
85-421 Language and Thought

Modern Languages
82-383 Introduction to Second Language Acquisition
82-480 Social and Cognitive Aspects of Bilingualism
82-787 Film Festival (When offered by German Professor with German Topics)

English
76-239 Introduction to Film Studies
76-354 Contemporary Literary and Cultural Studies
76-386 Language and Culture
76-387 Introduction to Sociolinguistics
76-483 Cross Cultural Rhetoric

Music
57-203 Medieval, Renaissance, and Baroque Music History
57-204 Eighteenth and Nineteenth Century Music History
57-205 Twentieth Century Music History
57-306 World Music
57-321 Music and Literary Imagination
57-323 Poetry and Music
57-324 Music and Dance
57-325 Music and Film
57-396 Introduction to Interdisciplinary Studies
57-397 European and American Cultural Studies
57-398 Global Heartbeat: A Cross Cultural Appreciation of Art, Song and Politics
58-399 Music, Cinema, Culture

Additional courses from other departments may be added to list as information becomes available.

The Minor in Japanese 54-57 units

Prerequisites 36 units

Intermediate level proficiency in the Japanese language. Students who arrive at Carnegie Mellon with previous language study and/or who have high Advanced Placement. International Baccalaureate or internal placement exam scores will be able to begin taking courses toward the major earlier in their undergraduate program. Study abroad which is strongly recommended.

1. Core Courses in Japanese 27-39 units*

Complete four courses.

82-272 Intermediate Japanese II*
82-273 Introduction to Japanese Language and Culture
82-371 Advanced Japanese I
82-372 Advanced Japanese II

*Placement out of 82-272 is possible. For students who place out of 82-272 a minimum if 12 additional units may be taken from category 2 below.

2. Japanese and Interdisciplinary Electives 18 units

In consultation with the Minor Advisor, complete two courses from List A and one course from List B.

List A. Japanese Electives

79-265 Ethnicity in Modern America
79-269 Japan's Social History Since 1945
79-272 Modern Japan 1868 to the Present
79-381 Male and Female in Japan
82-280 Learning about Language Learning
82-383 Introduction to Second Language Acquisition

List B. Interdisciplinary Studies

Complete one course. Students may substitute a second Departmental Elective for the Core Elective with the permission of the Modern Languages advisor.

82-474 Topics in Japanese Studies: Images of Japanese Families*
82-475 Topics in Japanese Studies: Aspects of Daily Life in a Buddhist Perspective*
82-477 Japanese Conversation Analysis
82-47x Topics in Japanese Studies Studies: Social Issues in Contemporary Japan
82-47x Topics in Japanese Studies: Japanese Education
82-47x Topics in Japanese Studies: Japanese Reading and Translation
82-47x Topics in Japanese Studies: Japanese Sociolinguistics
82-47x Current Issues and Trends in Japan
82-571/572 Special Topics: Japanese

*Students may repeat with new topics

New courses will be added as appropriate.

Note: x-numbered courses will be added over the next two to four years with the current teaching capacity. Additional courses from other departments will be added to the list of "core" courses or elective courses as the become available.
The Minor in Hispanic Studies 54 units

Prerequisites 0-42 units

Intermediate level proficiency in the appropriate language. Students who arrive at Carnegie Mellon with the previous language study and/or who have high Advancedment Placement, International Baccalaureate or internal placement exam scores will be able to begin taking courses toward the major earlier in their undergraduate program. Study abroad is strongly recommended.

1. Core Courses in Hispanic Studies

Complete two courses.
82-342 Spain: Language and Culture
82-343 Latin America: Language and Culture
82-344 U.S. Latinos: Language and Culture

Complete two courses.
82-345 Introduction to Hispanic Literary and Cultural Studies

2. Hispanic and Interdisciplinary 27 units

After consultation with the Minor Advisor, complete 3 courses (27 units) from List A or 2 courses (18 units) from List A and one course (9 units) from List B.

List A: Hispanic Electives
82-441 Studies in Peninsular Literature and Culture*
82-442 Analysis of Spoken Spanish
82-443 Spanish Reading and Translation Workshop
82-444 The Structure of Spanish
82-445 U.S. Latino Literature: Necessity is the Mother of All "Coyotes"
82-446 Political Drama of Spain
82-451 Studies in Latin American Literature and Culture
82-452 Modernisms and Underdevelopment
82-454 The Hispanic Caribbean: Rhyme, Reason and Song
82-455/456 Topics in Hispanic Studies*
82-457 Contemporary Latin American Texts: "Back to the Future" - Revision, Rewriting, and Representation
82-541/542 Special Topics: Spanish

* Students may repeat these course with new topics.

List B. Interdisciplinary Electives

From possibilities such as but not limited to the following, students should consult with the Major Advisor to identify an interdisciplinary elective to complement their program.

History
79-221 Religion in European Society
79-250 Two Revolutions: Dynamics of Change in Nineteenth Century Europe
79-251 European Cities
79-263 Riots, Revolts, and Revolutions
79-265 Ethnicity in Modern America
79-290 Modern Latin America, 1789 to the Present
79-292/82-452 The Latin American Fin de Siglo: Modernity, Modernisms and Underdevelopment
79-294 Cultures of South America
79-307 The Anthropology of Europe
79-325 Art and Religion

Philosophy
80-280 Linguistic Analysis

Psychology
85-375 Cross Cultural Psychology
85-421 Language and Thought

Modern Languages
82-383 Introduction to Second Language Acquisition
82-480 Social and Cognitive Aspects of Bilingualism

English
76-239 Introduction to Film Studies

76-354 Contemporary Literary and Cultural Theory
76-386 Language and Culture
76-387 Introduction to Sociolinguistics
76-483 Cross Cultural Rhetoric

Music
57-203 Medieval, Renaissance, and Baroque Music History
57-204 Eighteenth and Nineteenth Century Music History
57-205 Twentieth Century Music History
57-306 World History
57-321 Music and Literary Imagination
57-323 Poetry and Music
57-324 Music and Dance
57-325 Music and Film
57-396 Introduction to Interdisciplinary Studies
57-397 European and American Cultural Studies
57-398 Global Heartbeat: A Cross Cultural Appreciation of Art, Song and Politics
58-399 Music, Cinema, Culture

The Minor in English as a Second Language (ESL) 54 units

Prerequisites 0-24 units

English is the most commonly spoken second language in the world today. A minor in English as a Second Language (ESL) provides students with an introduction to the ESL field through those courses that are generally who elect to pursue the ESL minor are required to complete the following courses, which total 54 units.

1. Required Courses 36 units

Complete four courses.
76-389 Grammar and Standard Written English
82-280 Learning About Language Learning
82-383 Introduction to Second Language Acquisition
82-485 ESL Practicum

2. Core Elective 18 units

Complete two courses after consultation with the Minor Advisor.
76-385 Introduction to Discourse Analysis
76-387 Introduction to Sociolinguistics
80-181 Language and Thought
80-280 Linguistic Analysis
82-182 Language and Culture: Language in the Social Context
82-480 Social and Cognitive Aspects of Bilingualism
82-487 On Writing in a Second Language
85-211 Cognitive Psychology

New courses will be added as appropriate.

Faculty

MARIANA ACHUGAR, Assistant Professor of Spanish & Second Language Acquisition — Ph.D., University of California at Davis; Carnegie Mellon University, 2003—.

STEPHEN BROCKMANN, Associate Professor of German with courtesy appointments in English and History — Ph.D., University of Wisconsin-Madison; Carnegie Mellon University, 1993—.

CHARLENE CASTELLANO, Associate Teaching Professor of Russian with a courtesy appointment in English — Ph.D., Cornell University; Carnegie Mellon University, 1990—.

KENYA C. DWORKIN Y MENDEZ, Associate Professor of Spanish with courtesy appointments in English and History — Ph.D., University of California, Berkeley; Carnegie Mellon University, 1993—.

MICHEL FOUGERES, Associate Professor Emeritus of French — Ph.D., New York University; Carnegie Mellon University, 1969—.

BARBARA FREED, Professor of French and Second Language Acquisition — Ph.D., University of Pennsylvania; Carnegie Mellon University, 1990—.

ANNE GREEN, Associate Teaching Professor of German — Ph.D., University of Illinois at Urbana-Champaign; Carnegie Mellon University, 1993—.

CHRISTIAN HALLSTEIN, Teaching Professor of German — Ph.D., Pennsylvania State University; Carnegie Mellon University, 1979—.

SONO TAKANO HAYES, Associate Teaching Professor of Japanese — Ph.D., University of Pittsburgh; Carnegie Mellon University, 1987—.
ILSEDORE BARKOW JONAS, Professor Emeritus of German
— Ph.D., University of Pittsburgh; Carnegie Mellon
University, 1958—.

CHRISTOPHER M. JONES, Director of the Modern Language
Resource Center and Teaching Professor of French — Ph.D.,
University of Massachusetts, Amherst; Carnegie Mellon University,
1993—.

KEIKO KODA, Associate Professor of Japanese and Second
Language Acquisition, — Ph.D., University of Illinois at
Urbana-Champaign; Carnegie Mellon University, 1995—.

MARY LINDEMANN, Professor of History with a courtesy
appointment in Modern Languages — Ph.D., University of
Cincinnati; Carnegie Mellon University, 1987—.

PAZ MACIAS, Lecturer in Spanish — Ph.D. Cornell University;
Carnegie Mellon University, 2002—.

BRIAN MACWHINNEY, Professor of Psychology with a courtesy
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California, Berkeley; Carnegie Mellon University, 1981—.

SUSAN G. POLANSKY, Teaching Professor of Spanish, Associate
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Mellon University, 1986—.

GIOVANNI PUPPO, Instructor of Italian — Ph.D., University of
Rome; Carnegie Mellon University, 1975—.

SOPHIE QUEUJET, Lecturer in French — Ph.D., Yale University;
Carnegie Mellon University, 2003—.

BERYL SCHLOSSMAN, Professor of French and Francophone
Studies and European Studies with a courtesy appointment in
English — Ph.D., Université de Paris; Ph.D., Johns Hopkins
University; Carnegie Mellon University, 1993—.

JURIS SILENIEKS, Professor Emeritus of French — Ph.D.,
University of Nebraska; Carnegie Mellon University, 1960—.

THERESE TARDIO, Lecturer in Spanish — Ph.D.- University of
Pittsburgh; Carnegie Mellon University, 2001—.

G. RICHARD TUCKER, Paul Mellon Professor of Applied
Linguistics, Head of Modern Languages — Ph.D., McGill
University; Carnegie Mellon University, 1992—.

JAN VAIRO, Instructor of Italian — M.A., University of
Pittsburgh; Carnegie Mellon University, 1992—.

MICHAEL J. WEST, Teaching Professor of French — PhD.,
University of California, Santa Barbara; Carnegie Mellon
University, 1989—.

SUE-MEI WU, Lecturer in Chinese —Ph.D., Ohio State
University; Carnegie Mellon University, 2000—.

BONNIE L. YOUNGS, Associate Teaching Professor of
French — Ph.D., University of Pennsylvania; Carnegie
Mellon University, 1993—.

YUEMING YU, Associate Teaching Professor in Chinese —
Ed.D., University of Pittsburgh; Carnegie Mellon
University, 1992—.
The Department of Philosophy was founded in 1985 and reflects the tradition of philosophy as a central discipline in the humanities. The department has achieved an international reputation through the acclaimed research of its members and its innovative educational programs, not only in traditional topics such as ethics, philosophy of mind, logic, and theory of knowledge, but in such contemporary and applied areas as automated theorem proving, machine learning, the foundations of statistics, causal discovery, game and decision theory, conflict resolution, and business ethics.

Philosophy thrives through contact with other disciplines. Interdisciplinary work, a traditional strength of the Carnegie Mellon community, is vital to the department and is reflected in the courses we offer, many of which incorporate substantive material from a range of other disciplines. Some courses are actually team-taught with professors from other departments and schools around the university.

Our programs are designed to develop our students’ analytical sophistication and their practical and theoretical skills in specializations outside the department (see the sample curricula below). The department welcomes and, indeed, encourages minors and additional concentrations outside the department (see the sample curricula below). The department offers two different undergraduate major programs, and jointly sponsors an interdepartmental major with the Department of History:

• the B.A. or B.S. in Ethics, History, and Public Policy
• the B.S. in Logic and Computation
• the B.A. in Philosophy

The major in Logic and Computation is perhaps the most nontraditional of the department’s majors. It offers students a firm background in computer science, together with a solid grounding in logic, philosophy, and mathematics. This reflects the department’s commitment to the use of formal, analytic methods in addressing philosophical issues. A flexible system of electives allows students to focus their efforts in any of a wide range of disciplines, from engineering to the fine arts. As a capstone to the program, students engage in original research in their senior year, and write a thesis under the direction of an advisor.

The department also sponsors four minor programs:

• the minor in Ethics
• the minor in Linguistics
• the minor in Logic and Computation
• the minor in Philosophy

Finally, the department offers two master’s programs directly extending the departmental majors. Both programs are coordinated with and build on the undergraduate programs, so that majors can complete the requirements for the master’s degree in one additional year:

• the M.S. in Logic and Computation
• the M.A. in Philosophy

Students who choose the appropriate specialized track in the Logic and Computation major (namely, sample 2 of the Curricula listed below) can be admitted to the M.S. program in Language and Information Technology offered by the School of Computer Science. To complete the discussion of departmental programs, it should be mentioned that the department sponsors as part of the Program in Pure and Applied Logic (offered jointly with the Departments of Computer Science and Mathematics) a Ph.D. in Logic, Computation, and Methodology.

The Major in Ethics, History, and Public Policy

Preston Covey, Director

This is an interdepartmental major that is jointly sponsored by the Departments of History and of Philosophy. Preparing students for leadership positions is a vital goal of colleges and universities in every democratic and technologically advanced society. The intellectual challenges facing public and private sector leaders expand dramatically each year, and there is a compelling need in twenty-first-century America for broadly educated, ethically sensitive, and technically skilled public servants. They will have to demonstrate sophisticated interdisciplinary knowledge, deep understanding of how modern-day problems have evolved, and clear, rational criteria for ethical decision-making. The major in Ethics, History, and Public Policy seeks to provide students with a solid humanistic foundation for developing such high-level leadership capabilities. It also provides ample room for specialization, technical skill development, and internship experience in a wide range of policy areas. For a detailed discussion of the curriculum and the flexible tracks, consult the H&SS Interdepartmental Majors section of the catalogue.

The Major in Logic and Computation

Jeremy Avigad, Director

The Logic and Computation curriculum takes advantage of the preparation provided by the H&SS General Education Program in mathematics, philosophy, psychology, and statistics. It is flexible in that it permits students to focus on any of a number of areas including (but not limited to):

• computer science
• language and information technology
• artificial intelligence and cognitive science;
• logic and the foundations of mathematics;
• methodology and philosophy of science.

Students in the program take a common core of courses in logic, methodology, and computer science, together with an associated seminar in their senior year. The individual focus is achieved by selecting a sequence of four advanced and closely related courses. It is in this area of focus (or specialization) that students write their senior thesis under the supervision of a faculty member. A number of sample curricula are presented below.

The resulting education in logic, analytic philosophy, mathematics, statistics, and computer science enables students to pursue professional careers or graduate study. The analytic and communication skills developed in the major support a wide range of career choices, including those among the fields of technology, business, and law. Fields of graduate study for which students are well prepared include, for example, computer science, cognitive science, philosophy, logic, and linguistics.

Students who are interested in pursuing this major, or who are pursuing it already, should take note of the Cognitive Science major in the Department of Psychology. That major is so closely related that it is not difficult to pursue it as an additional major, and it provides an intellectually exciting complement.

Curriculum

Logic and Computation is a B.S. degree. In their freshman and sophomore years, students are expected to take four courses that provide preparation in logic, computer science, mathematics, and statistics: Programming Fundamentals (15-111), Concepts of Mathematics (21-127), Statistical Reasoning (36-201), Arguments and Mathematical Inquiry (80-211). This last course is already part of the major’s Core Requirements, but should be taken no later than the
spring of the sophomore year. This also applies to the computer science sequence 15-211/212.

NOTE: Students should complete the prerequisites before their junior year. It is strongly recommended that students take Arguments and Mathematical Inquiry no later than the spring of their sophomore year and, if possible, also Fundamental Data Structures and Algorithms and Principles of Programming. However, with suitable planning and advice from the program director, it is possible to complete the program in two years, beginning in the junior year.

The course requirements for the major consist of six core courses, four electives, and one seminar. The core courses provide comprehensive background in logic, computability, and analytic philosophy. Logic and Computation (80-310) and Minds, Machines, and Knowledge (80-300) must be taken no later than the fall of the junior year. Four advanced electives are chosen in the area of focus, and should support independent research towards fulfilling the senior thesis requirement. In their senior year, students present and discuss their research in the thesis seminar.

Prerequisites 28 units*

15-111 or 15-200 Intermediate/Advanced Programming (10 units)
21-127 Concepts of Mathematics
36-201 Statistical Reasoning

Logic and Computation Core 69 units*

80-211 Arguments and Mathematical Inquiry
80-300 Minds, Machines, and Knowledge
80-310 Logic and Computation
80-311 Computability and Incompleteness
80-511 Thesis seminar
15-211 Fundamental Data Structures and Algorithms**
15-212 Principles of Programming**

*Only 45 units are unique to the major; 15-211 and 15-212 count toward total units for the General Education Program, DCR6.

**It is recommended that students complete 15-211 and 15-212 in the sophomore year; H&SS students can use these courses to satisfy their General Education requirement in the category DCR6, Science and Technology.

Logic and Computation Electives 36 units

Bearing in mind prerequisites, Logic and Computation majors must complete four advanced courses in areas that use logical and computational tools, such as philosophy, computer science, linguistics, mathematical logic, psychology, or statistics. The sequence of courses, mostly at the 300-level, must be selected in consultation with the program director.

Sample Curricula

Here are five samples of Logic and Computation curricula (beyond the core courses), each reflecting a different emphasis.

Sample 1. A student interested in Computer Science might take the following courses:

80-315 Modal Logic (or: 80-413 Category Theory)
80-316 Probability and Artificial Intelligence
80-317 Constructive Logic
15-312 Programming Languages: Design and Processing

Sample 2. A student interested in Language and Information Technology might take the following courses:

80-280 Linguistic Analysis 80-480 Linguistic Theory 80-481 Formal Semantics 80-682 Introduction to Language Technologies

Sample 3. A student interested in Artificial Intelligence and Cognitive Science might take the following courses:

80-314 Logic in Artificial Intelligence
80-315 Modal Logic
or:
80-319 Computability and Learnability
80-316 Probability and Artificial Intelligence
85-411 Proof Theory

Sample 4. A student interested in Logic and the Foundations of Mathematics might consider the following courses:

80-312 Philosophy of Mathematics
(or: 80-254 Analytic Philosophy)
80-318 Proof Search
or:
80-319 Computability and Learnability
80-411 Proof Theory
or:
21-229 Set Theory
80-413 Category Theory

Sample 5. A student interested in Methodology might consider the following courses:

80-220 Philosophy of Science
or:
80-221 Philosophy of Social Science
80-319 Computability and Learnability
80-321 Causality and Social Policy
36-309 Experimental Design

Logic and Computation Degree Requirements (min.) 360 units

Logic and Computation as a Second Major

The Logic and Computation major is also suitable as a second major for students in H&SS or for students in other colleges within the university. Non-H&SS students interested in an additional major in Logic and Computation need to take only those courses in the H&SS General Education Program that are prerequisites to courses required in the major; all other H&SS General Education requirements are waived for these students. Depending on the student’s background, the requirements of the second major in Logic and Computation can be fulfilled with as few as five additional courses. However, the department limits the courses that may be ‘double counted’; the core courses in the Philosophy department may not be double counted.

The M.S. Program in Logic and Computation

The Department of Philosophy also offers a graduate M.S. degree in Logic and Computation, which culminates with the writing of a master’s thesis. It is ordinarily a two-year program, but students in the Logic and Computation major are able to complete the additional requirements in one year. Interested students are invited to contact the department for further information and apply to the program in their senior year. Details can be found on the department’s homepage: http://hss.cmu.edu/philosophy/
The Major in Philosophy

Horacio Arlo-Costa, Director

The Major in Philosophy is intended to be flexible and to facilitate double majors in other fields (including majors with a strong professional focus). It provides students with a broad humanities education and sharpens their analytical skills. We encourage students to choose a thematic concentration through their electives. Sample curricula emphasizing Pre-Law, Metaphysics and Epistemology, Ethics and Social Philosophy, and Philosophy of Mind are suggested below. However, alternative emphases can be proposed and approved by the Director. The Major in Philosophy is a B.A. degree.

Curriculum

In addition to the general education requirements of the student’s college, Philosophy majors and double majors must complete nine Philosophy courses in the Areas listed below. Only two of these nine courses may be at the 100-level, and (for H&SS students) only one of them may be counted also as satisfying the College’s General Education requirements (DCR 1 through 4). Students are to choose one course out of each of the Areas 1-4, two courses out of Area 5, and may freely select three courses in Area 6. These nine courses can be taken during the junior and senior year.

Area 1: Values and Normative Theory 9 units
One of the following:
80-x30 through 80-x34 Ethics/Ethical Theory
80-x35 through 80-x39 Social/Political Philosophy
80-x40 through 80-x49 Applied/Professional Ethics

Area 2: Philosophy of Mind/Language/Metaphysics 9 units
One of the following:
80-x70 through 80-x79 Philosophy of Mind/Metaphysics
80-x80 through 80-x89 Philosophy of Language

Area 3: Logic/Philosophy of Mathematics 9 units
One course from (80-x10 through 80-x19)

Area 4: Epistemology/Methodology 9 units
One of the following:
80-x00 through 80-x09 Epistemology/Methodology
80-x20 through 80-x29 Philosophy of Science

Area 5: History of Philosophy 18 units
Two of the following:
80-250 through 80-259 History of Philosophy

Area 6: Electives 27 units
Three other philosophy courses, or appropriate courses from other departments, with the permission of the Director.

Sample Curricula

Here are four sample curricula, reflecting different emphases.

1. A sample Pre-Law program is:

Area 1 80-236 Philosophy and Law
Area 2 80-180 Nature of Language
Area 3 80-212 Philosophical Analysis and Logic
Area 4 80-150 Nature of Reason
Area 5 80-250 Ancient Philosophy
Area 6 80-246 The Criminal Justice System in America: Ideals and Realities
80-355 Philosophy, Politics, and Economics
80-346 Values, Fact, and Policy

2. For an emphasis on Metaphysics and Epistemology a student might take:

Area 1 80-230 Ethical Theory
Area 2 80-275 Metaphysics
Area 3 80-211 Arguments and Mathematical Inquiry
Area 4 80-201 Introduction to Epistemology
Area 5 80-250 Ancient Philosophy
Area 6 80-201 Epistemology

3. For an emphasis on Ethics and Social Philosophy a student might take:

Area 1 80-230 Ethical Theory
Area 2 80-275 Philosophy of Religion
Area 3 80-110 Nature of Mathematical Reasoning
Area 4 80-221 Philosophy of Social Science or 80-321 Causation and Social Policy
Area 5 80-250 Ancient Philosophy
Area 6 80-346 Values, Fact, and Policy
80-335 Philosophy, Politics and Economics
80-342 Ethics and Oppression

4. For an emphasis on Philosophy of Mind a student might take:

Area 1 80-130 Introduction to Ethics
Area 2 80-270 Philosophy of Mind
Area 3 80-211 Arguments and Mathematical Inquiry
Area 4 80-201 Intro to Epistemology
Area 5 80-251 Modern Philosophy
Area 6 80-271 Philosophy and Psychology
Area 7 80-300 Minds, Machines, and Knowledge
Area 8 80-316 Probability and Artificial Intelligence

Additional Major

Students who want an additional major in Philosophy must fulfill the same departmental requirements as primary majors in Philosophy.

The M.A. Program in Philosophy

The Department of Philosophy also offers a graduate M.A. degree in Philosophy, which culminates with the writing of a master’s thesis. It is ordinarily a two-year program, but students in the Philosophy major are able to complete the additional requirements in one year. Interested students are invited to visit the department’s homepage for further information: www.hss.cmu.edu/philosophy/.

Philosophy Department Minors

All majors in the Department allow for minors; in addition, there is a Minor in Ethics and an interdepartmental minor in Linguistics. The requirements are again designed to be flexible and to allow students to tailor courses to their special interests, while providing some breadth.

The Minor in Ethics

With the explosive growth of science and technology have come both new possibilities and new problems. Developments in medicine, in biology, in chemistry, in nuclear engineering or in computer science all have costs as well as benefits, and they present us with many hard choices. Some of the hardest of these new problems are moral problems.

The Philosophy Department’s Minor in Ethics introduces students to central ethical concepts and theories proposed and defended by the great philosophers of the past; it provides an understanding of how these theories and concepts can be applied to practical problems. This background in ethical theory and its applications should help students to respond more sensitively and appropriately to the new and unavoidable ethical problems that businesses, unions, and branches of government must face.

Ethics Core Courses 27 units

Complete three courses from any of the following areas with at least two courses at the 200-level or higher.
80-x30 through 80-x34 Ethics / Ethical Theory
80-x35 through 80-x39 Social/Political Philosophy
80-x40 through 80-x49 Applied/Professional Ethics

Ethics Electives 18 units

Complete two courses at the 200-level or higher.
The Minor in Linguistics

The Interdepartmental Minor in Linguistics is jointly sponsored with the departments of English, Modern Languages, and Psychology. It synthesizes the linguistics related offerings in these departments and provides students with an academic experience that reflects both the interdisciplinary character of the subject and its cross-departmental representation in H&SS. Students who wish to receive a minor in Linguistics must complete six courses. For a detailed discussion of the curriculum and the flexible electives, consult the H&SS College section “Other Major, Double Major, and Minor Options”.

The Minor in Logic and Computation

The Minor in Logic and Computation provides students with general course work in logic, the theory of computation, and philosophy. Students must complete six courses, among them the following three core courses.

Logic and Computation Core Courses 27 units

- 80-211 Arguments and Mathematical Inquiry
- 80-210 Logic and Proofs
- 80-300 Minds, Machines, and Knowledge
- 80-310 Logic and Computation
- 80-311 Computability and Incompleteness

Logic and Computation Electives 27 units

Students must take two courses in the Philosophy Department at the 300-level or higher, in subjects related to logic and computation, and an additional course at the 300-level or higher in an area that uses logical and computational tools, such as philosophy, computer science, linguistics, mathematics, psychology, or statistics. The choice of electives must be approved by the program director.

The Minor in Philosophy

The Minor in Philosophy allows students to complement their primary majors with a broad philosophical grounding.

Logic/Methodology Requirements 9 units

Complete one course:
- 80-x10 through 80-x19 Philosophy of Logic/Mathematics
- 80-x20 through 80-x29 Philosophy of Science

History of Philosophy Requirements 18 units

Complete two courses:
- 80-250 through 80-259 History of Philosophy

Philosophy Electives 18 units

Complete two courses in the Philosophy Department at the 200-level or higher.

The Honors Program

The H&SS Senior Honors Program provides recognition of outstanding performance by students majoring in Philosophy, Logic and Computation or Ethics, History, and Public Policy. Students have the opportunity to develop their skills and to apply their knowledge through completion of an honors thesis in their senior year. By completing the thesis, students earn 18 units of credit and qualify for graduation with College Honors. To qualify for the honors program, students must maintain a quality point average of at least 3.50 in the major and 3.25 overall, and be invited by the department to become a participant.

Undergraduate Research Fellows

Qualified upper level undergraduates, preferably majors in one of the Philosophy Department's programs, may apply to serve in their junior or senior years as fellows in the Laboratory for Symbolic and Educational Computing. Applications are reviewed in the fall. Follow the link to LSEC from the Department’s home page: www.hss.cmu.edu/philosophy.

Faculty

HORACIO ARLO-COSTA, Associate Professor of Philosophy — Ph.D., Columbia University; Carnegie Mellon, 1998—.

JEREMY AVIGAD, Associate Professor of Philosophy — Ph.D., University of California, Berkeley; Carnegie Mellon, 1996—.

STEVEN AWODEY, Associate Professor of Philosophy — Ph.D., University of Chicago; Carnegie Mellon, 1997—.

CRISTINA BICCHIERI, Professor of Philosophy and Social and Decision Sciences — Ph.D., Cambridge University; Carnegie Mellon, 1989—.

ROBERT CAVALIER, Associate Teaching Professor of Philosophy—Ph.D., Duquesne University; Carnegie Mellon, 1987—.

PRESTON K. COVEY JR., Associate Professor of Philosophy — Ph.D., Stanford University; Carnegie Mellon, 1974—.

DAVID DANKS, Assistant Professor of Philosophy — Ph.D., University of California, San Diego, Carnegie Mellon, 2003 —

CLARK GLYMOUR, Alumni University Professor of Philosophy — Ph.D., Indiana University; Carnegie Mellon, 1984—.

MARALEE HARRELL, Lecturer in Philosophy — Ph.D., University of California, San Diego, Carnegie Mellon, 2003 —

KEVIN T. KELLY, Professor of Philosophy — Ph.D., University of Pittsburgh; Carnegie Mellon, 1985—.

ALEX LONDON, Assistant Professor of Philosophy — Ph.D., University of Virginia; Carnegie Mellon, 2000—.

PETER MADSEN, Associate Teaching Professor of Philosophy — Ph.D., Duquesne University; Carnegie Mellon, 1988—.

LINDA PALMER, Research Scientist in Philosophy — Ph.D., University of California, Irvine, Carnegie Mellon, 2004 —

RICHARD SCHEINES, Professor of Philosophy, Human-Computer Interaction, and Automated Learning and Discovery, Director HCI Undergraduate Major — Ph.D., University of Pittsburgh; Carnegie Mellon, 1987—.

DANA S. SCOTT, Hillman University Professor of Mathematical Logic, Computer Science and Philosophy (Emeritus) — Ph.D., Princeton University; Carnegie Mellon, 1981—.

TEDDY I. SEIDENFELD, Herbert A. Simon Professor of Philosophy and Statistics — Ph.D., Columbia University; Carnegie Mellon, 1985—.

WILFRIED SIEG, Professor of Philosophy — Ph.D., Stanford University; Carnegie Mellon, 1985—.

MANDY SIMONS, Associate Professor of Philosophy — Ph.D., Cornell University; Carnegie Mellon, 1998 —

PETER L. SPIRITES, Professor of Philosophy — Ph.D., University of Pittsburgh; Carnegie Mellon, 1987—.

PETER VANDERSCHRAAF, Associate Professor of Philosophy and Social and Decision Sciences — Ph.D., University of California, Irvine; Carnegie Mellon, 1997—.
Can newborn infants perceive the world as we do, or is it just “a blooming buzzing confusion”? Do personality, beliefs and social factors influence health? How do scientists make discoveries, and what abilities make discoveries possible? How does brain activity reveal differences in thinking? Can computers think the way people do? These are some of the questions that psychologists at Carnegie Mellon are trying to answer.

For the student who is majoring in Psychology or Cognitive Science, studying with faculty who are on the leading edge of research on questions like the above can be a very exciting experience.

The Psychology Department at Carnegie Mellon has long been noted as one of the pioneering Psychology Departments in the world, particularly in such areas as cognitive psychology, cognitive science, social psychology, developmental psychology, cognitive neuro-science, and health psychology. The Psychology Department offers B.A. and B.S. degrees in Psychology, as well as a B.S. degree in Cognitive Science, and together with the Department of Biological Sciences, a unified B.S. major in Psychology and Biological Sciences.

The Major in Psychology

Psychology is a science which embraces both biological and social sciences. It is a science concerned with establishing principles and laws regarding the ways in which people think and behave through the scientific study of human behavior.

The orientation of the Carnegie Mellon Psychology curriculum is toward developing highly skilled and knowledgeable graduates. A bit more than half of our graduates go on to graduate or professional school. The remainder seek to expand their problem-oriented skills so that job opportunities beyond those typically open to liberal arts students are available.

Majors in the department are expected not only to learn about findings already established by psychologists, but also to become proficient in the investigation and analysis of behavior. This includes observing behavior, formulating hypotheses, designing experiments to test these hypotheses, running experiments, performing statistical analyses, and writing reports. The department has many resources for students to use in acquiring these skills. For instance, students interested in child development may be involved in the child development laboratory and observational facilities which are a part of the Carnegie Mellon Children’s School. Students interested in environmental or health psychology might have opportunities to work in applied settings, and all Psychology majors have access to extensive computer facilities for data analysis and simulation work. The department also has a new state of the art set of undergraduate research laboratories and computer clusters.

In addition to formal class work, students are encouraged to participate in research, project and field work via a number of opportunities available to them. They may register for Independent Reading in Psychology, Independent Research in Psychology, or an Internship in Clinical or Developmental Psychology. In the Independent Research course, the student may work on an ongoing research project or develop and carry out a new research project with a faculty member. There is university and departmental funding available to help support student-initiated research projects and student travel to present research results at scientific meetings and conferences. In the Readings courses, the student reads extensively on a particular topic. The faculty member and student meet to discuss the readings, and the student writes a paper on the topic selected. The Psychology Department Website (www.psy.cmu.edu/), Graduate Catalog and Undergraduate Research Brochure provide descriptions of faculty research interests that the student can use in determining who should be approached to supervise a particular research or reading project. Clinical internships are available with a variety of clinical settings including at the Western Psychiatric Institute and Clinic (the teaching hospital of the Department of Psychiatry at the University of Pittsburgh), and Contact Pittsburgh (the Pittsburgh area community hotline). During the internship, students get first-hand experience with different clinical populations. Developmental Internships are available in the department-run CMU Children’s School. Finally, outstanding students are invited to participate in an Honors Program during their senior year. Over the course of their senior year, these students develop and carry out an original research project under faculty supervision.

Curriculum

The curriculum includes three levels of psychological course work. These result in a breadth of knowledge of psychology, training in research methods and in-depth advanced course work in student chosen areas of psychology. Both the B.A. and the B.S. degrees are available in Psychology. Candidates for both degrees must complete two semesters of calculus. There are three options in completing this requirement: 21-111/112 or 21-120 and either 21-122 or 21-256. Students are also required to complete a statistics sequence consisting of 36-201 or its equivalent, followed by 36-309, Experimental Design. Both courses should be completed before the junior year. A one-semester computer science course is also required for all Psychology majors. Finally, in addition to the H&SS General Education Natural Science requirement, B.A. candidates take one, and B.S. candidates take three additional semesters of natural science courses outside the department.

The Department desires that majors acquire breadth in the subject matter of Psychology and that they make informed choices among a set of required area survey courses. The requirement for demonstration of breadth can be met by taking Introductory Psychology (85-102) and three survey courses; it is recommended that this be started as early as possible in the student’s program. Alternatively, the breadth requirement can be met by taking an additional Survey course beyond the required set of three survey courses.

There are three suggested major tracks starting with the 200-level survey courses. These are cognitive or cognitive-neuroscience, developmental, and social-personality. The tracks are designed to provide increasing depth of knowledge in a particular area of psychology, although the student may as an alternative elect to combine advanced courses from more than one area into a meaningful program.

Overall, the major includes Introduction to Psychology (or a 4th survey course), 36-309, three survey courses at the 200-level, two research methods courses, two advanced courses and an experimental design course are required. These include a total of 81 units. Advanced courses, which are often in the form of seminars, examine in great depth portions of the three track areas. The 18-unit advanced course requirement must be fulfilled by taking content seminars or courses rather than through Independent Research, Independent Reading, or Internship courses. In addition to the small number of required psychology courses, the department offers a variety of other courses, seminars, independent research and supervised experiences. Students are encouraged to sample these by means of the large number of elective units that are part of the program.

Prospective Psychology majors are encouraged to begin major requirements and prerequisites prior to the junior year, if possible. In particular, completion of the calculus and statistics sequences, Introduction to Psychology and/or one or more Psychology Survey courses would enable students to take corresponding research methods courses in the sophomore or early in the junior year, and thus prepare themselves to take advantage of research opportunities in the department.
Mathematics & Statistics Prerequisites 37-38 units
21-111 Calculus I
and
21-112 Calculus II
or
21-120 Differential Calculus/Integral Calculus (10 units)
and
21-256 Multivariate Analysis and Approximation
or
21-120 Differential and Integral Calculus (10 units)
and
21-122 Integration and Differential Equations and Approximation (10 units)
36-201 Statistical Reasoning, Statistical Practice or equivalent
36-309 Experimental Design for Behavioral and Social Sciences (Prerequisite: 36-201 or equivalent)

Breadth Requirement 9 units
85-102 Introduction to Psychology or a fourth Survey Course*
* This, together with three survey courses, constitutes the breadth requirement.

Survey Courses 27 units
Complete three of the following survey courses.
85-211 Cognitive Psychology
or
85-213 Human Information Processing and Artificial Intelligence
85-219 Biological Foundations of Behavior
85-221 Principles of Child Development
85-241 Social Psychology
85-251 Personality

Research Methods 18 units
Complete two courses.
85-310 Research Methods in Cognitive Psychology*
85-320 Research Methods in Child Development*
85-340 Research Methods in Social Psychology*
*Prerequisites for all Research Methods courses: 36-309 or equivalent, and corresponding psychology survey course.
(Note: 36-309 may be taken concurrently as a co-requisite)

Advanced Courses 18 units
Complete two courses.
85-341 or higher Any advanced content course or seminar in psychology
or any psychology course higher than 85-351 exceptions: 85-480, 85-482, 85-484, 85-505, 85-506, 85-507, 85-508

Computer Science Requirement 10 units minimum
15-100 or higher Introductory/Intermediate Programming

Natural Science Requirement (B.A. 9 units B.S. 27 units)
The Psychology major requires (for B.S. candidates) three additional natural science courses (with two in the same science) beyond the College’s General Education natural science requirement. For the B.A. the requirement is one course beyond the General Education requirement in natural science. Given the growing relevance of biology to psychology, it is strongly recommended that for the B.S. a minimum of two courses in biology be included as part of the natural science requirement.

We also suggest that for the B.S., courses should come from the same area (biology, chemistry or physics).

Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey Course</td>
<td>Survey Course</td>
<td>Advanced Course</td>
<td>Advanced Course</td>
</tr>
<tr>
<td>Experimental Design for Behavioral and Social Sciences 36-309</td>
<td>Research Methods Course</td>
<td>Research Methods Course</td>
<td>Elective</td>
</tr>
<tr>
<td>Supplementary Science Requirement B.A./B.S.</td>
<td>Supplementary Science Elective for B.S. only</td>
<td>Supplementary Science Elective for B.S. Only</td>
<td>Elective</td>
</tr>
<tr>
<td>Computer Science Requirement</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

This is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years; not that it must be. Students may enter their major, and begin major course requirements, as early as the start of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

Additional Major
In order to complete an additional major in Psychology, a student must fulfill all of the Psychology major requirements within the department — in other words, the breadth requirement, computing requirement, three survey courses at the 200-level, two research methods courses, and two advanced courses. These courses must include at least 81 units, plus calculus prerequisites and the 36-201 statistics course or equivalent and 36-309). In addition, B.S. candidates must take the three-course science requirement.

Unified Double Major in Psychology & Biological Sciences
This unified major is intended to reflect the interdisciplinary nature of current research in the fields of Psychology and Biology, as well as the national trend in some professions to seek individuals broadly trained in both the social and natural sciences. Students entering from the College of Humanities and Social Sciences will earn a Bachelor of Science in Psychology and Biological Sciences. Students entering from the Joint Science and Humanities Scholars (SHS) program can complete the SHS educational core and choose either departmental order for their diploma.

Specific Pre-Major Requirements
The unified major specifies particular pre-major requirements in the areas of Mathematical Sciences and Statistics, Natural Science, and Computational Reasoning. Particular courses are specified in these areas because they are prerequisites for courses required in the major and therefore they are the most efficient way to complete the general education requirements for either HSS or SHS. All other general education categories can be filled in any way that satisfies the requirements of the student’s college or the SHS programs.

Mathematical Sciences/Statistics
21-120 Differential Calculus and Integral Calculus
21-122 Integration & Differential Equations and Calculus of Approximations
36-247 Statistics for Laboratory Sciences*
36-309 Experimental Design for behavioral and social sciences
* 36-201 can be used as an alternative, but 36-247 is strongly encouraged.
The Major in Cognitive Science

The Psychology Department offers a B.S. degree in Cognitive Science. The field of cognitive science has grown out of increasingly active interaction among psychology, linguistics, artificial intelligence, philosophy, and neuroscience. All of these fields share the goal of understanding intelligence. By combining these diverse perspectives, students of cognitive science are able to understand cognition at a deep level. Because this major is administered by the Psychology Department, it focuses on human cognition and the experimental study of the human mind as illuminated by the techniques of the above disciplines.

Curriculum

The Cognitive Science major is only offered as a B.S. degree. Candidates should complete before the junior year the two-semester calculus sequence 21-120/256 (or alternatively 21-120/122)* and a statistics sequence (36-201 or equivalent and 36-309). In addition, candidates complete 15-111 Intermediate/Advanced Programming, as their departmental computing course.

Because of the number and sequential nature of required courses, prospective Cognitive Science majors are encouraged to begin course work for the major prior to the junior year. In particular, completion of calculus, 36-201, and 85-211 or 85-213 before the junior year will enable students to complete 85-310 by the fall semester of the junior year and, if interested, to then take advantage of research opportunities in the department.

Similarly, completion of 15-111 and 21-127 early in their program of studies will allow students to move into the 15-211/212 sequence by the Junior year and prepare them for further work in artificial intelligence.

*The 3-Semester sequence 21-111/112/256 may be substituted by students who have already taken 21-111 before deciding on the major.

Computing Prerequisite

15-111 Intermediate/Advanced Programming* 10 units

* prerequisite for 15-211

Mathematics & Statistics Prerequisites

21-120 Differential and Integral Calculus (10 units)*
and 21-256 Multivariate Analysis and Approximation or 21-120 Differential and Integral Calculus (10 units) and 21-122 Integration, Differential Equations and Approximation (10 units)
21-127 Concepts of Mathematics+
36-201 Statistical Reasoning, Statistical Practice or equivalent 36-309 Experimental Design for the Behavioral and Social Sciences

+Along with 15-111, prerequisite for 15-211.

Artificial Intelligence Core (minimum) 33 units

15-211 Fundamental Data Structures and Algorithms I
15-212 Principles of Programming
15-381 Artificial Intelligence: Representation and Problem Solving or 85-412 Cognitive Modeling or 85-419 Introduction to Parallel Distributed Processing

Cognitive Psychology Core 27 units

85-211 Cognitive Psychology or 85-213 Human Information Processing and Artificial Intelligence 85-310 Research Methods in Cognitive Psychology
(Prerequisite for all research methods courses 36-309 and corresponding psychology survey course)

Plus complete one of the following:

85-412 Cognitive Modeling 85-419 Introduction to Parallel Distributed Processing 85-423 Cognitive Development

Cognitive Science Concentration Requirement 36 units

Note: The courses to fulfill this requirement should be chosen in Natural Sciences

09-105 Introduction to Modern Chemistry
09-106 Modern Chemistry II
33-xxx Physics I for Science Students
09-217 Organic Chemistry I
09-218 Organic Chemistry II

Computational Reasoning

99-101/102/103 CSW
15-100 Introductory/Intermediate Programming

Discipline Core Requirements

Biological Sciences

03-121 Modern Biology
03-231 Biochemistry
03-240 Cell Biology
03-330 Genetics

Psychology

85-102 Introduction to Psychology

Complete three of the following courses (85-219 should be included as one of the three):


Laboratory/Research Methods Requirements

09-221 Chemistry Laboratory I
09-222 Chemistry Laboratory II
03-343 Experimental Genetics and Molecular Biology

Research Methods in Psychology

Complete one of the following:


Prerequisite for all Research Methods courses: 36-309, and corresponding psychology survey course.

(Note: 36-309 may be taken concurrently as a co-requisite)

Additional Laboratory Requirement:

Complete one additional laboratory experience either as an additional 85-xxx Research Methods course in Psychology or a second laboratory in Biological Sciences at the 300 level or above.

Advanced Psychology/ Biological Sciences Electives: 54 units

1. Psychology Advanced Elective 1
2. Psychology Advanced Elective 2
3. Biology General Elective
4. Biology Advanced Elective 1 (03-360 recommended)
5. Biology Advanced Elective 2
6. Advanced Biological Sciences or Psychology Elective, 85-3xx or higher (Research recommended)

See p. 238 (Advanced Courses) for details.

Additional comments:

If a student drops the unified major program, a second Research Methods course would be required to complete the B.S. in Psychology. If a student drops the unified major program, the following additional courses would be required to complete the B.S. in Biological Sciences: 09-214 Physical Chemistry, 33-xxx Physics II and a second, 300-level Biology laboratory course.

This program does not satisfy all of the requirements for pre-medical preparation. Advising is suggested to determine the additional courses needed for that program.
collaboration with the student’s academic advisor.

Complete four courses from the following course listing. These four courses should be combined into an area of concentration that may include courses from more than one department developed in cooperation with the student’s major advisor. As the curriculum evolves, other courses may also be appropriate, and may be selected in consultation with one’s psychology faculty advisor.

One example of a concentration area would be cognitive modeling which might involve taking four of the following: 85-412, 85-419, 85-392, 85-417 (05-432 cross-listed course number in HCI) and 05-811 Cognitive Modeling for HCI. Another area might be cognitive neuroscience and could involve four of the following: 85-370 Perception, 85-408 Visual Cognition, 03-360 The Biology of the Brain, 85-414 Cognitive Neuropsychology, 85-419 Introduction to Parallel Distributed Processing, 85-429 Cognitive Brain Imaging, and 85-465 Cognitive Neuroscience.

Other areas that might be chosen include: human-computer interaction, machine learning, psycholinguistics, perception and natural language processing. Many other possibilities also exist.

### Computer Science
- 15-384 Robotic Manipulation
- 15-385 Artificial Intelligence: Computer Vision
- 15-396 Modeling of Cognitive Agents
- 15-453 Formal Language and Automata
- 15-681 Machine Learning
- 05-410 Introduction to Human Computer Interaction Methods

### Psychology
- 85-219 Biological Foundations of Behavior
- 85-352 Evolutionary Psychology
- 85-355 Introduction to Cognitive Neuroscience
- 85-370 Perception
- 85-375 Cross Cultural Psychology
- 85-382 Consciousness & Cognition
- 85-390 Human Learning and Memory
- 85-392 Human Expertise
- 85-408 Visual Cognition
- 85-412 Cognitive Modeling
- 85-413 Human Factors
- 85-414 Cognitive Neuropsychology
- 85-417 Introduction to Parallel Distributed Processing
- 85-419 Language and Thought
- 85-421 Infancy
- 85-422 Cognitive Development
- 85-423 Seminar on Higher Level Cognition and Brain Function
- 85-429 Seminar on Implicit and Explicit Memory
- 85-601/602 Senior Thesis
- 66-501/502 Honors Thesis

### Philosophy
- 80-210 Introduction to Logic
- 80-211 Arguments and Inquiry
- 80-220 Philosophy of Science
- 80-254 Pragmatism
- 80-270 Philosophy of Mind
- 80-271 Philosophy and Psychology
- 80-300 Minds, Machines and Knowledge
- 80-310 Logic and Computation
- 80-311 Computability and Incompleteness
- 80-314 Logic in Artificial Intelligence
- 80-316 Probability and Artificial Intelligence
- 80-410 Recursion and Hierarchies
- 80-421 Cognitive Architecture and Bayesian Networks
- 80-510 Seminar in Logic and Computation
- 80-518 Seminar in Epistemology

### Linguistics
- 76-385 Introduction to Discourse Analysis
- 80-280 Introduction to Linguistic Analysis
- 80-480 Linguistic Theory
- 80-481 Formal Semantics I
- 80-482 Formal Semantics II

### Decision Sciences
- 88-302 Behavioral Decision Making
- 88-356 Rational Choice

### Neurosciences
- 03-360 The Biology of the Brain
- 42-301 Physiology

Appropriate courses offered by the Department of Neurosciences at the University of Pittsburgh (available during the academic year through cross-registration) may also be included as part of this breadth option. This would include the following courses (course numbers are University of Pittsburgh numbers, offered through its Department of Neurosciences):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>NROSCI1000</td>
<td>Introduction to Neuroscience</td>
</tr>
<tr>
<td>NROSCI1011</td>
<td>Functional Neuroanatomy</td>
</tr>
<tr>
<td>NROSCI1012</td>
<td>Neuropysiology</td>
</tr>
<tr>
<td>NROSCI1030</td>
<td>Psychiatric Disorders and Brain Function</td>
</tr>
<tr>
<td>NROSCI1034</td>
<td>Neural Basis of Cognition</td>
</tr>
<tr>
<td>NROSCI1040</td>
<td>Biological Basis of Learning and Memory</td>
</tr>
</tbody>
</table>

### Supplementary Science Requirement (minimum) 18 units

The Cognitive Science program requires two additional science courses (in the same science) beyond the college’s two-course Science and Technology General Education requirement.

These can be selected from any one of the following areas.

- 03-xxx Biology*
- 09-xxx Chemistry 33-xxx Physics

*Those interested in a cognitive neuroscience focus are recommended to take biology courses, including if possible, 03-360, The Biology of the Brain.

### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental Structures of Computer Science 15-211</td>
<td>Fundamental Structures of Computer Science 15-212</td>
</tr>
<tr>
<td>Cognitive Psychology Core Course 85-211 or 85-213</td>
<td>Research Methods in Cognitive Psychology 85-310</td>
</tr>
<tr>
<td>Experimental Design for Behavioral and Social Sciences 36-309</td>
<td>Cognitive Science Breadth Requirement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Senior Year</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Artificial Intelligence Course</td>
<td>Elective</td>
</tr>
<tr>
<td>Cognitive Psychology Core Course 85-412, 85-419 or 85-423</td>
<td>Cognitive Science Breadth Requirement</td>
</tr>
<tr>
<td>Supplementary Science Requirement</td>
<td>Elective</td>
</tr>
<tr>
<td>Supplementary Science Requirement</td>
<td>Elective</td>
</tr>
<tr>
<td>Cognitive Science Breadth Requirement</td>
<td>Elective</td>
</tr>
</tbody>
</table>

This is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in a few as two years; not that is must be. Students may enter their major, and begin major course requirements, as early as the start of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

### Additional Major

In order to complete a double major in Cognitive Science, a student must fulfill the major requirements as listed under the Cognitive Science major. These include the programming requirement (15-111), the Mathematics and Statistics prerequisites, the A.I. Core, The...
Cognitive Psychology Core, the Cognitive Science Breadth Requirement, and the Supplementary Science Requirement. Students will be assigned a department advisor to help plan their program of studies in Cognitive Science.

**The Minor in Psychology**

This minor in Psychology is available to all students across the university.

There are three broad areas of concentration in the department, as defined by the three research methods courses together with associated prerequisite survey courses and related advanced courses and seminars.

### Curriculum

<table>
<thead>
<tr>
<th>I. Introductory courses</th>
<th>73 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-100 Cognitive Processes: Theory &amp; Practice</td>
<td>9 units</td>
</tr>
<tr>
<td>85-102 Introduction to Psychology</td>
<td></td>
</tr>
</tbody>
</table>

**II. Area Survey courses** 18 units

Complete only one of these courses.

| 85-211 Cognitive Psychology |
| 85-213 Human Information Processing and Artificial Intelligence |
| 85-219 Biological Foundations of Behavior |
| 85-221 Principles of Child Development |
| 85-241 Social Psychology |
| 85-251 Personality |

**III. Statistics** 19 units

| 36-201 or equivalent Experimental Design for the Behavioral and Social Sciences |
| 36-209 Statistical Reasoning, Statistical Practice |

**Upper Level Courses** 27 units

Complete three courses from categories IV and V, with at least one course from each.

**IV. Research Methods Courses** (minimum 9 units)

| 85-310 Research Methods in Cognitive Psychology* |
| 85-320 Research Methods in Child Development* |
| 85-340 Research Methods in Social Psychology* |

*Prerequisites (or corequisite) for all Research Methods courses: 36-309 and the appropriate survey course.

**V. Advanced courses** (minimum 9 units)

These courses exist within three areas (cognitive, cognitive-neuroscience, developmental and social psychology), and carry course numbers from 85-341 to 85-599. In cases where it is not obvious which track an advanced course belongs to from the title/description, the advanced courses usually include the appropriate survey course or research method course as a prerequisite in their catalog course description.

**The Honors Program**

The Honors Program provides recognition of outstanding performance by students in Psychology or Cognitive Science. Participation enables students to pursue their own research ideas through completion of an honors thesis. The honors thesis is completed during the senior year. By completing a thesis, the student earns 18 units of credit and qualifies for graduation with "College Honors." To qualify for the Honors Program, the student must maintain a quality point average of at least 3.50 in the major and 3.25 overall, and be invited by the college to become a participant.

**Faculty**

**JOHN R. ANDERSON,** Richard King Mellon University Professor of Psychology and Computer Science — Ph.D., Stanford University; Carnegie Mellon, 1978—.

**MARLENE BEHRMANN,** Professor of Psychology — Ph.D., University of Toronto; Carnegie Mellon, 1993—.

**PATRICIA A. CARPENTER,** Lee and Marge Gregg Professor of Psychology — Ph.D., Stanford University; Carnegie Mellon, 1972—.

**SHARON CARVER,** Director of Children’s School, Teaching Professor of Psychology — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1993—.

**MARGARET S. CLARK,** Professor of Psychology — Ph.D., University of Maryland; Carnegie Mellon, 1977—.

**SHELDON COHEN,** Professor of Psychology — Ph.D., New York University; Carnegie Mellon, 1982—.

**BROOKE C. FEENEY,** Assistant Professor of Psychology — Ph.D., State University of New York at Buffalo; Carnegie Mellon, 2001—.

**JOHN R. HAYES,** Professor of Psychology — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1965—.

**VICKI S. HELGESON,** Professor of Psychology — Ph.D., University of Denver; Carnegie Mellon, 1990—.

**LORI L. HOLT,** Associate Professor — Ph.D., University of Wisconsin; Carnegie Mellon, 1999—.

**MARCEL A. JUST,** D. O. Hebb Professor of Psychology — Ph.D., Stanford University; Carnegie Mellon, 1972—.

**DAVID KLAHR,** Professor of Psychology — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1969—.

**ROBERTA KLATZKY,** Professor of Psychology — Ph.D., Stanford University; Carnegie Mellon, 1993—.

**KENNETH R. KOEDINGER,** Associate Professor HCII — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2001—.

**KENNETH KOTOVSKY,** Professor of Psychology, Director, Undergraduate Studies in Psychology — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1988—.

**MARSHA C. LOVETT,** Assistant Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000—.

**BRIAN MACWHINNEY,** Professor of Psychology — Ph.D., University of California, Berkeley; Carnegie Mellon, 1981—.

**JAMES MCCLELLAND,** Walter Van Bingham Professor of Psychology — Ph.D., University of Pennsylvania; Carnegie Mellon, 1984—.

**DAVID PLAUT,** Professor of Psychology — Ph.D. Carnegie Mellon University; Carnegie Mellon, 1994—.

**DAVID RAKISON,** Assistant Professor — D.Phil., University of Sussex; Carnegie Mellon, 2000—.

**LYNNE M. REDER,** Professor of Psychology — Ph.D., University of Michigan; Carnegie Mellon, 1978—.

**MICHAEL SCHEIER,** Professor of Psychology, Head, Psychology Department — Ph.D., University of Texas; Carnegie Mellon, 1975—.

**ROBERT S. SIEGLER,** Heinz Professor of Psychology — Ph.D., State University of New York, Stony Brook; Carnegie Mellon, 1974—.

**JAMES J. STASZEWSKI,** Research Professor — Ph.D., Cornell University; Carnegie Mellon, 1995—.

**ERIK D. THIENEN,** Assistant Professor — Ph.D., University of Wisconsin, Madison; Carnegie Mellon, 2004—.

**NICK YEUNG,** Assistant Professor — Ph.D., University of Cambridge; Carnegie Mellon, 2004—.
The Department of Social and Decision Sciences is a multidisciplinary department that offers undergraduate programs that seamlessly combine frontier knowledge in the social sciences with the practical skills needed to excel in key decision-making roles in the public and private sectors and in advanced studies. Our students learn how to combine intellectual ideals with the realities of human and organizational behavior and to apply these lessons across a wide variety of endeavors, ranging from government service to leadership positions in the information economy.

The department offers undergraduate majors in Decision Science, Policy and Management, and Political Science. The majors leverage off of our departmental core that includes courses in decision analysis, empirical research, organizations, and policy analysis. In addition to completing this core, students also specialize in their major area through a set of required and elective courses.

Our faculty is committed to the academic success and growth of our students. For example, many of our undergraduates work with faculty on research projects and internships. The directors of the majors are easily accessible and encourage students to talk with them about the curriculum, progress, and available opportunities.

The Department of Social and Decision Sciences has a long history of creating innovative and prescient undergraduate programs that combine key ideas from across the social sciences into cohesive majors that allow our graduates to excel in their chosen professions or in the pursuit of advanced studies. Our emphasis on the theory and practice of individual and social decision making linked with our high-quality, multidisciplinary social science faculty, provides a solid foundation from which graduates can embrace a variety of future paths.

The Major In Decision Science

Baruch Fischhoff, Director
Office: Porter Hall 219E

The interdisciplinary field of Decision Science seeks to understand and improve the judgment and decision making of individuals, groups, and organizations. Qualified graduates can continue to PhD programs in Decision Science or related fields (e.g., psychology, business), pursue professional degrees (e.g., MBA, MD, JD), or take professional positions in business, government, consulting, or the non-profit sector. Students work with faculty to tailor their education to their specific needs and interest.

Carnegie Mellon is one of the leading centers for the study of Decision Science. To the best of our knowledge, we offer the only such undergraduate major. Our faculty are involved in applying Decision Research in a wide variety of areas, allowing them to share practical experiences with students. These applications include medical decision making (e.g., conveying the costs and benefits of treatment options to patients), legal decision making (e.g., understanding the effects of anger on attributions of responsibility), societal risk management (e.g., assessing and communicating the risks of terrorist attacks), marketing (e.g., understanding the effects of intertemporal choice on purchasing decisions), and business (e.g., identifying unrecognized conflicts of interest).

Decision Science is grounded in theories and methods drawn from psychology, economics, philosophy, statistics, and management science. Courses in the major cover the three aspects of decision science: (a) normative approaches, creating formal models of rational choice; (b) descriptive research, studying how cognitive, emotional, social, and institutional factors affect judgment and choice, and (c) prescriptive interventions, seeking to improve judgment and decision making. In addition to gaining a broad education in the principles of judgment and decision making, Decision Science majors gain broadly applicable skills in research design and analysis. They also have the chance to think about and discuss decision making in a wide variety of areas.

The core courses in Decision Science cluster into two categories. The theory cluster presents fundamental theories and results from the empirical study of decision making, as well as the application of decision making to real-world problems. The research methods cluster introduces students to methods for collecting and analyzing behavioral data. For example, students learn to perform surveys (e.g., uncovering consumer or managerial preferences), conduct experiments evaluating theories, and evaluate the effectiveness of prescriptive interventions.

The elective courses provide students with additional knowledge in areas of decision making that meet their personal intellectual and career goals. These courses are organized into four clusters: biological and behavioral aspects of decision making, managerial and organizational aspects, philosophical and ethical perspectives, and additional research tools. Students can concentrate in one area or spread their studies across them.

In addition to coursework, the department offers research opportunities for interested and qualified students. Participating in research helps students to extend their mastery of decision science, discover whether a research career is right for them, and get to know faculty and graduate students better.

Prerequisites

All Decision Science majors must complete mathematics and statistics prerequisites (see below), by the end of the sophomore year.

Mathematics and Statistics Prerequisites 19 units

- 21-111 Calculus I
- or 21-120 Differential and Integral Calculus
- 36-201 Statistical Reasoning and Practice

Curriculum 108 units

The core curriculum in Decision Science consists of two courses in empirical research methods and five courses in disciplinary perspectives on Decision Science.

Disciplinary Perspectives 45 units

- 88-120 Reason, Passion, and Social Cognition**
- 85-211 Cognitive Psychology
- 88-220 Policy Analysis I
- 88-223 Decision Analysis and Decision Support Systems
- 88-302 Behavioral Decision Making

** 88-120 should be taken in the freshman or sophomore year.

Research Methods 18 units

- 36-202 Statistical Methods
- 88-251 Empirical Research Methods

Electives 45 units

Complete five courses from the following categories of courses. Most courses listed below are 9-unit courses, but some are less. When courses offered for less than 9 units are chosen, students should note that a minimum of 45 units is required, and should plan to take one or more additional courses as appropriate. The selected courses may be from one category or from any combination of categories.

At least two of these courses (18 units) must be Social and Decision
Sciences courses (88-xxx).

1. Biological and Behavioral Aspects of Decision Making

73-347 Game Theory for Economists
85-219 Biological Foundations of Behavior
85-241 Social Psychology
85-414 Cognitive Neuropsychology
85-449 Emotion and Social Behavior
85-451 Psychology of Purpose
88-307 Irrationality
88-356 Rational Choice
88-379 Social Cognition
88-421 Advanced Topics in Emotion and Decision Making

Appropriate courses offered by the Department of Neuroscience at the University of Pittsburgh (available during the academic year through cross-registration) may also be included as part of this option. Contact the Decision Science faculty director for more information.

2. Managerial and Organizational Aspects of Decision Making

70-323 Business, Society and Ethics
73-226 Quantitative Economic Analysis
73-430 Topics in the Economics of Uncertainty
73-435 Economics of Negotiations
88-351 Mass Political Behavior: Issues, Elections and Public Opinion
88-354 Economics and Psychology of Organizational Communications
88-385 Managerial Decision Making
88-444 Public Policy & Regulation

3. Philosophical and Ethical Perspectives on Decision Making

19-426 Environmental Decision Making
80-241 Ethical Judgments in Professional Life
80-242 Conflict, Dispute Resolution
80-271 Philosophy and Psychology
80-360 Emotions, Beliefs, and Choices
80-340 Environmental Ethics and Decision Making
80-346 Value Fact and Policy
80-371 Philosophy and Psychology
88-430 Epistemology of Behavioral Decision Research

4. Statistical and Research Methods for Decision Analysis

36-303 Sampling, Survey and Society
36-309 Experimental Design for Behavioral and Social Sciences
36-310 Fundamentals of Statistical Modeling

Note: Some courses have additional prerequisites.

Decision Science, B.S.

Sample Curriculum*

<table>
<thead>
<tr>
<th>Sophomore Year</th>
<th>Junior Year</th>
<th>Senior Year</th>
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<tbody>
<tr>
<td>Fall</td>
<td>Fall</td>
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<td>Spring</td>
<td>Spring</td>
<td>Spring</td>
</tr>
</tbody>
</table>

- **Relevant Courses**
- **Open Prerequisites**
- **Elective**

*This is presented as a two-year (junior-senior) plan for completing major requirements, with the exception of 88-120. Its purpose is to show that this program can be completed in as few as two years; not that it must be. Students may enter their major, and begin major course requirements, as early as the start of the sophomore year, and in some instances in the freshman year. Students should consult their advisor when planning their program.

** This course should be taken as the first course in the Decision Science sequence. It is intended for students in their first or second year; it is offered in Spring semesters. It may be taken as late as the junior year.

Additional Major in Decision Science

Students who elect Decision Science as an additional major must fulfill all of the requirements of the Decision Science major.

Students pursuing Political Science with an additional major in Decision Science may only count 36-202, 88-220, and 88-251 toward the completion of both majors.

Students pursuing Policy and Management with an additional major in Decision Science and may only count 36-202, 88-220, 88-223, and 88-251 toward the completion of both majors.

Additional majors cannot count menu electives toward simultaneously fulfilling more than one major or minor. Students who are interested in an additional major in Decision Science should see the Director of the Decision Science program.

The Major in Policy and Management

Otto Davis, Director
Office: Porter Hall 223F

The Policy and Management major prepares students for key decision-making and management roles in government, the non-profit sector, and business. The major emphasizes analytic approaches to decision making, management, and organization, and combines such knowledge with the practical skills necessary for graduates to excel in both the public and private sectors. The multidisciplinary curriculum merges frontier knowledge on both the ideals of decision making, policy, and organization, as well as the realities of individual and organizational behavior that must be confronted if high-quality outcomes are going to be attained.

The major is comprised of four clusters of courses. The Analytic Methods cluster consists of four courses that provide theoretical training and practical experience in problem solving and decision making. These courses provide systematic methods for dealing with the complexities that make decisions difficult, ranging from incorporating issues of risk and uncertainty in decision making to dealing with choices that have mutually conflicting objectives. For example, a business or government agency may need to decide on a policy for mitigating the uncertain impacts of air pollution while simultaneously trying to minimize the costs of such a policy on manufacturing. A firm might want to consider the uncertain reductions in security dangers from alternative policies to protect against terrorism. In this cluster of courses, students will gain an appreciation of the economic analysis of complex decisions, as well as the trade-off between economic and political-based decision making.

The Organizational Context cluster consists of a single course that emphasizes the analysis of how people organize and coordinate their behavior to perform complex tasks that are beyond the capability of any single individual. The course uses a multidisciplinary approach to analyze the potential shortcomings of large organizations, such as inertia, group-think, coordination failure, and bureaucratic infighting.

The Research Methods cluster is a two course requirement focused on key methods for collecting and analyzing data that are needed to make informed decisions. Students learn to use interviews, surveys, experiments, and econometric methods to enhance their ability to test existing, and design new, policies.

Finally, the Policy Making, Management, and Technology cluster consists of five elective courses chosen by the student, in coordination with an advisor, to add depth and breadth to the major. These courses are chosen from three categories that emphasize different aspects of decision making and management: (1) policy making, (2) management, and (3) technology and information.

The Policy and Management major provides an excellent combination of theoretical and practical skills for students who intend to seek
management positions. Because of its strong analytic orientation, it is also an excellent major for those who intend to go on to professional school programs in law, business, or public policy. It is also an appropriate choice for students pursuing graduate degrees in economics, political science, or decision science. One such graduate option is the accelerated masters program offered by the H. J. Heinz III School of Public Policy and Management, in which a student earns both a B.S. in Policy and Management and a M.S. in Public Policy and Management in five years.

### Prerequisites

All Policy and Management majors must complete mathematics and statistics prerequisites (see below), by the end of the sophomore year.

**Mathematics and Statistics Prerequisites**

- 21-111 Calculus I
- 21-112 Calculus II
- 21-210 Calculus I and
- 21-256 Multivariate Analysis and Approximation
- 21-120 Differential and Integral Calculus (10 units) and
- 21-122 Integration, Differential Equations and Approximation (10 units)

28-29 units

### Curriculum

**111 units**

**Analytical Methods**

- 88-220 Policy Analysis I
- 88-221 Policy Analysis II
- 88-222 Policy Analysis III
- 88-223 Decision Analysis and Decision Support Systems

**Organizational Context**

- 88-260 Organizations

**Research Methods**

- 36-202 Statistical Methods
- 88-251 Empirical Research Methods

**Policy Making, Management, and Technology**

45 units

Complete five courses from the following categories of courses. Most courses listed below are 9-unit courses, but some are less. When courses offered for less than 9 units are chosen, students should note that a minimum of 45 units is required, and should plan to take one or more additional courses as appropriate. The selected courses may be from one category or from any combination of categories.

At least three of these courses (27 units) must be Social and Decision Sciences courses (88-xxx).

### 1. Policy Making

- 73-340 Labor Economics
- 73-352 Public Economics
- 73-357 Regulation: Theory and Policy
- 73-420 Monetary Theory and Policy
- 79-329 Sex, Population, and Birth Control
- 79-331 Crime and Punishment in American History
- 79-335 Drug Use and Drug Policy
- 80-235 Political Philosophy
- 80-346 Value, Fact, & Policy
- 88-305 Philosophy of Social Science
- 88-324 Electoral Systems and Processes
- 88-327 Politics of Economic Development
- 88-352 International Environmental Law and Policy
- 88-358 Policy Making Institutions
- 88-362 Climate Change, Energy Policy, Environment, and Sustainable Development
- 88-425 Politics of Economic Deregulation
- 88-444 Public Policy and Regulation

### 2. Management

- 70-322 Business and Society
- 73-359 Benefit-Cost Analysis
- 73-469 Economics of E-Commerce
- 80-241 Ethical Judgments in Professional Life
- 80-242 Conflict and Dispute Resolution
- 80-244 Environment, Management, and Ethics
- 88-341 Organizational Communication
- 88-343 Economics of Technological Change

### 3. Technology and Information

- 19-402 Telecommunications Policy
- 19-448 Science, Technology and Ethics
- 79-230 Technology in American Society
- 79-340 History of Modern Warfare
- 88-340 Economics of Entrepreneurship in High Technology Industries
- 88-343 Economics of Technological Change
- 88-344 Organizational Intelligence in the Information Age
- 88-345 The Rise of Industrial Research and Development
- 88-347 Complex Technological Systems: Past, Present and Future

**NOTE:** Some courses have additional prerequisites.

### Policy and Management, B.S.

**Sample Curriculum**

#### Junior Year

<table>
<thead>
<tr>
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<th>Spring</th>
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<tbody>
<tr>
<td>Policy Analysis I 88-220</td>
<td>Policy Analysis II 88-221</td>
</tr>
<tr>
<td>Analyses 88-260</td>
<td>Empirical Research Methods 88-251</td>
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<tr>
<td>Policy and Management Elective</td>
<td>Policy and Management Elective</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Organizational Context 9 units</th>
<th>Empirical Research Methods 88-251</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizations 88-260</td>
<td>Decision Analysis &amp; Decision Support Systems 88-223</td>
</tr>
<tr>
<td>Policy and Management Elective</td>
<td>Policy and Management Elective</td>
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</tbody>
</table>

#### Senior Year

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<tr>
<td>Elective</td>
<td>Elective</td>
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<tr>
<td>Decision Analysis &amp; Decision Support Systems 88-223</td>
<td>Statistical Methods 36-202</td>
</tr>
<tr>
<td>Policy and Management Elective</td>
<td>Elective</td>
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</table>

*This is presented as a two-year (junior-senior) plan for completing major requirements. Its purpose is to show that this program can be completed in as few as two years; not that it must be. Students may enter their major, and begin major course requirements, as early as the start of the sophomore year, and in some instances in the first year. Students should consult their advisor when planning their program.

### Additional Major

Students who elect Policy and Management as an additional major must fulfill all of the requirements of the Policy and Management major.

Students pursuing Decision Science with an additional major in Policy and Management may only count 36-202, 88-220, 88-223, and 88-251 toward the completion of both majors.

Students pursuing Political Science with an additional major in Policy and Management may only count 36-202, 88-220, 88-223, and 88-251 toward the completion of both majors.

Additional majors cannot count menu electives toward simultaneously fulfilling more than one major or minor. Students who are interested in an additional major in Policy and Management should see the Director of the Policy and Management program.
The Major in Political Science

Silvia Borzutzky, Director
Office: Porter Hall 208B

The Political Science major at Carnegie Mellon is a uniquely rigorous, analytical, and interdisciplinary way to learn about politics and government. The major combines the study of classical issues in political behavior, institutions, and philosophy with the new tools and skills that are necessary in the job market and as a basis for graduate training.

The Political Science major builds on the H&SS General Education requirements through nine required courses that reflect the interdisciplinary nature of the Department of Social and Decision Sciences and its strengths in the areas of decision making, information, and organizations. Together these requirements provide an outstanding background in social science theory and methods, as well as solid grounding in the study of politics. A capstone course, in which theories and methods learned in the classroom are applied to a real-world problem for a real-world client, is one of the required courses.

Additionally, students in the Political Science major take four electives from the following four clusters: Law, American Politics, International Relations and Comparative Politics, and Political Theory and Methodology. A wide range of courses is offered within each cluster. The student's course selection of the electives, decided in coordination with the director for the major, provides a depth and breadth of knowledge. This typically involves two elective courses in one cluster. At least two of the electives must be from the Department of Social and Decision Sciences (88-xxx).

The Department encourages students to complement their formal coursework with internship experiences. Whether the internship is in Pittsburgh or elsewhere, such as through the Washington Semester Program, students are able to experience directly the inner workings of government and government-related organizations, and to network with professionals in the field. Students can also spend a semester or year abroad at a wide range of overseas programs with which Carnegie Mellon is affiliated. The major is also compatible with the H. John Heinz III School of Public Policy and Management accelerated masters program, where a student earns both a B.S. in Political Science and a M.S. in Public Policy and Management in five years.

The Political Science major prepares the student for a wide variety of careers in addition to being part of a liberal arts education. Political Science provides a valuable background for those pursuing careers in business or in public service through employment in government and the nonprofit sector. The major also provides a solid preparation for graduate study in law, public policy, business, and political science.

Prerequisites

All Political Science majors must complete mathematics and statistics prerequisites (see below), by the end of the sophomore year.

Mathematics and Statistics Prerequisites 18-19 units

21-111 Calculus I
or
21-120 Calculus 1
or
21-120 Differential and Integral Calculus (10 units)
36-201 Statistical Reasoning and Practice

Curriculum 111 units

Political Core 27 units
88-104 Decision Processes in American Political Institutions

Complete two of the following three courses:
88-205 Comparative Politics
88-324 Electoral Systems and Processes
88-358 Policy Making Institutions*  
*88-104 is a prerequisite for this course.

Theoretical Perspectives 30 units
88-220 Policy Analysis I
88-221 Policy Analysis II

Research Methods 18 units
36-202 Statistical Methods
88-251 Empirical Research Methods

Theories and Applications 36 units
Select four courses from the following categories of courses. Most courses listed below are 9-unit courses, but some are less. When courses offered for less than 9 units are chosen, students should note that a minimum of 36 units is required, and should plan to take one or more additional courses as appropriate. The selected courses may be from one category or from any combination of categories. A student’s course selection among these menu electives is decided in close coordination with the faculty director to provide a depth and breadth of knowledge. At least two of these courses (18 units) must be Social and Decision Sciences courses (88-xxx).

1. Law
70-364 Business Law
70-385 International Trade and International Law
73-354 Law and Economics
73-357 Regulation: Theory and Policy
79-331 Crime and Punishment In America
80-236 Philosophy and Law
80-244 Environment, Management, and Ethics
80-340 Environmental Ethics & Decision Processes
88-181 Topics in Law: 1st Amendment
88-184 Topics in Law: The Bill of Rights
88-352 International Environmental Law and Policy
88-382 Climate Change, Energy Policy, and Environmental Protection

2. American Politics
70-332 Business and Society
79-232 Vietnam: America’s Lost War
79-241 African-American History I
79-242 African-American History II
79-331 Crime and Punishment in America
79-335 Drug Use Drug Policy
79-345 American Environmental History: Critical Issues
80-244 Management, Environment, & Ethics
88-317 American Legislative Institutions
88-324 Electoral Systems and Processes***
88-329 American Foreign Policy: 1945-Present
88-358 Policy Making Institutions***
88-425 Politics of Economic Deregulation

3. International Relations and Comparative Politics
73-371 International Trade and Economic Development
73-372 International Money and Finance
79-232 Vietnam: America’s Lost War
79-233 The United States and the Middle East Since 1945
79-260 Mayan America
79-271 Modern China
79-272 Modern Japan1868 to Present
79-280 Russian History from the First to the Last Tsar
79-281 Modern Soviet History: From Communism to Capitalism
79-290 Modern Latin America, 1789-Present
79-291 The Cold War in Documents and Film
79-352 Arab-Israeli Condition: War and Peace
79-354 Stalin and Stalinism
79-397 Religion and Politics in the Middle East
88-205 Comparative Politics***
88-314 Politics through Film: Tyranny and Resistance
88-318 Contemporary Latin American Politics
88-324 Electoral Systems and Processes***
88-326 Theories of International Relations
88-327 Politics of Economic Development
88-330 Political Economy of Inequality and Redistribution
88-333 Foreign Aid: The U.S., the E.U. and the Developing World
88-334 Transitions to Democracy in Eastern Europe and Latin America
88-352 International Environmental Law and Policy
88-357 Comparative Foreign Policy: China, Russia, and the US
88-358 Policy Making Institutions***
88-359 Globalization

4. Political Theory and Methodology
73-356 Political Economy of Public Institutions
The Minor in Decision Science

Baruch Fischhoff, Program Director
Office: Porter Hall 219E

The minor in Decision Science provides students with a selective survey of disciplinary perspectives. The courses present descriptive and normative approaches to judgement and decision making, as well as some application of theories and results to real-world problems. Students who elect Decision Science as a minor must complete the four core courses (below) and two electives from the elective set (below).

Curriculum

54 units

Core Courses 36 units

88-120 Reason, Passion, and Social Cognition
88-220 Policy Analysis I
88-223 Decision Analysis and Decision Support Systems
88-302 Behavioral Decision Making

Elective Courses 18 units

Complete any two courses from the following categories.

1. Biological and Behavioral Aspects of Decision Making

73-347 Game Theory for Economists
85-219 Biological Foundations of Behavior
85-241 Social Psychology
85-414 Cognitive Neuropsychology
85-449 Emotion and Social Behavior
85-451 Psychology of Purpose
88-307 Irrationality
88-356 Rational Choice
88-379 Social Cognition
88-421 Advanced Topics in Emotion and Decision Making

2. Managerial and Organizational Aspects of Decision Making

70-332 Business, Society and Ethics
73-226 Quantitative Economic Analysis
73-430 Topics in the Economics of Uncertainty
73-435 Economics of Negotiations
88-351 Mass Political Behavior: Issues, Elections and Public Opinion
88-354 Economics and Psychology of Organizational Communications
88-385 Managerial Decision Making
88-444 Public Policy & Regulation

3. Philosophical and Ethical Perspectives on Decision Making

19-426 Environmental Decision Making
80-241 Ethical Judgments in Professional Life
80-242 Conflict, Dispute Resolution
80-271 Philosophy and Psychology
80-306 Emotions, Beliefs, and Choices
80-340 Environmental Ethics and Decision Making
80-346 Value Fact and Policy
80-371 Philosophy and Psychology
88-430 Epistemology of Behavioral Decision Research

4. Statistical and Research Methods for Decision Analysis

36-303 Sampling, Survey and Society
36-309 Experimental Design for Behavioral and Social Sciences
36-310 Fundamentals of Statistical Modeling

Note: Some courses have additional prerequisites.
The Minor in Policy and Management
Otto Davis, Program Director
Office: Porter Hall 223F

Regardless of major, many Carnegie Mellon graduates will face managerial challenges and responsibilities in their professional lives. Whether these are in their area of expertise or in more general settings, these roles will to some degree require assumption of the responsibility for directing the work of others. The Policy and Management minor is intended for students who expect to need these management concepts and skills.

Curriculum

Required Courses 54 units

Required Courses 36 units
88-220 Policy Analysis I
88-221 Policy Analysis II
88-223 Decision Analysis and Decision Support Systems
88-260 Organizations

Electives 18 units

Complete two courses from the following categories.

At least one of the courses (9 units) must be a Social and Decision Sciences course (88-xxx).

1. Policy Making
73-340 Labor Economics
73-352 Public Economics
73-357 Regulation: Theory and Policy
73-420 Monetary Theory and Policy
79-329 Sex, Population, and Birth Control
79-331 Crime and Punishment in American History
79-335 Drug Use and Drug Policy
80-235 Political Philosophy
80-346 Value, Fact, & Policy
88-305 Philosophy of Social Science
88-324 Electoral Systems and Processes
88-327 Politics of Economic Development
88-352 International Environmental Law and Policy
88-358 Policy Making Institutions
88-382 Climate Change, Energy Policy, Environment, and Sustainable Development
88-425 Politics of Economic Deregulation
88-444 Public Policy and Regulation

2. Management
70-322 Business and Society
73-359 Benefit-Cost Analysis
73-469 Economics of E-Commerce
80-241 Ethical Judgments in Professional Life
80-242 Conflict and Dispute Resolution
80-244 Environment, Management, and Ethics
88-341 Organizational Communication
88-343 Economics of Technological Change

3. Technology and Information
19-402 Telecommunications Policy
19-448 Science, Technology and Ethics
79-230 Technology in American Society
79-340 History of Modern Warfare
88-340 Economics of Entrepreneurship in High Technology Industries
88-343 Economics of Technological Change
88-344 Organizational Intelligence in the Information Age
88-345 The Rise of Industrial Research and Development
88-347 Complex Technological Systems: Past, Present and Future

NOTE: Some courses have additional prerequisites.

The Minor in Political Science
William R. Keech, Director
Office: Porter Hall 208G

The minor in Political Science consists of 54 units of course work. Half of these are in three required courses; the remainders are electives.

Curriculum

Required Courses 27 units
88-104 Decision Processes in American Political Institutions
88-220 Policy Analysis I
88-205 Comparative Politics
or
88-324 Electoral Systems and Processes
or
88-358 Policy Making Institutions

Elective Courses 27 units

Select three courses from the following categories of courses. When courses offered for less than 9 units are chosen, students should note that a minimum of 27 units is required in this category, and should plan to take one or more additional courses as appropriate. A student’s course selection among these menu electives is decided in close coordination with his or her academic advisor to provide a depth and breadth of knowledge. The selected courses may be from one category or from any combination of categories.

At least two of these courses (18 units) must be Social and Decision Sciences courses (88-xxx).

1. Law
70-364 Business Law
70-365 International Trade and International Law
73-354 Law and Economics
73-357 Regulation: Theory and Policy
79-331 Crime and Punishment in America
80-236 Philosophy and Law
80-244 Environment, Management, and Ethics
80-340 Environmental Ethics & Decision Processes
88-181 Topics in Law: 1st Amendment
88-184 Topics in Law: The Bill of Rights
88-352 International Environmental Law and Policy
88-382 Climate Change, Energy Policy, and Environmental Protection

2. American Politics
70-332 Business and Society
79-232 Vietnam: America’s Lost War
79-241 African-American History I
79-242 African-American History II
79-331 Crime and Punishment in America
79-335 Drug Use Drug Policy
79-345 American Environmental History: Critical Issues
80-244 Management, Environment, & Ethics
88-317 American Legislative Institutions
88-324 Electoral Systems and Processes
88-329 American Foreign Policy: 1945-Present
88-358 Policy Making Institutions
88-425 Politics of Economic Deregulation

3. International Relations and Comparative Politics
73-371 International Trade and Economic Development
73-372 International Money and Finance
79-232 Vietnam: America’s Lost War
79-233 The United States and the Middle East Since 1945
79-260 Mayan America
79-271 Modern China
79-272 Modern Japan1868 to Present
79-280 Russian History from the First to the Last Tsar
79-281 Modern Soviet History: From Communism to Capitalism
79-290 Modern Latin America, 1789-Present
79-351 The Cold War in Documents and Film
79-352 Arab-Israeli Condition: War and Peace
79-354 Stalin and Stalinism
79-397 Religion and Politics in the Middle East
88-205 Comparative Politics
88-314 Politics through Film: Tyranny and Resistance
4. Political Theory and Methodology

73-356 Political Economy of Public Institutions
80-136 Social Structure, Public Policy, & Ethical Dilemmas
80-235 Political Philosophy
80-242 Conflict and Dispute Resolution
80-256 Modern Moral Philosophy
88-305 Philosophy of Social Science
88-308 Philosophy, Politics and Economics
88-330 Political Economy of Inequality and Redistribution
88-351 Mass Political Behavior: Issues, Elections and Public Opinion
88-356 Rational Choice
88-358 Policy Making Institutions***
88-355 Political Economy
88-374 Government Response to Market Failures

***Course counts as a Theories and Applications elective only if not taken in fulfillment of Political Core requirement.

NOTE: Some courses have additional prerequisites.

Faculty

CRISTINA BICCHIERI, Professor of Philosophy — Ph.D., Cambridge University; Carnegie Mellon, 1989—.

SILVIA BORZUTZKY, Associate Teaching Professor — Ph.D., University of Pittsburgh; Carnegie Mellon, 2001—.

OTTO A. DAVIS, W.W. Cooper University Professor of Economics and Public Policy — Ph.D., The University of Virginia; Carnegie Mellon, 1960—.

ROBYN M. DAWES, Charles J. Queenan, Jr. University Professor of Psychology — Ph.D., The University of Michigan; Carnegie Mellon, 1985—.

JULIE DOWNS, Researcher — Ph.D., Princeton University; Carnegie Mellon, 1995—.

PAUL S. FISCHBECK, Professor of Social and Decision Sciences and Engineering and Public Policy — Ph.D., Stanford University; Carnegie Mellon, 1990—.

BARUCH FISCHHOFF, Howard Heinz University Professor of Social and Decision Sciences and of Engineering and Public Policy — Ph.D., The Hebrew University of Jerusalem; Carnegie Mellon, 1987—.

CHRISTINA FONG, Research Scientist — Ph.D., University of Massachusetts, Amherst; Carnegie Mellon, 2001—.

CLEOTILDE GONZALEZ, Assistant Professor of Information and Decision Sciences — Ph.D., Texas Tech University; Carnegie Mellon, 2000—.

DAVID A. HOUNSHELL, David M. Roderick Professor of Technology and Social Change — Ph.D., University of Delaware; Carnegie Mellon, 1991—.

WILLIAM R. KEECH, Professor of Political Economy — Ph.D., University of Wisconsin-Madison; Carnegie Mellon, 1997—.

STEVEN KLEPPER, Arthur Arton Hamerschlag Professor of Economics and Social Science — Ph.D., Cornell University; Carnegie Mellon, 1980—.

JENNIFER S. LERNER, Estella Loomis McCandless Associate Professor of Social and Decision Sciences and Psychology — Ph.D., The University of California, Berkeley; Carnegie Mellon, 1998—.

GEORGE F. LOEWENSTEIN, Professor of Economics — Ph.D., Yale University; Carnegie Mellon, 1990—.

JOHN H. MILLER, Professor of Economics and Social Sciences — Ph.D., The University of Michigan; Carnegie Mellon, 1989—.

ANGELA NO, Assistant Professor; Carnegie Mellon, 2003—.
Department of Statistics

Mark J. Schervish, Department Head
Department Office: Baker Hall 132

Uncertainty is inescapable: randomness, measurement error, deception, and incomplete or missing information complicate all our lives. Statistics is the science and art of making predictions and decisions in the face of uncertainty. Statistical issues are central to big questions in public policy, law, medicine, industry, computing, technology, finance, and science. Indeed, the tools of Statistics apply to problems in almost every area of human activity where data are collected.

Statisticians must master diverse skills in computing, mathematics, decision making, forecasting, interpretation of complicated data, and design of meaningful comparisons. Moreover, statisticians must learn to collaborate effectively with people in other fields and, in the process, to understand the substance of these other fields. For all these reasons, Statistics students are highly sought-after in the marketplace.

Recent Statistics majors at Carnegie Mellon have taken jobs at leading companies in many fields, including Intel, Proctor and Gamble, Price Waterhouse-Coopers, D.E. Shaw, Harvard Management Company, and Marketing and Planning Systems. Other students have been taken research positions at the National Security Agency, the Census Bureau, and internships at the Joint Program in Survey Methodology in Washington D.C. and the Epidemiology Data Center at the University of Pittsburgh. Many of our students have also gone on to graduate study at some of the top programs in the country, including Statistics at Carnegie Mellon, Cornell, Minnesota, and the University of Washington; Biostatistics at Michigan and Harvard; Industrial Engineering at Stanford; Operations Research at Penn State; and Clinical Psychology and Neuroscience at the University of Pittsburgh.

The Department and Faculty

The Department of Statistics at Carnegie Mellon University is world-renowned for its contributions to statistical theory and practice. Research in the department runs the gamut from pure mathematics to the hottest frontiers of science. Current research projects are helping make fundamental advances in neuroscience, cosmology, seismology, finance, and genetics.

The faculty are recognized around the world for their expertise and have garnered many prestigious awards and honors. (For example, three members of the faculty have been awarded the COPPS medal, the highest honor given by professional statistical societies.) At the same time, the faculty is firmly dedicated to undergraduate education. The entire faculty, junior and senior, teaches courses at all levels, including the introductory courses. The faculty are accessible and are committed to involving undergraduates in research.

The Department augments all these strengths with a friendly, energetic working environment and exceptional computing resources. Talented graduate students join the department from around the world, and add a unique dimension to the department’s intellectual life. Faculty, graduate students, and undergraduates interact regularly.

How to Take Part

There are many ways to get involved in Statistics at Carnegie Mellon:

• The Bachelor of Science in Statistics in the College of Humanities and Social Sciences (H&SS) is a broad-based, flexible program that helps you master both the theory and practice of Statistics. The program can be tailored to prepare you for later graduate study in Statistics or to complement your interests in almost any field, including Psychology, Physics, Biology, History, Business, Information Systems, and Computer Science.

• The Minor (or Additional Major) in Statistics is a useful complement to a (primary) major in another Department or College. Almost every field of inquiry must grapple with statistical problems, and the tools of statistical theory and data analysis you will develop in the Statistics minor will give you a critical edge.

• The Statistical and Mathematical Sciences Program (within the Science and Humanities Scholars Program), is an alternative path for the study of Statistics that is jointly administered by the Department of Mathematical Sciences and the Department of Statistics.

• The Statistics Data Mining Track in the Information Systems Major in the College of Humanities and Social Sciences offers fundamental training in the application and development of information systems, particularly in the analysis and interpretation of large and dynamic databases. (See Information Systems Program).

• The Statistics Concentration within the Mathematical Sciences Major (see Department of Mathematical Sciences) is jointly administered by the Department of Mathematical Sciences and the Department of Statistics.

• Many exciting Research Projects are ongoing in the Statistics Department, and the department enthusiastically seeks to involve undergraduates in this work. Both majors and non-majors are welcome.

• Non-majors are eligible to take most of our courses, and indeed, they are required to do so by many programs on campus. Such courses offer a good way to get involved in cutting-edge research within the Statistics Department.

Basic Curriculum

Statistics consists of two intertwined threads of inquiry: Statistical Theory and Data Analysis. The former uses probability theory to build and analyze mathematical models of data in order to devise methods for making effective predictions and decisions in the face of uncertainty. The latter involves techniques for extracting insights from complicated data, designs for accurate measurement and comparison, and methods for checking the validity of theoretical assumptions. Statistical Theory informs Data Analysis and vice versa. The Statistics Department curriculum follows both of these threads and helps the student develop the complementary skills required. We first describe the different categories within our basic curriculum and the courses offered within each category. We then give details about the requirement for the Major and Minor in Statistics.

Mathematical Foundations (Prerequisites)

Mathematics is the language in which statistical models are described and analyzed, so some experience with basic calculus and linear algebra is an important component for anyone pursuing a program of study in Statistics.

Calculation*:

There are three sequences of mathematics courses at Carnegie Mellon that provide sufficient preparation in calculus:

Sequence 1
21-111 Calculus I
21-112 Calculus II

Sequence 2
21-120 Differential and Integral Calculus
21-122 Integration, Differential Equations and Approximation
Sequence 3

- 21-120 Differential and Integral Calculus
- 21-256 Multivariate Analysis and Approximations

Other sequences are possible, and require approval from the undergraduate advisor.

Linear Algebra**

There are two mathematics courses at Carnegie Mellon that provide sufficient preparation in linear algebra:

- 21-241 Matrix Algebra
- 21-341 Linear Algebra I

* It is recommended that students complete this requirement during their freshman year.
** This requirement needs to be completed before taking 36-401

Data Analysis

Data analysis is the art and science of extracting insight from data. The art lies in knowing which displays or techniques will reveal the most interesting features of a complicated data set. The science lies in understanding the various techniques and the assumptions on which they rely. Both aspects require practice to master.

The Beginning Data Analysis courses give a hands-on introduction to the art and science of data analysis. The courses cover similar topics but differ slightly in the examples they emphasize. 36-201 draws examples from many fields and satisfies the H&SS College Core Requirement in Statistical Reasoning. This course is the recommended course for students in the College. A score of 5 on the Advanced Placement (AP) Exam in Statistics may be used to waive this requirement but does not confer course credit. Other courses emphasize examples in business (36-207), engineering and architecture (36-220), and the laboratory sciences (36-247).

The Intermediate Data Analysis courses build on the principles and methods covered in the introductory course, and more fully explore specific types of data analysis methods.

The Advanced Data Analysis courses draw on students’ previous experience with data analysis and understanding of statistical theory to develop advanced, more sophisticated methods. These core courses involve extensive analysis of real data and a substantial component of independent research.

Beginning

- 36-201 Statistical Reasoning and Practice
- 36-207 Probability and Statistics for Business Applications
- 36-220 Engineering Statistics and Quality Control
- 36-247 Statistics for the Laboratory Sciences

Intermediate

- 36-202 Statistical Methods
- 36-208 Regression Analysis (cross listed as 70-208)
- 36-309 Experimental Design for Behavioral and Social Sciences

Advanced

- 36-303 Sampling, Surveys, and Society
- 36-315 Statistical Graphics and Visualization
- 36-350 Data Mining
- 36-401 Modern Regression
- 36-402 Advanced Data Analysis

Probability Theory

The theory of probability gives a mathematical description of the randomness inherent in our observations. It is the language in which statistical models are stated, so an understanding of probability is essential for the study of advanced statistical theory. Students who are taking Statistical Theory Sequence 1 (see below) will learn probability theory in the first part of the course 36-310. For students taking Statistical Theory Sequences 2 or 3 (see below), a full course in probability theory is necessary as a prerequisite:

Typically, students take corresponding pairs 36-225/36-226 or 36-625/36-626, but it is possible to substitute 36-217 for 36-225. 36-225 is the standard introduction to probability. 36-217 is tailored for engineers and Computer Scientists but should be of interest for

students in the sciences as well. 36-410 is an upper level probability course, which exposes students to more sophisticated probability models. All of the probability courses listed below qualify as Statistical Electives, and thus taking any of them as prerequisites can satisfy additional Major and Minor requirements.

- 36-217 Probability Theory and Random Processes
- 36-225 Introduction to Probability and Statistics I
- 36-625 Probability and Mathematical Statistics I
- 36-410 Introduction to Probability Models

Statistical Theory

Statistical theory provides a mathematical framework for making inferences about unknown quantities from data. The theory reduces statistical problems to their essential ingredients to help devise and evaluate inferential procedures. It provides a powerful and wide-ranging set of tools for dealing with uncertainty.

The Statistics Department offers three parallel sequences that cover statistical theory. Sequence 1 is intended for students with less experience in mathematics and probability and provides a conceptual bridge between data analysis methods and the theory underlying them. Sequences 2 and 3 cover the theory in greater depth and with more mathematical content for students who are concentrating in technical fields. The latter is more mathematically rigorous and is good preparation for later graduate work in Statistics or other disciplines. Sequences 2 and 3 both require a prerequisite in Probability Theory (see previous category).

Sequence 1

- 36-310 Fundamentals of Statistical Modeling

Sequence 2

- 36-226 Introduction to Probability and Statistics II

Sequence 3

- 36-626 Probability and Mathematical Statistics II

Special Topics

The Statistics Department offers seminar courses that focus on specific statistical applications or advanced statistical methods. At least one of these Special Topics seminars (36-461) will be offered every year; others are offered intermittently according to interest and demand. Past topics included statistics and the law, Bayesian statistics, non-parametric statistics, applied multivariate methods, statistical genetics, and statistical methods in epidemiology. The objective of the seminar course is to expose students to important topics in statistics and/or interesting applications which are not part of the standard undergraduate curriculum.

- 36-461 Topics in Statistics
- 36-462 Topics in Statistics

Statistical Electives

Statistical electives courses can be either within or outside the statistics department (some restrictions apply – see requirements).

Courses within Statistics

Any course in Probability Theory, Advanced Data Analysis, or Special Topics categories that does not satisfy any other requirement for a Statistics Major and Minor (detailed below) may be counted as a Statistical Elective.

Courses outside Statistics

The following is a partial list of courses that qualify as electives as they provide intellectual infrastructure that will advance the student’s understanding of statistics and its applications. Other courses may qualify as well; consult with the Statistics Undergraduate Advisor.

- 15-100 Introductory/Intermediate Programming
- 15-111 Intermediate/Advanced Programming
- 15-200 Advanced Programming/Practicum
- 21-127 Concepts of Mathematics
- 21-259 Calculus in Three Dimensions
- 21-260 Differential Equations
- 21-292 Operations Research I
- 21-301 Combinatorial Analysis
- 80-220 Philosophy of Science
- 80-221 Philosophy of Social Science
Probability Theory prerequiste for Statistical Advanced Data Analysis 27 units: one of 36-303, Beginning Data Analysis 9 units (one course) or other fields and learn the nuances of interdisciplinary collaboration. Majors gain experience applying statistical tools to real problems in the interpretation and display of complex data. In addition, Statistics wide array of skills in computing, mathematics, statistical theory, and Program (see relevant section in the catalog for details).

Students should carefully check the course descriptions to determine if additional prerequisites are necessary.

Concentration Area

The power of Statistics, and much of the fun, is that it can be applied to answer such a wide variety of questions in so many different fields. A critical part of statistical practice is understanding the questions being asked so that appropriate methods of analysis can be used. Hence, a critical part of statistical training is to gain experience applying the abstract tools to real problems. The Concentration Area is a set of four related courses outside of Statistics that prepares the student to deal with statistical aspects of problems that arise in another field. These courses are usually drawn from a single discipline of interest to the student and are chosen in consultation with the Statistics Undergraduate Advisor. For example, students intending to pursue careers in public policy could take further courses in History or Economics, students intending to pursue careers in the health or biomedical sciences could take further courses in Biology or Chemistry, and students intending to pursue graduate work in Statistics could take further courses in advanced Mathematics. Double majors usually satisfy this requirement by default (see "Additional Majors" section below).

Research

One goal of the Statistics program is to give students experience with statistical research. A wide variety of exciting research projects are ongoing in the department, and students have many opportunities to get involved in a project that interests them. Before graduation, students will be expected to participate in an independent research project under faculty supervision. Students may satisfy this requirement through projects in specific courses, such as 36-303 and 36-402, through an independent study, 36-295, or through a summer research position.

Qualified seniors are also encouraged to participate in an advanced research project or independent study under the supervision of a Statistics faculty advisor. Students earn credit for this work by enrolling in 36-495. Students who maintain a quality point average of at least a C is required in 36-310 or in 36-226. (In particular, this is required in order or be able to continue to senior level courses).

The Major in Statistics

Students in the Bachelor of Science program develop and master a wide array of skills in computing, mathematics, statistical theory, and the interpretation and display of complex data. In addition, Statistics majors gain experience applying statistical tools to real problems in other fields and learn the nuances of interdisciplinary collaboration.

Sample Programs

The following sample programs illustrate two (of many) ways to satisfy the requirements of the Statistics Major. It is possible to complete the requirements of the Major in as few as two years, but many students prefer to spread them out over more than two years. The program is flexible enough to support many other possible schedules and to emphasize a wide variety of interests. The first schedule below has a heavier emphasis on data analysis; it includes Mathematical Foundations Sequence 1 and 15-127 as a Statistical Elective outside of Statistics. The second schedule below has a heavier emphasis on statistical theory and probability; it substitutes an extra Statistical Elective (36-225) for Beginning Data Analysis, and includes Mathematical Foundations Sequence 2.

In both schedules, C.A. refers to Concentration Area courses.

Schedule 1

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td>36-201 21-111</td>
<td>36-202 21-112</td>
</tr>
<tr>
<td>Sophomore</td>
<td>15-127 (elective)</td>
<td>36-303 36-315</td>
</tr>
<tr>
<td>Junior</td>
<td>21-241 C.A.</td>
<td>36-310 C.A.</td>
</tr>
<tr>
<td>Senior</td>
<td>36-401 36-461 C.A.</td>
<td>36-402 C.A.</td>
</tr>
</tbody>
</table>
Schedule 2

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td>21-120</td>
<td>21-256</td>
</tr>
<tr>
<td></td>
<td>21-241</td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td>36-225</td>
<td>36-226</td>
</tr>
<tr>
<td>Junior</td>
<td>36-350, 36-309</td>
<td>36-315 C.A.</td>
</tr>
<tr>
<td></td>
<td>C.A.</td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>36-401, 36-461</td>
<td>36-402 C.A.</td>
</tr>
<tr>
<td></td>
<td>C.A.</td>
<td></td>
</tr>
</tbody>
</table>

Additional Majors

Students who elect Statistics as a second or third major must fulfill all Statistics degree requirements. However, the Concentration Area requirement is usually waived in consultation with the student’s advisor. Majors in many other programs would naturally complement a Statistics Major, including GSIA’s undergraduate business program, Economics, Social and Decision Sciences, Policy and Management, History and Policy, and Psychology.

Students are advised to begin planning their curriculum (with appropriate advisors) as soon as possible. This is particularly true if the other major has a complex set of requirements and prerequisite material.

Substitutions and Waivers

Many departments require Statistics courses as part of their Major or Minor programs. Students seeking transfer credit for those requirements from substitute courses (at Carnegie Mellon or elsewhere) should seek permission from their advisor in the department setting the requirement. The final authority in such decisions rests there. The Statistics Department does not provide approval or permission for substitution or waiver of another department’s requirements.

However, the Statistics Director of Undergraduate Studies will provide advice and information to the student’s advisor about the viability of a proposed substitution. Students should make available as much information as possible concerning proposed substitutions. Students seeking waivers may be asked to demonstrate mastery of the material.

Statistics Majors and Minors seeking substitutions or waivers should speak to the Statistics Director of Undergraduate Studies.

The Minor in Statistics

The Minor in Statistics develops skills that complement major study in other disciplines. The program helps the student master the basics of statistical theory and advanced techniques in data analysis. This is a good choice for deepening understanding of statistical ideas and for strengthening research skills.

Requirements

<table>
<thead>
<tr>
<th>Basic Curriculum Category</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Foundation (prereq)</td>
<td>Calculus: 19-20 units via Sequence 1, 2, or 3</td>
</tr>
<tr>
<td></td>
<td>Algebra: 9 units via 21-241 or 21-341</td>
</tr>
<tr>
<td>Beginning Data Analysis</td>
<td>9 units (one course) or Statistical Elective*</td>
</tr>
<tr>
<td>Intermediate Data Analysis</td>
<td>9 units (one course)</td>
</tr>
<tr>
<td>Advanced Data Analysis</td>
<td>27 units: one of 36-303, 36-315, or 36-350 + both</td>
</tr>
<tr>
<td></td>
<td>36-401 and 36-402</td>
</tr>
<tr>
<td>Probability Theory</td>
<td>prreq for Statistical Theory sequences 2 or 3 (counts as Statistical Elective)</td>
</tr>
<tr>
<td>Statistical Theory</td>
<td>9 units via sequences 1, 2 or 3**</td>
</tr>
<tr>
<td>Total</td>
<td><strong>82 Units</strong></td>
</tr>
</tbody>
</table>

* For students who enter the program with 36-225/226 or 36-625/626, in which case either 36-225 or 36-625 can serve as the elective.

** In order to be a Major or a Minor in good standing, a grade of at least a C is required in 36-310 or in 36-226. (In particular, this is required in order or be able to continue to senior level courses.)

Sample Programs

The following two sample programs illustrates two (of many) ways to satisfy the requirements of the Statistics Minor. Keep in mind that the program is flexible and can support many other possible schedules. The first schedule has a heavier emphasis on data analysis, and is one that would be typically taken by students in the College of Humanities and Social Sciences (such as psychology majors). The second schedule (or similar) is more mathematical, and is suggested, for example, for students who major in Computer Science.
Faculty

ANTHONY BROCKWELL, Assistant Professor - Ph.D., The University of Melbourne, Australia; Carnegie Mellon, 1999-.

VERA BULAEVSKAYA, Visiting Assistant Professor – Ph.D., University of Minnesota; Carnegie Mellon, 2003-.

MAX BUOT, Visiting Assistant Professor - Ph.D., University of Virginia; Carnegie Mellon, 2003-.

BERNIE DEVLIN, Adjunct Associate Professor - Ph.D., Pennsylvania State University; Carnegie Mellon, 1994-.

MICHELE DIPIETRO, Instructor and Associate Director, Eberly Center - Ph.D., Carnegie Mellon, 2001-.

GEORGE T. DUNCAN, Professor of Statistics and Public Policy - Ph.D., University of Minnesota; Carnegie Mellon, 1974-.

WILLIAM F. EDDY, Professor of Statistics - Ph.D., Yale University; Carnegie Mellon, 1976-.

STEPHEN E. FIENBERG, University Professor and Maurice Falk Professor of Statistics and Social Sciences - Ph.D., Harvard University; Carnegie Mellon, 1980-1991; 1993-.

CHRISTOPHER GENOVESE, Associate Professor of Statistics - Ph.D., University of California, Berkeley; Carnegie Mellon, 1994-.

JOEL B. GREENHOUSE, Professor of Statistics - Ph.D., University of Michigan; Carnegie Mellon, 1982-.

BRIAN JUNKER, Professor of Statistics - Ph.D., University of Illinois; Carnegie Mellon, 1990-.

ROBERT E. KASS, Professor of Statistics - Ph.D., University of Chicago; Carnegie Mellon, 1981-.

BERT KLEI, Visiting Research Scientist – Ph.D., Cornell University; Carnegie Mellon, 2003-.

JOHN P. LEHOCZKY, Thomas Lord Professor of Statistics and Dean of the College of Humanities and Social Sciences – Ph.D., Stanford University; Carnegie Mellon, 1969-.

KATHRYN ROEDER, Professor of Statistics - Ph.D., University of Pennsylvania; Carnegie Mellon, 1994-.

CHAD M. SCHAFER, Visiting Assistant Professor – Ph.D., University of California, Berkeley; Carnegie Mellon, 2004-.

MARK J. SCHERVISH, Department Head and Professor of Statistics - Ph.D., University of Illinois; Carnegie Mellon, 1979-.

TEDDY SEIDENFELD, Herbert A. Simon Professor of Philosophy and Statistics - Ph.D., Columbia University; Carnegie Mellon, 1985-.

HOWARD SELTMAN, Research Scientist - Ph.D., Carnegie Mellon University; Medical College of Pennsylvania - M.D. Carnegie Mellon, 1999-.

VALERIE VENTURA, Research Scientist - Ph.D., University of Oxford; Carnegie Mellon, 1997-.

ISABELLA VERDINELLI, Professor in Residence - Ph.D., Carnegie Mellon University; Carnegie Mellon, 1991-.

PANTELOS K. VLACHOS, Research Scientist - Ph.D., University of Connecticut; Carnegie Mellon, 1996-.

LARRY WASSERMAN, Professor of Statistics - Ph.D., University of Toronto; Carnegie Mellon, 1988-.

LAN ZHANG, Assistant Professor of Statistics - Ph.D., University of Chicago; Carnegie Mellon, 2001-.
The H. John Heinz III School of Public Policy and Management
H. John Heinz III School of Public Policy and Management

Mark Wessel, Dean
Office: 1509 Hamburg Hall
http://www.heinz.cmu.edu/

What draws students to the graduate programs of the H. John Heinz III School of Public Policy and Management? Students entering the Heinz School are accomplished, talented and committed to important issues of public interest. At this school, each student gains the skills and knowledge necessary to transform that talent and commitment into a successful career and a positive force for change.

The Heinz School is a dynamic community of scholars and practitioners developing fundamental knowledge about and seeking innovative, applied solutions to today’s most critical problems of public policy and management. The degree programs offered at the Heinz School are:

- Master of Science in Public Policy and Management (options include joint and dual degree programs with the Tepper School of Business, and a dual degree program with the University of Pittsburgh School of Law)
- Master of Arts Management
- Master of Entertainment Industry Management
- Master of Science in Health Care Policy and Management
- Master of Medical Management
- Master of Public Management
- Master Science in Educational Technology Management
- Master of Science in Information Security Policy and Management
- Doctor of Philosophy in Public Policy and Management

Distinctive features of the Heinz School include the quality of its research and teaching, and the attention it gives to the needs of its students. The Heinz School educational environment offers:

- An innovative curriculum incorporating analytic rigor; depth of substantive knowledge; applied project work; marketable and transferable skill development; and the integration of policy, technology and management.
- Daily access to faculty members known internationally for expertise in their fields.
- Exposure to cutting-edge technologies and management practices geared toward the needs of the changing organizations pursuing the public interest.
- The flexibility to adapt to the specific interests and career aspirations of students.
- Support for diversity and individual student needs.

The Heinz School programs vary by structure, yet they share a common goal – preparing students for professional positions in which they can help to improve society and the organizations that comprise it.

Options for Carnegie Mellon undergraduates

The Heinz School does not offer undergraduate degrees. It does offer two study options, however, for students pursuing Carnegie Mellon undergraduate degrees – 1) Accelerated Master’s Program (AMP), and 2) undergraduate minor in Health Care Policy and Management.

Accelerated Master’s Program

Through the Heinz School Accelerated Master’s Program (AMP), exceptional Carnegie Mellon undergraduate students can earn their master’s degree, along with their undergraduate degree, in less time than it would take to earn each degree separately. For example, a Carnegie Mellon student could earn an undergraduate degree and a Master of Science or Master of Arts Management degree in five years of study. In the AMP program, students take their undergraduate course load during their first three years, a combination of Heinz School courses and undergraduate courses in their fourth year, and finish their master’s degree in their fifth year of study.

Students admitted to the AMP program register for their final undergraduate year at Carnegie Mellon as undergraduates, pay undergraduate tuition, and receive undergraduate financial aid. They enroll in courses required for their B.A./B.S. degree and also take courses toward their Heinz School degree. They receive their B.A./B.S. degree at the end of the fourth year. For the fifth year, they register as Heinz School graduate students, pay graduate tuition, and receive graduate financial aid, if eligible.

Undergraduate Minor in Health Care Policy and Management

The minor in health care policy and management is offered jointly by the Heinz School, the College of Humanities and Social Sciences, and the Mellon College of Science. The minor is designed to provide students considering a career in the health professions with an understanding of the ways in which social, political, managerial and economic changes are transforming the face of health care, and the roles of organizations and individuals that provide it. Students will become familiar with the critical policy and management issues and will begin to learn to operate effectively in the emerging health care environment. The curriculum combines economic, organizational, managerial, historical, and psychological perspectives on these issues to provide a foundation for a deepened understanding of the changing structure of health care organizations and policy.

Curriculum: 60 units (minimum) Prerequisites:

73-250, 88-220, or equivalent.

Required Courses: 33 units

90-761 Introduction to Health Care Policy and Management
90-735 Health Economics
79-384 Medicine and Society

Elective Courses: 27 units

See page 287 for additional information and lists of elective courses.

How is the Heinz School different?

Diversity

The Heinz School student body is nationally recognized for its diversity in ethnicity, gender and citizenship. It also is diverse in terms of students’ academic backgrounds, which include undergraduate degrees in architecture, biology, business administration, computer science, economics, education, engineering, English, fine arts, government, history, information systems, philosophy, political science, sociology and many other fields.

Practical Experience

The Heinz School doesn’t just teach skills in the classroom. Students work in teams to analyze and develop solutions for current international, national and local problems and present their findings to the officials who have responsibility for addressing those problems. Students take a paid summer internship to practice the skills they’ve learned in school.

Impact on Society

The expertise of a renowned faculty is transferred to society through the education and research mission of the Heinz School, as well as the efforts of its policy and research centers. These include the National Consortium on Violence Research, Institute for the Study of Information Technology and Society, the Center for Economic Development, the Arts and Culture Observatory and the Center for Arts Management and Technology. Heinz School students can work on projects initiated in these centers or as research assistants for center faculty.
What kinds of careers do Heinz School graduates pursue?
A Heinz School degree opens doors to a wide range of professional careers in government agencies, nonprofit organizations, consulting firms, arts groups, foundations, private businesses and a host of other organizations. Heinz School graduates can get the kind of interesting, exciting jobs they want, because they have the expertise in finance, accounting, information systems, and decision-making that employers need.

The Heinz School Ph.D. program in particular prepares qualified students from a variety of academic and professional backgrounds for careers in research, academia, government-related organizations and the private sector, in positions where expertise in advanced research is desired. Graduates of the Ph.D. program work as professors, research scientists, research directors and consultants, across diverse areas of public service and management.

Some of the jobs that have been held by Heinz School graduates include:
- Budget Analyst, Congressional Budget Office
- President/Chief Executive Officer, Urban League of Philadelphia
- Vice President, Public Finance Division, Donaldson, Lufkin & Jenrette Securities Corp.
- Executive Director, Allegheny Conference on Community Development
- Executive Director, Maryland Small Business Development Financing Authority
- District Manager, AT&T Consumer Information
- Senior Consultant, Ernst and Young
- Director of Marketing, Bardavon 1869 Opera House, Poughkeepsie, NY
- Consultant, Hill Arts and Entertainment
- Special Projects Coordinator, Washington Very Special Projects

The Faculty
Heinz School faculty members have been recognized nationally and internationally for their accomplishments in research and their contributions to public policy. Their backgrounds are in economics, operations research, information systems and technology, fine arts, sociology, public policy, statistics, organizational management and behavior, finance, statistics, labor relations, and demography among other areas. Following is information on many full-time Carnegie Mellon faculty members who teach and do research at the Heinz School. For a more complete, current list, visit www.heinz.cmu.edu/researchers/faculty/.

ACQUISTI, ALESSANDRO, Assistant Professor of Information Systems and Public Policy — Ph.D., UC Berkeley; Carnegie Mellon, 2003 — .
ARORA, ASHISH, Professor of Economics and Public Policy — Ph.D., Stanford University; Carnegie Mellon, 1991—.
BABCOCK, LINDA, James M. Walton Professor of Economics — Ph.D., University of Wisconsin at Madison; Carnegie Mellon, 1988—.
BARR, EDWARD, Associate Teaching Professor — M.S., Indiana University of Pennsylvania; Carnegie Mellon, 2000—.
BLUMSTEIN, ALFRED, J. Erik Jonsson University Professor of Urban Systems and Operations Research; Director, National Consortium on Violence Research — Ph.D., Cornell University; Carnegie Mellon, 1969—.
BORZUTSKY, SYLVIA, Associate Teaching Professor — Ph.D., University of Pittsburgh; Carnegie Mellon, 2001—.
CALLAN, JAMES, Associate Professor of Computer Science — Ph.D., University of Massachusetts at Amherst; Carnegie Mellon, 1999—.
CARLEY, KATHLEEN, Professor of Organizational Sociology (joint with Department of Social and Decision Sciences) — Ph.D., Harvard University; Carnegie Mellon, 1984—.
CAULKINS, JONATHAN, Professor of Operations Research and Public Policy; Faculty Chair, Master of Public Policy and Management Program — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1990—.

CLAY, KAREN, Assistant Professor of Economics and Public Policy — Ph.D., Stanford University; Carnegie Mellon, 1997—.
COHEN, JACQUELINE, Principal Research Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1982—.
COHEN, WESLEY, (Affiliated) Professor of Economics and Social Sciences — Ph.D., Yale University; Carnegie Mellon, 1982—.

DAVIS, DEVRA, Visiting Professor — Ph.D., University of Chicago; Carnegie Mellon, 2000—.
DAVIS, OTTO, W.W. Cooper University Professor of Economics and Public Policy — Ph.D., University of Virginia; Carnegie Mellon, 1960—.
DEKAY, MICHAEL, Assistant Professor of Engineering, Public Policy, and Decision Sciences (joint with Department of Engineering and Public Policy) — Ph.D., University of Colorado; Carnegie Mellon, 1996—.
DOMINITZ, JEFFREY, Assistant Professor of Economics and Public Policy — Ph.D., University of Wisconsin at Madison; Carnegie Mellon, 2000—.
DUNCAN, GEORGE, Professor of Statistics — Ph.D., University of Minnesota; Carnegie Mellon, 1974—.
EPPLER, DENNIS, (Affiliated) Thomas Lord Professor of Economics — Ph.D., Princeton University; Carnegie Mellon, 1974—.

KLEPPER, STEVEN, (Affiliated) Professor of Economics and Social Science — Ph.D., Cornell University; Carnegie Mellon, 1980—.
KRAMERTHD, DAVID, Professor of Organizations and Public Policy — Ph.D., University of California at Irvine; Carnegie Mellon, 1991—.
KRAMSHAN, RAMAYYA, William W. and Ruth F. Cooper Professor of Management Science and Information Systems; Faculty Chair, Master of Information Systems Management Program — Ph.D., University of Texas at Austin; Carnegie Mellon, 1987—.
KURLAND, KRISTIN, Associate Teaching Professor (joint with School of Architecture) — B.A., University of Pittsburgh; Carnegie Mellon, 1999—.
LARKEY, PATRICK, Professor of Public Policy and Decision Making — Ph.D., University of Michigan; Carnegie Mellon, 1977—.
LAVE, LESTER, James Higgins Professor of Economics and Finance, Professor of Urban and Public Affairs, Professor of Engineering and Public Policy — Ph.D., Harvard University; Carnegie Mellon, 1963—.
LEWIS, GORDON, Associate Professor of Sociology; Faculty Chair, Master of Public Management Program — Ph.D., Stanford University; Carnegie Mellon, 1969—.
LEWIS, PAMELA, Teaching Professor of Professional Speaking — D.A., Carnegie Mellon University; Carnegie Mellon, 1980—.
MADSEN, PETER, Senior Lecturer in Ethics and Public Policy — Ph.D., Duquesne University; Carnegie Mellon, 1988—.
MARINELLI, DONALD, (Affiliated) Professor of Drama and Arts Management (College of Fine Arts) — Ph.D., University of Pittsburgh; Carnegie Mellon, 1984—.

MARTIN, DAN, Director, Master of Arts Management Program, and Associate Professor (College of Fine Arts) — M.F.A., Brooklyn College/ City University of New York; Carnegie Mellon, 1993—.

MCCARTHY, MICHAEL, Associate Teaching Professor of Information Systems Management — M.S., University of Pittsburgh; Carnegie Mellon, 1999—.

MERTZ, JOE, Associate Teaching Professor — Ph.D., Carnegie Mellon; Carnegie Mellon, 1994—.

MORGAN, M. GRANGER, Lord Chair Professor of Engineering and Public Policy, and Head, Department of Engineering and Public Policy — Ph.D., University of California at San Diego; Carnegie Mellon, 1974—.

NAGIN, DANIEL, Theresa and H. John Heinz III Professor of Public Policy, and Research Director, National Consortium on Violence Research — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1979—.

NYBERG, ERIC, Assistant Professor of Computer Science and Public Policy (joint with School of Computer Science) — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1986—.

PADMAN, REMA, Professor of Operations Research and Information Management; Faculty Chair, Master of Science in Health Care Policy and Management Program — Ph.D., University of Texas at Austin; Carnegie Mellon, 1989—.

ROEHRIG, STEPHEN, Associate Professor of Information Systems and Public Policy — Ph.D., University of Pennsylvania Wharton School; Carnegie Mellon, 1991—.

ROUSSEAU, DENISE, H. J. Heinz II Professor of Organizational Behavior (joint with Graduate School of Industrial Administration)— Ph.D., University of California at Berkeley; Carnegie Mellon, 1994—.

SKINNER, KIRON, (Courtesy) Assistant Professor of History and Political Science — Ph.D., Harvard University; Carnegie Mellon, 1999—.

SMITH, DONALD, Professor of Practice; University Director for Economic Development — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1995—.

SMITH, KATHLEEN, Associate Teaching Professor — Ph.D. candidate, University of Pittsburgh; Carnegie Mellon, 1991—.

SMITH, MICHAEL, Assistant Professor of Information Technology — Ph.D., Alfred P. Sloan School of the Massachusetts Institute of Technology; Carnegie Mellon, 2000—.

STEWMAN, MELVIN, Assistant Professor of Economics — Ph.D., University of Michigan; Carnegie Mellon, 2000—.

STEWMAN, SHELBY, Professor of Sociology and Demography — Ph.D., Michigan State University; Carnegie Mellon, 1973—.

STRAUSS, ROBERT, Professor of Economics and Public Policy; Faculty Chair, Master of Science in Educational Technology Management Program — Ph.D., University of Wisconsin; Carnegie Mellon, 1979—.

SZCZYPULA, JANUSZ, Associate Teaching Professor in Information Systems — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000—.

TARR, JOEL, Richard S. Caliguiri Professor of Urban and Environmental History and Policy — Ph.D., Northwestern University; Carnegie Mellon, 1967—.

TAYLOR, LOWELL, Professor of Economics and Public Policy; Associate Dean of Faculty — Ph.D., University of Michigan; Carnegie Mellon, 1990—.


THOMAS, HELEN, Assistant Professor of Information Systems — Ph.D., Georgia Institute of Technology; Carnegie Mellon, 2002—.

VOGT, WILLIAM, Assistant Professor of Economics — Ph.D., Stanford University; Carnegie Mellon, 1996—.

WESSEL, MARK, Dean, University of Wisconsin; Carnegie Mellon, 1992—.
Mellon College of Science

Richard D. McCullough, Dean
Eric W. Grotzinger, Associate Dean for Undergraduate Affairs
Undergraduate Office: Doherty Hall 1324
www.cmu.edu/mcs/

The Mellon College of Science (MCS) has provided the undergraduate training for many of today’s leading scientists. We have earned national recognition for our integration of undergraduate education and research from such organizations as the National Science Foundation, the Howard Hughes Medical Institute, and the Beckman Foundation. MCS students gain a broad education in science, mathematics, and the liberal arts while using state-of-the-art computational approaches in their courses, laboratories, and research activities. Our faculty members are committed to teaching as well as to a wide range of scientific research. This combined emphasis on education and research brings special benefits to students, including increased awareness of current scientific developments that are incorporated in classroom instruction, and, most importantly, opportunities to participate with faculty, graduate students, and other research scientists in a variety of research projects.

In the context of rigorous training in each field, the MCS curriculum emphasizes problem-solving, communication, and analytical skills, and it teaches our students the value of hard work and discipline. Our students go on to highly successful careers in a broad range of fields like astrophysics, biotechnology, computer science, business management, environmental science, health care policy, marketing analysis, medicine, patent law, and pharmaceuticals. Our alumni credit their education in science for preparing them for a lifetime of learning and achievement; their employers attest to their ability to succeed and to continue learning in an ever-changing world.

The MCS Departments of Biological Sciences, Chemistry, Mathematical Sciences, and Physics each outline their degree programs and courses in the departmental sections. Each program is based on a core of courses required by the college — two semesters each of calculus and physics and one semester each of chemistry, biology, and computer science. These courses lay a broad foundation in the sciences and not only enable our students to choose a major from any of the programs offered in MCS, but also prepare them for exploration of interdisciplinary aspects of science.

Students select their major in the spring of the first year so that the sophomore year begins with a focus within a department. Most of the courses required within a major are scheduled in the sophomore and junior years, leaving much of the senior year and part of the junior year open for electives. This provides the opportunity to participate in undergraduate research, explore interdisciplinary studies, study abroad, pursue additional majors or minors in other fields, or take other specialty courses oriented toward immediate job placement upon graduation or entry into graduate studies.

Tailoring Your Education

The Mellon College of Science offers students tremendous opportunity for tailoring their education to meet individual professional objectives. Whether you target your degree to a particular field in your discipline via departmental options and concentrations, add a secondary major, minor, or degree to your primary degree program, participate in honors programs, or pursue a master’s degree along with your bachelor’s degree, MCS has much to offer you. Many of these opportunities are outlined below.

Departmental Concentrations

Each department in MCS offers degrees and programs that allow students to explore particular fields within a science discipline. These are outlined below — see the departmental sections for further details.

**Biological Sciences**
- Biochemistry
- Biophysics
- Cell Biology
- Computational Biology
- Developmental Biology
- Genetics
- Molecular Biology
- Microbiology
- Zoology

**Chemistry**
- Biochemistry
- Colloids, Polymers, and Surfaces
- Computational Chemistry
- Environmental Chemistry
- Management
- Material Chemistry
- Polymer Science

**Mathematical Sciences**
- Computational and Applied Mathematics
- Computational Finance
- Discrete Mathematics and Logic
- Mathematics
- Operations Research
- Statistics

**Physics**
- Applied Physics
- Astrophysics
- Biological Physics
- Chemical Physics
- Computational Physics

Minors, Double Majors, and Double Degrees

As an MCS student, you can pursue additional majors and minors to complement your primary degree, not only within the science college, but also through the other colleges at Carnegie Mellon. Carnegie Mellon offers many exciting interdisciplinary majors and minors, some of which are listed below. In addition, every college and most departments have designed minors or second majors in their discipline so that you can gain expertise in their fields as well. Some students choose to gain this expertise by following a double degree program. This results in two distinct bachelor's degrees. Please see the section on Undergraduate Academic Regulations on page 54 for a more formal definition of these "Multiple Degree" programs.

Interdisciplinary Majors and Minors

Here is a sampling of just a few of the interdisciplinary minors and majors offered at Carnegie Mellon. Please see the appropriate sections elsewhere in this catalog for specific descriptions and course requirements.
- Biological Sciences and Psychology Major
- Engineering Studies Minor
- Environmental Policy Major
- Health Care Policy and Management Minor
- International Affairs Minor
- Multimedia Production Minor
- Robotics Minor
- Scientific Computing Minor
- Technology and Policy Minor

For a complete list of the minors offered at Carnegie Mellon, please see the catalog section on Undergraduate Options on page 76.

Intercollege Programs

MCS participates in two intercollege programs, the Bachelor of Science and Arts Degree program and the Science and Humanities Scholars program. Enrollment in these unique programs is by invitation only for incoming first-year students, and by application for current students.
Bachelor of Science and Arts Degree Program (BSA)

Students in the Bachelor of Science and Arts Degree program are jointly admitted to MCS and the College of Fine Arts (CFA). This is a degree program for students who are naturally gifted in both the arts and the sciences, and allows for the combining of talents in these areas. See page 89 for details.

Science and Humanities Scholars Program (SHS)

Students in the Science and Humanities Scholars Program (SHS) are jointly admitted to MCS and the College of Humanities and Social Sciences (H&SS). Participants in this program follow a special general education core, but have the flexibility to choose a primary major in either of the two colleges. See page 89 for details.

Honors Degree Programs in MCS

Several of the departments in MCS offer students an opportunity to participate in a departmental honors degree program. Some of these programs result in a master's degree along with the bachelor's degree (see next section on accelerated master's programs). These programs are listed below; see the department's section of the catalog for more details.

- Honors Program in Research Biology
- Departmental Honors in Chemistry
- Honors B.S./M.S. Program in Chemistry
- Honors B.S./M.S. Program in Mathematical Sciences

Accelerated Master's Programs

Carnegie Mellon offers some accelerated master's programs for motivated students, whereby students complete both the bachelor's and the master's degree in four or five years. Some programs are in the student's home department in MCS as part of an honors program, while others are offered through one of our graduate schools at Carnegie Mellon. Below is a listing of the programs currently available to MCS students; please see the appropriate sections of the catalog for more details.

- Honors B.S./M.S. Program in Chemistry
- Honors B.S./M.S. Program in Chemical Biology
- Honors B.S./M.S. Program in Mathematical Sciences
- Accelerated Master's Program in the Heinz School of Public Policy and Management
- 3-1-1 Master's Program in Biotechnology Management (joint program between the Heinz School, Mellon College of Science, and the Tepper School of Business)

Pre-Professional Programs

Many students in the Mellon College of Science decide to pursue professional training such as medical school or law school after completing their undergraduate work. Carnegie Mellon offers strong advising services to support these students. Through these programs, students get help with everything from course selection to identification of important experiential opportunities to the application process itself.

Health Professions Program

Faculty Contact: Amy Burkert

Please see page 76 for details on the Health Professions Program.

Pre-Law Advising Program

Faculty Contact: Joseph Devine

Please see page 77 for details on the Pre-Law Advising Program.

University Self-Defined Majors

With a well-thought proposal, you may be able to pursue a major you have designed to meet your particular interests and goals. Please see the catalog section on Undergraduate Options on page 76 for more details about this opportunity.

Study Abroad

There are many programs for studying abroad, usually during your junior year. Please see the catalog section on Undergraduate Options on page 78 for more details, and talk with the Office of International Education to get information and advice specifically for you.

Applying Your Education Through Research

An important feature of education in MCS is the opportunity for undergraduate research experience. This experience may be arranged as a course taken for credit or occasionally as a part-time job. Our web site (www.cm.edu/mcs/) offers a range of useful information including links to faculty research areas, links to undergraduate research programs at other institutions, and ideas on how to get involved. Because of the strong research base of MCS, undergraduate research positions offer an exciting opportunity to apply your theoretical training to participate in the discovery of new knowledge.

Students can earn MCS Research Honors for significant research accomplishments; see the policy outlined below for the requirements.

Mellon College of Science Research Honors

Undergraduates in the Mellon College of Science will be awarded MCS Research Honors at graduation if they have met one of these requirements:

1. Successfully completed the Honors BS/MS program in the Department of Chemistry or Department of Mathematical Sciences. Or

2. Successfully completed the departmental honors program in Biological Sciences or Chemistry and presented an oral summary at the year-end departmental research symposium or faculty panel. Or

3. Earned a cumulative grade point average of 3.20 or higher and carried out significant research. Typically, this would consist of an academic project carried out during two semesters in the senior year. However, a single project that spans a summer and a semester or that the research mentor deems to be significant and sustained, even if the student worked for pay rather credit, will be allowed. In addition the following must be completed:

- In the last semester of their senior year, students will register for 38-455 MCS Honors Research, 6 units. To register for this course, students need to complete the MCS Research Honors Thesis Form. In this course, the student will write a 15 - 30 page thesis that must be approved by the research advisor.
- Presentation of an oral summary of the research before a faculty panel.

Final approval of nominations for MCS research honors will come from the Dean of MCS and the Associate Dean for Undergraduate Affairs.

Research Centers

The Mellon College of Science is home to a number of innovative research centers. These centers are particularly strong because of the interdisciplinary collaboration of their scientists. This interdisciplinary research brings international prestige to the college. Many students conduct undergraduate research with one of these centers.

The Center for Computational Finance’s mission is to improve the interaction between academic research and the finance industry.

The Center for Macromolecular Engineering’s goals are to enhance the benefits of polymer science to society by developing new methods to prepare advanced polymer materials, train and develop tomorrow’s scientists, and transfer technology to industry.

The Center for Molecular Analysis features modern high-performance analytical instruments for use by researchers. In addition to the analytical instrumentation, the CMA provides collaborations, analytical assistance, and training. The CMA houses two NMRs, four photon spectrometers, and two mass spectrometers.
The Center for the Neural Basis of Cognition is a joint program between Carnegie Mellon University and the University of Pittsburgh. It synthesizes the disciplines of basic and clinical neuroscience, cognitive psychology, and computer science, combining neurobiological, behavioral, computational, and brain imaging methods.

The Center for Nonlinear Analysis was established in 1991. A special focus for applications emphasizes new and innovative methods to study contemporary issues in materials science. The center has created a vigorous environment for collaboration among mathematical and allied scientists.

The Green Design Initiative involves forming partnerships with industrial corporations, foundations, and government agencies to develop joint research and education programs which improve environmental quality while encouraging sustainable economic development.

The Institute for Green Oxidation Chemistry has been established as a research, education, and development center in which a holistic approach to sustainability science is being developed. The focus of the institute is in three areas: renewable energy technologies, chemical feedstocks, and benign alternatives to polluting technologies.

The Molecular Biosensor and Imaging Center uses an interdisciplinary approach to develop reagents, microscopes, and imaging tools and applies them to the investigation of fundamental problems in biology and biotechnology.

The Pittsburgh NMR Center for Biomedical Research is a joint program between Carnegie Mellon University and the University of Pittsburgh. It is supported as a Biotechnology Resource Center by the National Institutes of Health.

The Pittsburgh Supercomputing Center provides information on advanced scientific computing for engineering and research.

Hunt Institute for Botanical Documentation, founded in 1961, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation.

The Institute for Green Oxidation Chemistry is a collaboration among Carnegie Mellon University, the University of Pittsburgh, and the Pittsburgh Supercomputing Center.

First Year for Science Students

An MCS education is based on a broad foundation in the sciences: two semesters each of calculus and physics and one semester each of biology, chemistry and computer science. This foundation corresponds to the following courses required for all MCS students.

### Science Core Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-122</td>
<td>Integration, Differential Equations, and Approximation</td>
<td>9-12</td>
</tr>
<tr>
<td>33-111</td>
<td>Physics for Science Students I</td>
<td>10</td>
</tr>
<tr>
<td>33-112</td>
<td>Physics for Science Students II</td>
<td>9-12</td>
</tr>
<tr>
<td>03-121</td>
<td>Modern Biology</td>
<td>10</td>
</tr>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
</tbody>
</table>

In the first year, students take two semesters of calculus, 21-120 Differential and Integral Calculus and 21-122 Integration, Differential Equations, and Approximation. They also take three of the remaining five science core courses. The other two science core courses are completed by the end of the junior year. Additional courses in the first year include one course from the intended major; humanities, social sciences or fine arts courses; an optional first-year seminar; and Computing Skills Workshop, a course that introduces students to the computing environment and ethics of computing at Carnegie Mellon.

With this broad science background, a student is prepared to undertake any of the degree programs offered by the college when selecting a major at the end of the first year.

### Fall Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Science Core Course</td>
<td>9-12</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Science Core Course</td>
<td>10</td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument</td>
<td>9</td>
</tr>
<tr>
<td>99-101</td>
<td>Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Optional First-Year Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

### Spring Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-122</td>
<td>Integration, Differential Equations, and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Science Core Course</td>
<td>9-12</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Departmental Elective from Intended Major</td>
<td>9-10</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Humanities, Social Sciences, or Fine Arts Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Optional Free Elective Course</td>
<td>9-10</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Optional First-Year Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

### Notes

1. Departmental electives from the intended major are as follows:

   **Biological Sciences or Chemistry**
   09-106 Modern Chemistry II 10 units

   **Mathematical Sciences**
   21-127 Concepts of Mathematics 9 units

   **Physics**
   33-104 Experimental Physics 9 units

2. A free elective is any Carnegie Mellon course. However, a maximum of nine units of physical education and/or military training may be taken as free electives in any MCS degree program. Credit earned for physical education and military science courses will not be calculated in a student’s GPA.

3. Students who enter with advanced placement credits will follow a similar schedule with modifications for their AP work.

### MCS First-Year Seminars

First-year students in the Mellon College of Science have the opportunity to explore a special area of modern science in optional 3 unit mini-seminars. The seminars focus on a variety of topics in each department, from astrophysics and math software to polymers and proteins. Enrollment in the seminars is deliberately limited to encourage student participation and increase interaction with the professor. These seminars are an excellent opportunity for students to gain specific insight into a scientific discipline early in their undergraduate training. Although the topics offered vary each semester, here is a sample of recent seminar titles:

- EUREKA: An Interdisciplinary Laboratory Experience
- Proteins in Disease
- Polymers and the Modern World
- Macromolecules for Nanotechnology
- Science and Science Fiction
- Curing Cancer
- Pills and Poisons: How Scientists View Molecules
- Fractals

For more information on these unique seminars, please see the MCS departmental sections of this catalog.

### Humanities, Social Sciences, and Fine Arts Requirements

All candidates for the bachelor’s degree must complete a minimum of 72 units offered by the College of Humanities and Social Science and/or the College of Fine Arts. These courses for MCS students are to meet the following distribution requirements:

**A. Designated Writing Course (9 units)**

- 76-101 Interpretation and Argument
- 82-085 Reading & Writing in a Multicultural Setting (intended for students who speak English as a second language)
B. Distributional Course Requirements (27 units)
Complete three courses, one each from Category 1, Category 2, and Category 3. Listed below are examples of courses that meet the requirement for each category. Students wishing to substitute a course that is not listed should meet with their advisor.

Category 1: Cognition, Choice and Behavior
80-130 Introduction to Ethics
80-150 Nature of Reason
80-180 Nature of Language
80-181 Language and Thought
80-221 Philosophy of Social Science
80-230 Ethical Theory
80-241 Ethical Judgments in Professional Life
80-242 Conflict, Dispute Resolution
80-270 Philosophy of Mind
80-271 Philosophy and Psychology
85-100 Introduction to Intelligence in Humans, Animals and Machines
85-102 Introduction to Psychology
85-211 Cognitive Psychology
85-221 Principles of Child Development
85-241 Social Psychology
85-251 Personality
85-261 Abnormal Psychology
88-120 Reason, Passion, and Cognition

Category 2: Economic, Political and Social Institutions
36-303 Sampling, Surveys, and Society
70-332 Business, Society, and Ethics
73-100 Principles of Economics
79-223 Protest and Dissent in American History
79-331 Crime and Punishment
79-335 Drug Use and Drug Policy
79-345 American Environmental History: Critical Issues
79-350 Theories of International Relations
80-135 Introduction to Political Philosophy
80-136 Social Structure, Public Policy, and Ethical Dilemmas
80-235 Political Philosophy
80-236 Philosophy and the Law
80-243 Environment Management and Ethics
80-341 Computers, Society, and Ethics
88-104 Decision Processes in American Political Institutions
88-110 Experiments with Economic Principles
88-205 Comparative Politics

Category 3: Cultural Analysis
57-173 Survey of Western Music History
66-250 Introduction to Religion
70-342 Managing Across Cultures
76-227 Comedy
76-232 African-American Studies
76-241 Introduction to Gender Studies
79-104 Introduction to World History
79-113 Culture and Identity in American Society
79-201 Introduction to Anthropology
79-206 Development of American Culture
79-207 Development of European Culture
79-209 Theory and Practice in Anthropology
79-218 The Roots of Rock & Roll
79-241 African-American History I
79-242 African-American History II
79-270 Chinese Culture and Society
79-268 Poverty, Charity, and Welfare
79-384 Medicine and Society
80-100 What Philosophy Is
80-151 God in the West
80-250 Ancient Philosophy
80-251 Modern Philosophy
80-253 Continental Philosophy
80-256 Analytical Philosophy
80-255 Pragmatism
80-261 Aesthetics of Mass Art
82-273 Introduction to Japanese Language & Culture
82-294 Topics in Russian Language and Culture
82-303 French Culture
82-304 Francophone World
82-325 Introduction to German Studies
82-333 Introduction to Chinese Language & Culture
82-342 Spain: Language and Culture
82-343 Latin America: Language and Culture
82-344 US Latinos: Language and Culture
82-345 Hispanic Literary and Cultural Studies

C. Elective Course Requirements (36 units)
Complete courses totaling 36 units from H&SS, CFA, or Business Administration. These can include language courses and music courses, for instance. In this category, you have the freedom to design how you want to structure your remaining general education requirements. For example you can use these electives to build a depth sequence of 2-4 courses in a particular area or you can take courses from different areas or some combination of each.

Check our web site for courses from H&SS, CFA and Business Administration that may not be used to satisfy these requirements, plus a list of courses in other colleges (including CIT and the Heinz School) that do satisfy these requirements. The direct URL is www.cmu.edu/mcs/education/edu.HSSFA.html.

Transfer into MCS Departments
Undergraduate students admitted to MCS can choose to pursue any major within MCS. This choice must be made prior to the first semester of the sophomore year (normally during the second semester of the first year) and does not require approval by any department.

Undergraduate students admitted to colleges other than MCS and wishing to transfer into an MCS department during their first year should consult with the MCS Associate Dean for Undergraduate Affairs. Undergraduate students will be considered for transfer after spring mid-semester grades for the first year have been posted.

MCS undergraduate students beyond the first year wishing to transfer into another MCS department may do so if they are not on academic probation and if there is room in the department of their choice. If the demand for any department exceeds the space available, then the department will admit students based on a comparative evaluation of all applicants at the end of each semester, up to the limit of available space.

Undergraduate students not in MCS and wishing to transfer into a department in MCS beyond the first year will be considered for transfer on a space available/academic performance basis. An MCS department may refuse a transfer to a non-MCS student if there are space restrictions and/or if the student’s chance for success is determined to be questionable based on past academic performance.

Procedure for transfer of students from another university into an MCS department:
A student first applies through the Office of Admission. If the Office of Admission believes the applicant is acceptable, the student’s record is sent to the appropriate department for evaluation and a decision on acceptance. The MCS department head has the right to refuse to accept the student if there are space restrictions and/or if the student’s chance for success in the MCS department is determined to be questionable based on past academic performance.

Academic Standards and Actions
MCS Dean’s List
Each semester MCS recognizes those students with outstanding academic records by naming them to the Dean’s List. The criteria for such recognition are as follows:

Dean’s List
The student must earn a quality point average of at least 3.5 while completing a minimum of 36 factorable units and earning no incomplete grades.

Dean’s List High Honors
The student must earn a quality point average of at least 3.75 while completing a minimum of 36 factorable units and earning no incomplete grades.

Probation, Suspension, and Drop
In the first year, quality point averages below 1.75 in either semester invoke an academic action. For all subsequent semesters an academic action will be taken if the semester QPA or the cumulative QPA (excluding the first year) is below 2.00.

The relation indicated below between probation, suspension, and drop is normal, not binding. In unusual circumstances, MCS College
Council may suspend or drop a student without prior probation.

**Probation**
The action of probation will be taken if:

- One semester of the first year is below 1.75 QPA.
- The semester QPA of a student in good standing beyond the first year falls below 2.00. The term of probation is one semester as a full-time student. First-year students are no longer on probation at the end of the second semester if their semester QPA is 1.75 or above.

A student is occasionally continued on probation who has had one semester on probation and is not yet meeting minimum requirements but whose record indicates that the standards are likely to be met at the end of the next semester of study.

**Suspension**
A student who does not meet minimum standards at the end of one semester of probation will be suspended.

A first-year student will be suspended if the QPA from each semester is below 1.75.

A student in the third or subsequent semester of study will be suspended if the semester factor or the cumulative factor (excluding the first year) is below 2.00 for two consecutive semesters.

The minimum period of suspension is one academic year (two semesters). At the end of that period a student may return to school on probation by:

- Receiving permission in writing from the Associate Dean of MCS.
- Completing a "returning student’s form" for Enrollment Services;

and

- Providing transcripts and clearance forms if the student has been in a degree program at another college or university, even though academic credit earned will not transfer to Carnegie Mellon unless prior approval has been granted by the Associate Dean.

Employment within the university in non-student jobs is possible for students on academic suspension, subject to the hiring criteria of the hiring department. However, a student on academic suspension wishing to accept a job on campus must speak with the Associate Dean of the student’s college to ensure that the employment will not constitute a violation of the terms of suspension. The Associate Dean will generally allow such employment, in consultation with the Dean of Student Affairs. One employment benefit not available to students on academic suspension who accept a full-time job with the University is the option to take courses through tuition remission. The option to take courses becomes available only after the academic suspension is over.

**Drop**
This is a permanent severance from the Mellon College of Science. Students are dropped when it seems clear that they will never be able to meet minimum standards. A student who has been suspended and who fails to meet minimum standards after returning to school is dropped.

A student who has been academically dropped or academically suspended and who is not employed by the University must absent themselves from campus and is, for the term of the suspension, barred from all activities and affiliations that stem from one's status as an enrolled student. These include registering or enrolling for courses, sitting in on classes, living in student or fraternity/sorority housing, membership and participation in student activities, and employment in student jobs. (NOTE: Exceptions to the restriction from student jobs for students on academic suspension will in general be granted for summer employment if the position was accepted prior to the decision to suspend.)

**Graduation Requirements**
A requirement for graduation is the completion of the program specified for a degree with a cumulative quality point average of 2.00 or higher for all courses taken after the first year. A minimum of 360 units must be completed. This will include the MCS Science Core Courses, H&SS or CFA requirements and all departmental course requirements.

Students will be required to meet the residency requirement and to have met all financial obligations to the university before being awarded a degree. (The residency requirement is detailed on p. 48)

A student may seek permission to modify graduation requirements by petition to the MCS College Council.

**Graduation Honors**
There are two types of honors awarded at graduation.

**University Honors**
University Honors are automatically awarded to students who have earned a cumulative Q.P.A. of 3.5 or better after seven semesters.

**College Research Honors**
Please see the section “Applying your Education through Research” on page 283 for information on how to qualify for College Research Honors.
Minors Offered by the Mellon College of Science

The Mellon College of Science offers several minors to students interested in broadening their scientific training or acquiring a level of expertise in a particular scientific field. The intercollege minors described below are designed to supplement your degree in science; the departmental minors offer you a means of exploring another field and are open to students throughout the university.

**Intercollege Minors**

Please see the descriptions below.

- Computational Finance
- Environmental Science
- Health Care Policy and Management
- Scientific Computing

**Departmental Minors in the Mellon College of Science**

For descriptions, please see the departmental sections which follow.

- Biological Sciences
- Chemistry
- Discrete Mathematics and Logic
- Mathematical Sciences
- Physics

**The Minor in Health Care Policy and Management**

**Sponsored by:**

H. John Heinz III School of Public Policy and Management
College of Humanities and Social Sciences
Mellon College of Science

**Faculty Advisors:**

Caroline Acker, Naum Kats, and Stephanie Wallach, College of Humanities and Social Sciences
Brenda Peyser, H. John Heinz III School
Amy Burkert, Mellon College of Science

The face of health care is changing. The practice of medicine is being fundamentally altered by the forces of change in public policy, health care organizations and in the industry as a whole. The role of individual professionals in this industry is changing as rapidly as the industry itself. Traditional career paths have been replaced by new opportunities that require new skills. New organizations are placing new demands on their professional and medical staffs. The criteria of efficiency and financial stability are entering the domains of diagnosis and treatment.

This minor is designed to provide students considering a career in the health professions with an understanding of how these changes are likely to affect their careers. Students will become familiar with the critical policy and management issues and will begin to learn to operate effectively in the emerging health care environment. The curriculum combines economic, organizational, managerial, historical and psychological perspectives on these issues to provide a foundation for a deepened understanding of the changing structure of health care organizations and policy.

**Curriculum (minimum) 60 units**

Six courses (a minimum of 60 units) are required to complete this minor. Entry into the minor requires completion of 73-250, Intermediate Microeconomics or 88-220, Policy Analysis I or the equivalent by approval.

**Required Courses** 33 units

Students are required to take the following courses.

- 79-384 Medicine and Society
- 90-761 Introduction to Health Care Policy and Management
- 90-735 Health Economics

**Elective Courses** 27 units

Complete three courses totaling a minimum of 27 units.

**Heinz School Courses (12 units each)**

- 90-721 Non-Profit and Health Marketing
- 91-830 Financial Management of Health Systems
- 91-836 Legal Issues in Health Systems Management
- 91-844 Managing Quality Improvement
- 91-853 Health Care Information Systems
- 91-861 Health Policy
- 91-862 Managed Care

**Humanities and Social Sciences Courses (9 units each)**

- 76-494 Medical Communications
- 79-335 Drug Use and Drug Policy
- 79-336 Epidemic Disease and Public Health
- 80-245 Medical Ethics
- 85-241 Social Psychology
- 85-442 The Social Psychology of Health
- 85-446 The Psychology of Gender
- 85-451 The Psychology of Purpose
- 88-373 Mental Health Ideologies

Please note that some of these courses have prerequisites that will not count toward the completion of the requirements for this minor.

**Minor in Environmental Science**

**Faculty Contact:**

Neil Donahue, Chemistry and Chemical Engineering Departments

The primary mission of the environmental sciences minor is to prepare students in the Mellon College of Science for careers or postgraduate education in the diverse fields of environmental science. We feel strongly that these endeavors must be grounded in strong fundamental science; consequently, the program extends majors in the Mellon College of Science. We also award minors to students from other colleges, provided that they can build a course of study with sufficient scientific rigor to meet the standards of the program.

As a capstone program, the minor is built around advanced courses that extend as well as broaden the specialized education associated with the major programs. Environmental sciences are highly interdisciplinary in nature, and while it is necessary that students have an exposure to introductory courses in several of these disciplines, it is by no means sufficient; in-depth knowledge is required. We encourage all students to pursue generally broad studies, including subjects that encompass human interactions with the environment, and will provide guidance to all students interested in the area. We encourage those students who intend to devote focused attention to environmental sciences to pursue this minor.

Environmental Sciences are broadly defined as pursuits designed to develop fundamental understanding of the natural environment and human interactions with the environment. Research problems are frequently motivated by perceived problems (air, water and soil pollution, reduction in biodiversity, global climate change, etc...), but inevitably extend to the fundamental mechanisms underlying these phenomena. Research can be highly specialized (focusing for example on the biochemistry of a particular enzyme or the synthesis of a particular catalyst) or highly general (focusing for example on the complex, nonlinear interactions of populations on complex ecosystems). Our program is designed to ensure that students of the field are conversant with questions on all of these scales, from the microscopic to the global.
Required Courses:

Science Requirements (27 units)

- 09-217 Organic Chemistry I
- 09-218 Organic Chemistry II
- 03-231/232 Organic Chemistry (or equivalent)

Laboratory Requirement (12 units)

- 09-221 Laboratory 1: Introduction to Chemical Analysis
- 12-252 Environmental Engineering Lab

Statistics Requirement (9 units)

- 36-247 Statistics for Laboratory Sciences
- 12-251 Introduction to Environmental Engineering

Additional Course Requirements:

Complete one course from each of the following groups (substitutions can be made with the approval of the Environmental Science Advisor).

Science (Mechanism)

- 03-441 Molecular Biology of Prokaryotes
- 03-442 Molecular Biology of Eukaryotes
- 09-510 Introduction to Green Chemistry
- 09-520 Special Topics in Atmospheric Chemistry
- 06-630 Atmospheric Chemistry: Air Pollution & Global Change
- 12-726 Mathematical Modeling of Environmental Quality Systems

Engineering (Process)

- 12-651 Air Quality Engineering
- 12-655 Water Quality Engineering
- 12-720 Water Resource Chemistry
- 42-606 Biotechnology & Environmental Processes

Policy

- 19-446 Quantitative Research Analysis
- 19-448 Science, Technology, & Ethics
- 72-358 Economics of the Environmental & Natural Resources
- 79-365 Climate Change, Environmental Policy & Practice
- 80-244 Management, the Environment, & Ethics
- 80-352 International Environmental Law & Policy

Minor in Scientific Computing

Faculty Contact:
Richard Holman, Physics Department

Sometimes called “computational science,” scientific computing is the application of high-performance computers and modern computational technologies to problems in the sciences and engineering. Research in this area is inherently multidisciplinary, requiring strong ties with a scientific discipline.

MCS students can easily build on their scientific training with this applied computational program. The curriculum consists of five areas of concentration, which span the natural sciences, mathematics, programming and research. The curriculum is structured to allow flexibility in choosing courses that meet students’ particular interests or best compliment their major. The minor is also a natural choice for students majoring in any technical area.

Required Courses

Students must meet the requirements of the following categories:

A. Non-Introductory Science Requirement (9-12 units)

Complete 1 course from Biological Sciences, Chemistry, or Physics at the 200 level or higher, excluding those courses listed below as part of the requirements of the minor. Courses with a significant science component from other colleges may be substituted with approval from the program administrator.

B. Computational Science Requirement (18-24 units)

Complete 2 of the following courses:

- 03-310 Introduction to Computational Biology
- 03-510 Computational Biology
- 09-560 Computational Chemistry
- 33-241 Introduction to Computational Physics

C. Computational Methods Requirement (9 units)

Complete one of the following courses from outside of your home department.

- 21-320 Symbolic Programming Methods
- 21-369 Numerical Methods
- 21-380 Introduction to Mathematical Modeling
- 33-232 Physical Analysis
- 33-456 Advanced Computational Physics
- 36-410 Introduction to Probability Modeling

D. Applied Scientific Computing Research Project(s) (9 units)

Complete one approved research project in an area of applied scientific computing. In some cases, this research could be replaced with 9 units of an approved project-based course in advanced scientific computing. The administrator of the minor will maintain a list of appropriate courses. Under special circumstances summer research may count toward this requirement, although it cannot be counted toward the units required for graduation.

E. Complete any additional course from category C or D (9 units)
A major revolution is occurring in the field of biological sciences. Biology is undergoing unprecedented technological advances in biochemistry, biophysics, cell biology, genetics, molecular biology, developmental biology, neuroscience and computational biology. Carnegie Mellon’s Department of Biological Sciences is nationally recognized as one of the outstanding departments in these areas. Advances in basic research are already being used to solve problems, not only in medicine and public health, but also in areas such as agriculture, forestry, mining, energy, and in industrial and pharmaceutical manufacturing processes. The department provides its students with an education that has both intellectual breadth and depth of exposure to modern research biology. This education can be used to gain employment immediately after graduation in government, industry or academic research laboratories, or to pursue graduate studies in science, medicine, public health, law or business.

The department offers a bachelor of science (B.S.) degree in biological sciences. This program has a distinctive core curriculum that provides a foundation in biology, chemistry, computer science, mathematics and physics. In addition to the core courses, the program includes six biology electives, five free electives and eight humanities, social science and fine arts electives. With these electives, students can shape a degree program according to their own interests and career goals. A bachelor of arts (B.A.) degree is available when coupled with an additional major from any department in the College of Humanities and Social Sciences. In addition, the department offers a B.S. in Computational Biology for students with interests in computational modeling and analysis of biological systems as well as a unified B.S. in Biological Sciences and Psychology.

For students who have an interest in a particular field of biology and wish to have a specialized focus, the department offers options in biochemistry, biophysics, cell biology, computational biology, developmental biology, genetics, molecular biology and neuroscience that provide the relevant training in each area. The options are especially recommended for students who are considering graduate school in one of these areas.

A degree in biological sciences provides excellent preparation for medical school or other graduate programs in the health professions. These students are aided by the Carnegie Mellon Health Professions Program (HPP), an advisory and resource service for all Carnegie Mellon students who are considering careers in the health care field. (See page 76 for more information.)

In this exciting era that includes the influence of biology and the life sciences on many fields from medicine to law, the in-depth exposure to multiple disciplines provides opportunities for students to prepare for involvement at the forefront of emerging new fields, markets and policy changes. The Department of Biological Sciences at Carnegie Mellon is working at these new interfaces through interdisciplinary research and educational programs. Many students broaden their education by pursuing minors and additional majors in disciplines throughout the university, not just within the Mellon College of Science. Students also explore interdisciplinary studies through the Science and Humanities Scholars program, or pursue interests at the interface between the arts and sciences through the Bachelor of Science and Arts (B.S.A.) degree program combining biological sciences with a discipline in the College of Fine Arts.

One of the most important features of the Department of Biological Sciences is the opportunity for undergraduate students to interact with faculty. The faculty members are prominent research scientists who also teach beginning and advanced courses. The teaching laboratories are located in the same building as the faculty research laboratories and share scientific equipment. We encourage students to be aware of the faculty research work and to develop research projects with faculty. While such research is usually most important in the senior year, it may begin in the junior, or, in unusual cases, the sophomore year. The department has an Honors Program in Research Biology that is intended to facilitate a more intensive involvement in research for eligible students. During the past four years, more than 80 percent of the undergraduate biology majors have worked with faculty on their research and, in some cases, have been co-authors of research papers and have given presentations at national meetings.

**B.S. Biological Sciences**

The B.S. in Biological Sciences is built around a core program and elective units as detailed in the following section.

### Course Requirements

<table>
<thead>
<tr>
<th>Course Requirements</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Biological Sciences</td>
<td></td>
</tr>
<tr>
<td>03-121 Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-231 or 03-232 Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-240 Cell Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-330 Genetics</td>
<td>9</td>
</tr>
<tr>
<td>03-343 Experimental Genetics and Molecular Biology</td>
<td>12</td>
</tr>
<tr>
<td>03-344 or 03-345 Experimental Biochemistry</td>
<td>12</td>
</tr>
<tr>
<td>03-345 Experimental Cell and Developmental Biology</td>
<td>12</td>
</tr>
<tr>
<td>03-201 &amp; 03-202 Colloquium</td>
<td>2</td>
</tr>
<tr>
<td>03-411 &amp; 03-412 Topics in Research</td>
<td>2</td>
</tr>
<tr>
<td>03-xxx Biological Sciences Electives*</td>
<td>54</td>
</tr>
<tr>
<td>Mathematics, Physics and Computer Science</td>
<td></td>
</tr>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-122 Integration, Differential Equations, and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>33-111 Physics for Science Students I</td>
<td>12</td>
</tr>
<tr>
<td>33-112 Physics for Science Students II</td>
<td>12</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>99-101 or 99-102 or 99-103 Computer Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry</td>
<td></td>
</tr>
<tr>
<td>09-105 Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>09-106 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-218 Organic Chemistry II</td>
<td>9</td>
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<tr>
<td>09-221 Laboratory I: Introduction to Chemical Analysis</td>
<td>12</td>
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<tr>
<td>09-222 Laboratory II: Organic Synthesis and Analysis</td>
<td>12</td>
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<tr>
<td>09-214 Physical Chemistry</td>
<td>9</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>246</strong></td>
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<tr>
<td>Elective Units</td>
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<tr>
<td>Free Electives</td>
<td>42</td>
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<tr>
<td>H&amp;SS and Fine Arts Electives</td>
<td>72</td>
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<tr>
<td>(see p. 284 of the Mellon College of Science section)</td>
<td></td>
</tr>
<tr>
<td><strong>Minimum number of units required for degree:</strong></td>
<td><strong>360</strong></td>
</tr>
<tr>
<td>Biological Sciences Electives*</td>
<td></td>
</tr>
<tr>
<td>The following specifications apply to Biological Sciences electives:</td>
<td></td>
</tr>
<tr>
<td>• At least 18 units must be at the 03-3xx level or above, exclusive of 03-445 Undergraduate Research.</td>
<td></td>
</tr>
<tr>
<td>• Up to three interdisciplinary electives may count as biology electives.</td>
<td></td>
</tr>
<tr>
<td>• Up to 18 units of 03-445 Undergraduate Research may count as biology electives; a maximum of 36 units can count toward graduation.</td>
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</tr>
<tr>
<td>• Courses in biology taken through cross-registration at another university may count as electives if prior permission has been obtained from the Carnegie Mellon Department of Biological Sciences advisor.</td>
<td></td>
</tr>
</tbody>
</table>
Departmental Electives Group

03-122 Organismic Botany
03-124 Modern Biology Laboratory
03-125 Evolution and the History of Life
03-130 Biology of Organisms
03-310 Introduction to Computational Biology
03-311 Introduction to Computational Molecular Biology
03-315 Magnetic Resonance Imaging in Neuroscience
03-350 Developmental Biology
03-360 Biology of the Brain
03-380 Virology
03-390 Molecular and Cellular Immunology
03-438 Physical Biochemistry
03-439 Introduction to Biophysics
03-441 Molecular Biology of Prokaryotes
03-442 Molecular Biology of Eukaryotes
03-443 Molecular Biology of Eukaryotes
03-445 Cellular and Genetic Mechanisms of Development
03-450 Computational Biology
03-511 Computational Molecular Biology and Genomics
03-512 Computational Methods for Biological Modeling and Simulation
03-513 Bioinformatics Data Integration Practicum
03-534 Biological Imaging and Fluorescence Spectroscopy
03-545 Honors Research
03-620 Techniques in Electron Microscopy
03-710 Computational Biology
03-711 Computational Genomics and Molecular Biology
03-712 Computational Methods for Biological Modeling and Simulation
03-713 Bioinformatics Data Integration Practicum
03-730 Advanced Genetics
03-738 Physical Biochemistry
03-740 Advanced Biochemistry
03-741 Advanced Cell Biology
03-742 Molecular Biology of Eukaryotes
03-744 Membrane Trafficking
03-751 Advanced Developmental Biology
03-761 Neural Plasticity in Sensory and Motor Systems
03-871 Structural Biophysics

Interdisciplinary Electives Group

Up to three of the following courses may count as biology electives:

09-518 Bioorganic Chemistry: Nucleic Acids and Carbohydrates
09-519 Bioorganic Chemistry: Peptides, Proteins and Combinatorial Chemistry
09-521 Bioinorganic Chemistry
15-211 Fundamental Structures of Computer Science I
21-127 Concepts of Mathematics
21-259 Calculus in Three Dimensions
21-260 Differential Equations
36-247 Statistics for Lab Sciences
42-301 Physiology
42-621 Biotechnology and Environmental Processes
85-219 Biological Foundations of Behavior

Options for the B.S. in Biological Sciences

Students who wish to specialize in a particular area of biology can do so through a set of departmentally defined options. Students who complete the required biology electives for any option can have up to two noted on his or her transcript. Options need not be declared.

The elective courses required for each of the options are listed below:

Biochemistry Option

Required Biology Electives:
03-438 Physical Biochemistry
21-259 Calculus in Three Dimensions
or
21-260 Differential Equations

Any one of the following courses:
09-518 Bioorganic Chemistry: Nucleic Acids and Carbohydrates
09-519 Bioorganic Chemistry: Peptides, Proteins and Combinatorial Chemistry
09-521 Bioinorganic Chemistry

Recommended Biology Electives:
03-441 Molecular Biology of Prokaryotes
03-442 Molecular Biology of Eukaryotes
03-534 Biological Imaging and Fluorescence Spectroscopy
03-439 Introduction to Biophysics
03-740 Advanced Biochemistry
03-871 Structural Biophysics

Biophysics Option

Required Biology Electives:
03-438 Physical Biochemistry
03-39 Introduction to Biophysics
21-259 Calculus in Three Dimensions
or
21-260 Differential Equations

Recommended Biology Electives:
03-315 Magnetic Resonance Imaging in Neuroscience
03-534 Biological Imaging and Fluorescence Spectroscopy
03-871 Structural Biophysics

Cell Biology Option

Required Biology Electives:
03-350 Developmental biology
03-441 Molecular Biology of Prokaryotes
03-741 Advanced Cell Biology

Recommended Biology Electives:
03-360 Biology of the Brain
03-438 Physical Biochemistry
03-450 Cellular and Genetic Mechanisms of Development
03-442 Molecular Biology of Eukaryotes
03-751 Advanced Developmental Biology

Computational Biology Option

Required Biology Electives:
03-510 Computational Biology
15-211 Fundamental Structures and Algorithms I

Any one of the following courses:
36-247 Statistics for Laboratory Sciences
21-260 Differential Equations
21-241 Matrix Algebra

Recommended Biology Electives:
03-511 Computational Molecular Biology and Genomics
03-512 Computational Methods for Biological Modeling
15-212 Fundamental Structures of Computer Science II
15-451 Algorithm Design and Analysis
09-560 Computational Chemistry

Developmental Biology Option

Required Biology Electives:
03-350 Developmental Biology
03-441 Molecular Biology of Prokaryotes
03-442 Molecular Biology of Eukaryotes
03-751 Advanced Developmental Biology

Recommended Biology Electives:
03-360 Biology of the Brain
03-438 Physical Biochemistry
03-450 Cellular and Genetic Mechanisms of Development
03-741 Advanced Cell Biology

Genetics Option

Required Biology Electives:
03-441 Molecular Biology of Prokaryotes
03-442 Molecular Biology of Eukaryotes
03-730 Advanced Genetics (minimum grade of B in 03-330 required)

Recommended Biology Electives:
03-350 Developmental Biology
03-380 Virology
03-438 Physical Biochemistry
03-450 Cellular and Genetic Mechanisms of Development

Molecular Biology Option

Required Biology Electives:
03-441 Molecular Biology of Prokaryotes
03-442 Molecular Biology of Eukaryotes

Recommended Biology Electives:
03-350 Developmental Biology
03-380 Virology
Professional Masters Degree in Computational Biology

Students who are interested in more advanced training in this emerging field may want to consider the Professional Master of Science Program in Computational Biology. For more information on this program, contact the Department of Biological Sciences.

B.S. Biological Sciences and Psychology

This unified major is intended to reflect the interdisciplinary nature of current research in the fields of biology and psychology, as well as the national trend in some professions to seek individuals broadly trained in both the social and natural sciences. Students in the Mellon College of Science will earn a B.S. in Biological Sciences and Psychology. Students in the joint SHS program can complete the SHS educational core and choose either departmental order for their diploma.

Course Requirements

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<td>03-330 Genetics</td>
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<td>03-343 Experimental Genetics and Molecular Biology</td>
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<td>or</td>
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<tr>
<td>03-345 Experimental Cell and Developmental Biology</td>
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<td>03-201 &amp;</td>
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<tr>
<td>03-202 Colloquium</td>
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<td>03-411 &amp;</td>
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<td>03-412 Topics in Research</td>
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<td>03-510 Computational Biology</td>
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<tr>
<td>03-3XX Advanced Biology Elective</td>
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<tr>
<td><strong>Mathematics, Physics and Computer Science</strong></td>
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<tr>
<td>21-120 Differential and Integral Calculus</td>
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<tr>
<td>21-122 Integration, Differential Equations, and Approximation</td>
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<td>21-127 Concepts of Mathematics</td>
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<tr>
<td>21-260 Differential Equations</td>
<td>9</td>
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<td>33-111 Physics for Science Students I</td>
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<td>33-112 Physics for Science Students II</td>
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<tr>
<td>15-111 Intermediate/Advanced Programming</td>
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<tr>
<td>15-211 Fundamental Data Structures and Algorithms</td>
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<tr>
<td>15-212 Principles of Programming</td>
<td>12</td>
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<tr>
<td>15-3XX Advanced Computing Electives</td>
<td>18</td>
</tr>
<tr>
<td>99-101 or</td>
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<td>99-102 or</td>
<td></td>
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<tr>
<td>99-103 Computer Skills Workshop</td>
<td>3</td>
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<tr>
<td><strong>Chemistry</strong></td>
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<tr>
<td>09-105 Introduction to Modern Chemistry</td>
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<tr>
<td>09-106 Modern Chemistry</td>
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<tr>
<td>09-217 Organic Chemistry I</td>
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<td>09-218 Organic Chemistry II</td>
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<tr>
<td>09-221 Laboratory I: Introduction to Chemical Analysis</td>
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<tr>
<td>09-222 Laboratory II: Organic Synthesis and Analysis</td>
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<tr>
<td>09-214 Physical Chemistry</td>
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<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Course Requirements</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td><strong>Elective Units</strong></td>
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</tr>
<tr>
<td>Free Electives</td>
<td>15</td>
</tr>
<tr>
<td>H&amp;SS and Fine Arts Electives</td>
<td>72</td>
</tr>
<tr>
<td><strong>Minimum number of units required for degree:</strong></td>
<td>360</td>
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</table>
**Elective Units**

Free Electives 33-36
H&SS and Fine Arts Electives** 27

**Minimum number of units required for degree:** 360

* Excluding 85-261, Abnormal Psychology
**1 Cognitive Choice and Behavior elective and 4 H&SS and Fine Arts electives of the MCS general education requirements are fulfilled by the psychology requirements.

**B.A. Biological Sciences with an Additional Major**

The Department of Biological Sciences offers a B.A. when combined with an additional major that is intended for students who wish to combine their interest in science with one of the majors in the College of Humanities and Social Sciences. The requirements for the B.A. degree are distributed as follows:

<table>
<thead>
<tr>
<th>Course Requirements</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biological Sciences</strong></td>
<td></td>
</tr>
<tr>
<td>03-121 Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-231 or Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-240 Cell Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-330 Genetics</td>
<td>9</td>
</tr>
<tr>
<td>03-124 or Organic Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-343 Biological Sciences Laboratory</td>
<td>9-12</td>
</tr>
<tr>
<td>03-201 &amp; 2 Colloquium</td>
<td>2</td>
</tr>
<tr>
<td>03-411 &amp; Topics in Research</td>
<td>2</td>
</tr>
<tr>
<td>03-XXX General Biology Electives</td>
<td>18</td>
</tr>
<tr>
<td>03-3XX Advanced Biology Elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>Mathematics, Physics and Computer Science</strong></td>
<td></td>
</tr>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-122 Integration, Differential Equations, and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>33-111 Physics for Science Students I</td>
<td>12</td>
</tr>
<tr>
<td>33-112 Physics for Science Students II</td>
<td>12</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>99-101 or 2 Computer Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>99-102 or Chemistry</td>
<td></td>
</tr>
<tr>
<td>09-105 Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>09-106 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>09-217 Organic Chemistry II</td>
<td>9</td>
</tr>
<tr>
<td>09-218 Organic Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-221 Laboratory I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-222 Laboratory II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>195-198</td>
</tr>
</tbody>
</table>

**Minor In Biological Sciences**

All university students are eligible to pursue a minor in biological sciences in conjunction with a major in any other department in the university. A minimum of six biological sciences courses and two chemistry prerequisites must be completed to fulfill the minor in biological sciences. The curriculum includes four required courses and two elective courses as specified below. Units awarded for undergraduate research are not applicable to elective courses. Courses taken in other departments or colleges will be considered on an individual basis.

<table>
<thead>
<tr>
<th>Prerequisite and Required Courses for the Minor</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105 Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>03-121 Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-231 or Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-240 Cell Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-330 Genetics</td>
<td>9</td>
</tr>
<tr>
<td>03-XXX General Biology Elective</td>
<td>9</td>
</tr>
<tr>
<td>03-3XX Advanced Biology Elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>19 + 54</td>
</tr>
</tbody>
</table>

**Faculty**

ERIC T. AHRENS, Assistant Professor of Biological Sciences — Ph.D., University of California, Los Angeles; Carnegie Mellon, 2000—.

BRUCE A. ARMITAGE, Associate Professor of Chemistry — Ph.D., University of Arizona; Carnegie Mellon, 1997—.

ZIV BAR-JOSEPH, Assistant Professor, Center for Automated Learning and Discovery, School of Computer Science — Ph.D. Massachusetts Institute of Technology; Carnegie Mellon, 2003—.

ALISON L. BARTH, Assistant Professor of Biological Sciences — Ph.D., University of California, Berkeley; Carnegie Mellon, 2002—.

PETER B. BERGET, Associate Professor of Biological Sciences — Ph.D., University of Minnesota; Carnegie Mellon, 1986—.

WILLIAM E. BROWN, Professor of Biological Sciences — Ph.D., University of Minnesota; Carnegie Mellon, 1973—.

AMY L. BURKERT, Teaching Professor of Biological Sciences; Associate Department Head for Undergraduate Affairs; Director, University Health Professions Program — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1997—.

PHIL G. CAMPBELL, Associate Research Professor, Institute for Complex Engineered Systems, Carnegie Institute of Technology—Ph.D. Pennsylvania State University; Carnegie Mellon, 1999—.

JUSTIN C. CROWLEY, Assistant Professor of Biological Sciences, — Ph.D., Duke University; Carnegie Mellon, 2003—.

AMY K. CSINK, Assistant Professor of Biological Sciences, — Ph.D., University of Georgia; Carnegie Mellon, 1998—.

CARRIE B. DOONAN, Associate Teaching Professor of Biological Sciences — Ph.D., University of Connecticut; Carnegie Mellon, 1993—.

M. DANNIE DURAND, Associate Professor of Biological Sciences — Ph.D., Columbia University; Carnegie Mellon, 2000—.

WILLIAM F. EDDY, Professor of Statistics — Ph.D., Yale University; Carnegie Mellon, 1976—.

CHARLES A. ETTENSOHN, Professor of Biological Sciences — Ph.D., Yale University; Carnegie Mellon, 1987—.

ERIC W. GROTZINGER, Teaching Professor of Biological Sciences; Associate Dean, Mellon College of Science — Ph.D., University of Pittsburgh; Carnegie Mellon, 1979—.

DAVID D. HACKNEY, Professor of Biological Sciences — Ph.D., University of California, Berkeley; Carnegie Mellon, 1978—.

CHIEN HO, Alumni Professor of Biological Sciences; Director, NMR Center for Biomedical Research — Ph.D., Yale University; Carnegie Mellon, 1979—.

JEFFREY O. HOLLINGER, Professor of Biological Sciences and Biomedical Engineering; Director, Bone Tissue Engineering Center — Ph.D., D.D.S., University of Maryland; Carnegie Mellon, 2000—.
T.D. JACOBSEN, Assistant Director and Principal Research Scientist, Hunt Institute for Botanical Documentation — Ph.D., Washington State University; Carnegie Mellon, 1979—.

JONATHAN W. JARVIK, Associate Professor of Biological Sciences — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1978—.

ELIZABETH W. JONES, Dr. Frederick A. Schwertz Distinguished Professor of Life Sciences; Head, Department of Biological Sciences — Ph.D., University of Washington; Carnegie Mellon, 1974—.

LINDA R. KAUFFMAN, Teaching Professor of Biological Sciences — Ph.D., University of Pittsburgh; Carnegie Mellon, 1977—.

ROBERT W. KIGER, Distinguished Service Professor of Botany; Professor of History of Science; Director and Principle Research Scientist, Hunt Institute for Botanical Documentation — Ph.D., University of Maryland; Carnegie Mellon, 1974—.

CHRISTOPHER J. LANGMEAD, Assistant Professor of Computer Science — Ph.D., Dartmouth College; Carnegie Mellon 2004—.

FREDERICK LANNI, Associate Professor of Biological Sciences — Ph.D., Harvard University; Carnegie Mellon, 1982—.

CHRISTINA H. LEE, Assistant Professor of Biological Sciences — Ph.D., University of California, San Francisco; Carnegie Mellon, 2000—.

ADAM D. LINSTEDT, Associate Professor of Biological Sciences — Ph.D., University of California, San Francisco; Carnegie Mellon, 1995—.

ANTONIO-JAVIER LÓPEZ, Associate Professor of Biological Sciences — Ph.D., Duke University; Carnegie Mellon, 1989—.

BROOKE M. McCARTNEY, Assistant Professor of Biological Sciences— Ph.D., Duke University; Carnegie Mellon, 2003—.

JAMES L. MCCLELLAND, Professor of Psychology; Co-director, Center for the Neural Basis of Cognition — Ph.D., University of Pennsylvania; Carnegie Mellon, 1984—.

WILLIAM R. McCLURE, Professor of Biological Sciences — Ph.D., University of Wisconsin; Carnegie Mellon, 1981—.

JONATHAN S. MINDEN, Associate Professor of Biological Sciences — Ph.D., Albert Einstein College of Medicine; Carnegie Mellon, 1990—.

ROBERT F. MURPHY, Professor of Biological Sciences and Biomedical Engineering — Ph.D., California Institute of Technology; Carnegie Mellon, 1983—.

JOHN F. NAGLE, Professor of Physics and Biological Sciences — Ph.D., Yale University; Carnegie Mellon, 1967—.

GORDON S. RULE, Robert Eberly Professor of Biological Sciences — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1996—.

RUSSELL S. SCHWARTZ, Assistant Professor of Biological Sciences — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2002—.

V. EMILY STARK, Lecturer, Biological Sciences, Coordinator of Graduate Programs — M.S., Carnegie Mellon University; Carnegie Mellon, 2003—.

JOEL R. STILES, Associate Professor of Mellon College of Science and Senior Scientific Specialist, Pittsburgh Super Computing Center — Ph.D., M.D., University of Kansas School of Medicine; Carnegie Mellon, 1999—.

JOSEPH P. SUHAN, Special Senior Lecturer, Electron Microscopy in Biological Sciences — MA, Hofstra University; Carnegie Mellon, 1989—.

NATHAN N. URBAN, Assistant Professor of Biological Sciences — Ph.D., University of Pittsburgh; Carnegie Mellon, 2002—.

FREDERICK UTECH, Principal Research Scientist, Hunt Institute for Botanical Documentation — Ph.D., Washington University; Carnegie Mellon, 1977—.

LINDA M. VISOMIRSKI-ROBIC, Special Lecturer, Biological Sciences — Ph.D., Case Western Reserve; Carnegie Mellon, 2003—.

ALAN S. WAGGONER, Professor of Biological Sciences; Director, Molecular Biosensor and Imaging Center — Ph.D., University of Oregon; Carnegie Mellon, 1999—.

HEATHER E. WEITZEL, Lecturer, Biological Sciences — Ph.D., Carnegie Mellon University, 2003—.

JAMES F. WILLIAMS, Professor of Biological Sciences — Ph.D., University of Toronto; Carnegie Mellon, 1976—.

JOHN L. WOOLFORD JR., Professor of Biological Sciences — Ph.D., Duke University; Carnegie Mellon, 1979—.

C. ROY WORTHINGTON, Professor Emeritus, Biological Sciences Emeritus — Ph.D., Adelaide University; Carnegie Mellon 1969.

Adjunct Faculty

CYNTHIA M. MORTON, Adjunct Associate Professor of Biological Sciences;Associate Curator of the Carnegie Museum of Natural History— Ph.D., New York Botanical Garden/CUNY; Carnegie Mellon, 2002—.

D. LANSING TAYLOR, Adjunct Professor of Biological Sciences — Ph.D., State University of New York at Albany; Carnegie Mellon, 1982—.

GEORGE S. ZUBENKO, Adjunct Professor of Biological Sciences; Professor of Psychiatry, University of Pittsburgh School of Medicine — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1984—.
Chemistry is an area of science involved with the study of the properties and reactions of substances ranging from living cells to subatomic particles. It is at the center of many sciences, providing the fundamental knowledge and tools needed to address many of society’s needs and to explore the unknown. Fields as diverse as genetic engineering and nanotechnology look to chemistry when they look to the future, for that is where the ultimate in understanding — the molecular level — resides.

The chemistry profession is extraordinarily diverse, with career opportunities available in the chemical, petroleum, plastics, metals, and pharmaceutical industries. Chemistry plays an increasingly important role in the rapidly expanding biomedical and biotechnology industries. In addition to careers in industry and academia, many chemists find challenging careers in the public sector in the laboratories of the National Institutes of Health, the Department of Agriculture, the Environmental Protection Agency, the National Institute of Standards and Technology, and the Department of Energy. Chemistry is a particularly suitable major for pre-medical and other pre-health profession students. Medical schools look favorably on the rigorous reasoning skills chemists develop, as evidenced by an excellent record for student admission to advanced education in these areas. The Health Professions Program advises all Carnegie Mellon students considering careers in health fields. (See Health Professions Program description in this catalog for more information.) Chemistry is particularly attractive to pre-law majors anticipating a career in a legal department in a chemical industry or in patent, intellectual property or environmental law. Students interested in industrial careers often combine their chemistry program with undergraduate courses in business administration or go on to study for an M.B.A.

The Department offers two degrees: the B.S. and the B.A. One-third of the courses for the B.A. degree are free electives that may be taken in any of the departments of the University and therefore offer a high degree of flexibility. For the B.S. degree, electives normally are technical courses in chemistry or related fields of sciences, such as biology, physics, mathematics, or computer science, although they can be in other non-technical areas as well. It is possible to have all of the technical requirements completed after the junior year, allowing students the flexibility to combine electives in the senior year into a focused program of specialization. One of these programs is the B.S. in chemistry with the computational chemistry track. The track is an intense concentration in coursework related to scientific computing. Students interested in graduate studies in chemistry may enroll in graduate lecture courses. Those desiring immediate job placement may be interested in one or more of the formal options that supplement the chemistry B.S. degree. These are described in detail later. Carnegie Mellon has one of the strongest polymer science programs in the country and the undergraduate polymer science option offers training that is particularly valuable for an industrial career. The Computational Chemistry track provides students with expertise in scientific computing that is highly sought after by employers in the pharmaceutical industry.

An honors program is offered for highly motivated undergraduates. It is designed primarily for students who wish to undertake a strong research-intensive program of study in contemporary chemistry. The program “B.S. in Chemistry with Departmental Honors” requires the completion of at least one graduate level course, a research project, and the writing of a bachelor’s honors thesis. Two advanced tracks, leading to the B.S. in Chemistry with Departmental Honors together with a Masters Degree in Chemistry or a B.A. in Chemistry with Departmental Honors and a Masters Degree in Chemical Biology, involve completion of five graduate level courses and a more extensive thesis research project. These tracks are especially attractive to students who have earned advanced placement credit in one or more science and/or mathematics courses at Carnegie Mellon. With enough advanced placement credit or by carrying heavier than usual course loads, students can complete the Honors/M.S. degree programs in 8 to 10 semesters.

Department of Chemistry

Hyung J. Kim, Head
Karen H. Stump, Director of Undergraduate Studies
Office: Doherty Hall 1317
www.chem.cmu.edu

Additional majors (double majors) are available with nearly all other departments provided the student can fit the required courses into the schedule. Generally, all the requirements for both departments must be met for an additional major (except for some courses with similar content). Students interested in biochemistry could pursue a B.S. in Chemistry with an Additional Major in Biological Sciences. Programs are also available that lead to the degree B.S. in Chemistry with a minor in another discipline such as biological sciences, physics, mathematics, computer science, engineering studies, business administration and certain departments in the H&SS (Humanities and Social Sciences) college. Requirements for most minor programs are described by individual departments in this catalog. However, it is recommended that students who are interested in pursuing a minor as part of their degree consult with the department involved for current requirements and further guidance. Dual degree programs are available in which students receive two separate undergraduate degrees from two different departments in the University. These require students to complete at least 90 units of work per additional degree in addition to the units required for the first degree.

Several five-year programs have been developed to allow a student to earn both a B.S. in Chemistry and a Master of Science degree in either Chemistry, Polymer Science, or Public Policy and Management.

Study abroad exchange programs are available for chemistry majors and programs of one to two semesters can generally be accommodated without delaying time to graduation beyond B.S. students. One example of a formal exchange program is spending two semesters at École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland. A language program of 3 months duration during the summer is available to students at no extra tuition cost. Study abroad is encouraged by the chemistry department and also can be arranged on an individual basis at universities in Europe, Asia, New Zealand, and Australia during both the academic year and the summer. Students interested in study abroad should consult with their academic advisor and the University’s Study Abroad Advisor.

One of the most attractive features of the Department of Chemistry is the opportunity for students to interact with prominent research scientists in entry-level as well as advanced courses and in research. Since the spring of 2003, undergraduate laboratory instruction takes place in a new state-of-the-art facility. Participation in undergraduate research is encouraged and qualified students may begin projects as early as their first year. Approximately 80 to 90% of the graduating chemistry majors have taken part in research either for pay or for credit as part of their undergraduate training. Chemistry majors have been very successful in obtaining Small Undergraduate Research Grants (SURG) from the University to help support their research projects. Undergraduate and research laboratories are equipped with the latest scientific instrumentation. The use of computers is emphasized throughout the curriculum.

Curriculum — B.S. in Chemistry

The MCS curriculum requires seven Science Core Courses to be completed by the end of the junior year. These are: 21-120 (Differential and Integral Calculus), 21-122 (Integration, Differential Equations and Approximation), 33-112 (Physics I for Science Students), 33-111 (Physics II for Science Students), 09-105 (Introduction to Modern Chemistry), 03-121 (Modern Biology), and 15-100 (Introductory/Intermediate Programming). In the sample curriculum given below for chemistry majors, six of these are in the first year. Students should take the last Science Core Course as early as possible and by the end of their sixth semester. Course 09-106 (Modern Chemistry II) is defined as a Technical MCS Elective.

NOTE: Students who plan to continue in any computer science program as part of their chemistry degree (e.g. Computational Chemistry Option or Track) or take any upper level computer science courses and have any previous programming experience should take
15-111 (Intermediate/Advanced Programming) in lieu of 15-100. If you have no prior programming experience you should take 15-100 followed by 15-200 (Advanced Programming/Practicum) in order to take upper level computer science courses.

### First Year

**Fall (Four Course Schedule)** | **Units**
--- | ---
09-105 Introduction to Modern Chemistry | 10
21-120 Differential and Integral Calculus | 10
33-111 Physics I for Science Students | 12
76-101 Interpretation and Argument | 9
99-101 Computing Skills Workshop | 3

|  | 44 |

Students interested in majoring in chemistry should consider enrolling in the 3-unit lab course 09-101, Introduction to Experimental Chemistry, in the fall or spring semester of the freshman year. Although not required, the laboratory course is recommended for chemistry majors.

### Spring

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
</table>
09-106 Modern Chemistry II | 10 |
21-122 Integration, Differential Equations and Approximation | 10 |
33-112 Physics II for Science Students | 12 |
15-100 Introductory/Intermediate Programming (or core elective) | 10 |
xx-xxx H&SS Distribution Course 1 | 9 |

|  | 51 |

An optional 3-unit Freshman Chemistry Seminar, 09-102, is offered to MCS students in the spring semester. These are low enrollment, discussion oriented classes on special topics in modern chemistry.

### Sophomore Year

**Fall** | **Units**
--- | ---
09-201 Undergraduate Seminar I | 1
09-217 Organic Chemistry I | 9
09-221 Laboratory I: Introduction to Chemical Analysis | 12
09-222 Mathematical Methods for Chemists | 9
03-121 Modern Biology (or core elective) | 9
xx-xxx H&SS Distribution Course 2 | 9

|  | 49 |

### Spring

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
09-202 Undergraduate Seminar II | 1 |
09-204 Issues in Chemistry | 3 |
09-218 Organic Chemistry II** | 9 |
09-222 Laboratory II: Organic Synthesis and Analysis | 12 |
09-348 Inorganic Chemistry | 10 |
xx-xxx H&SS Distribution Course 3 | 9 |

|  | 44 |

### Junior Year

**Fall** | **Units**
--- | ---
09-301 Undergraduate Seminar III | 1
09-321 Laboratory III: Molecular Design and Synthesis | 12
09-344 Physical Chemistry (Quantum) | 9
09-331 Modern Analytical Instrumentation | 9
xx-xxx H&SS/CFA Elective 1 (of 4)* | 9

|  | 40 |

### Spring

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
09-302 Undergraduate Seminar IV | 1 |
09-322 Laboratory IV: Molecular Spectroscopy and Dynamics | 12 |
09-345 Physical Chemistry (Thermo) | 9 |
09-xxxx Chemical Elective (see notes on electives) | 9 |
xx-xxx H&SS/CFA Elective 2 (of 4)* | 9 |

|  | 40 |

### Senior Year

**Fall** | **Units**
--- | ---
09-401 Undergraduate Seminar V | 1
xx-xxx Chemical Elective (see notes on electives) | 9
xx-xxx Free Electives | 27
xx-xxx H&SS/CFA Elective 3 (of 4)* | 9

|  | 46 |

### Spring

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
09-402 Undergraduate Seminar VI | 3 |
xx-xxx Electives | 36 |
xx-xxx H&SS/CFA Elective 4 (of 4)* | 9 |

|  | 48 |

* Certain non-technical courses from Business Administration, Heinz School, and EPP also may be used. A listing of approved and non-approved courses for the H&SS/CFA electives is available at the following web site, www.cmu.edu/mcs/education/edu_HSSFA.html, or see the Mellon College of Science section in this catalog for the Humanities and Social Sciences and Fine Arts Requirements. Accounting, finance, management, marketing, production, and statistics courses may NOT be used. Also, 70-100 (Introduction to Business) and 85-219 (Biological Foundations of Behavior) may NOT be used as electives in the H&SS/CFA category. If in doubt, check with your advisor.

**A 3-unit course 09-220 Supramolecular Chemistry is offered as an elective to compliment 09-218. (Enrollment Limited)**

### Distribution of Units for the B.S. Degree (and Requirements for An Additional Major in Chemistry)

**Minimum Total Chemistry Units (161; See distribution below)**

#### Required Chemistry Courses*

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
</table>
09-105 Introduction to Modern Chemistry** | 10 |
09-106 Modern Chemistry II | 10 |
09-204 Issues in Chemistry | 3 |
09-217 Organic Chemistry I | 9 |
09-218 Organic Chemistry II | 9 |
09-231 Mathematical Methods for Chemists*** | 9 |
09-331 Modern Analytical Instrumentation | 9 |
09-344 Physical Chemistry (Quantum) | 9 |
09-345 Physical Chemistry (Thermo) | 9 |
09-348 Inorganic Chemistry | 10 |
09-221 Lab I: Introduction to Chemical Analysis | 12 |
09-222 Lab II: Organic Synthesis and Analysis | 12 |
09-321 Lab III: Molecular Design and Synthesis | 12 |
09-322 Lab IV: Molecular Spectroscopy and Dynamics | 12 |
09-xxxx Chemistry Seminars | 8 |
09-xxxx Chemistry Electives (includes 9 units of lab elective) | 18 |

* These are the required courses for students earning an additional major in chemistry.

** 09-105, Honors Chemistry, may be taken instead of 09-105.

*** 21-259, Calculus in Three Dimensions, and an additional Mathematics/Statistics Elective (see Notes on Electives below) can be taken to fulfill the requirement for 09-231.

### Other Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Units</th>
</tr>
</thead>
</table>
Biology | 9 |
Computer Science | 10 |
Mathematics | 20 |
Physics | 24 |
Humanities and Social Sciences or Fine Arts courses | 72 |
Free Electives | 61 |
Computing Skills Workshop | 3 |

### Minimum number of units required for the degree: 360

The above B.S. curriculum recommends a range of 40-51 units/semester to meet the minimum degree requirement. Students are strongly encouraged to take extra elective courses (except in the first semester of the freshman year) in whatever subjects they wish in order to enrich their backgrounds and enhance their educational experience.

### Notes on Electives

#### Mathematics/Statistics Elective

The B.S. degree in Chemistry requires 09-231 (Mathematical Methods for Chemists) as the advanced math requirement. In order to provide some flexibility, a student may take 21-259 (Calculus in Three Dimensions) and one 9-unit mathematics or statistics elective course to fulfill this requirement. Recommended courses include (but are not necessarily limited to): 21-260 (Differential Equations), 21-127 (Concepts of Mathematics), or 36-247 (Statistics for Laboratory Sciences). Less mathematically rigorous courses in statistics such as 36-201 (Statistical Reasoning) and 36-202 (Introduction to Statistical Methods) can not be used towards fulfillment of this requirement.
Chemistry Electives

A minimum of 18 units of chemical electives is required. At least nine must be in a chemistry laboratory course, defined as one of the following. Note that some of these have prerequisites not normally taken by chemistry majors.

- 09-445 Undergraduate Research* 9 units
- 03-344 Experimental Techniques in Biochemistry 12 units
- 06-xxx Approved Chemical Engineering Laboratory * 9-12 units
- 09-560 Computer Chemistry 12 units
- 39-802 Colloids, Polymers and Surfaces Laboratory II 9-12 units

*This must be an experimental project involving research work.

Other chemical electives can be satisfied by 09-445, Undergraduate Research, or by any other chemistry course 09-3xx or higher, undergraduate or graduate, for which the student has the necessary prerequisites, or by 03-231/232 Biochemistry I. Certain interdisciplinary courses (e.g. 39-xxx) relating to chemistry also can be used. The scheduling of these electives can vary and students should check with the Department offering the course to see which courses are offered in any given year or semester.

Free Electives

Free electives are defined as including any course offered by Carnegie Mellon except those in science or engineering fields that are primarily intended for non-majors. A maximum of 9 units total of Physical Education and/or ROTC courses can be counted as free elective units. The Chemistry Department does not require technical electives.

Options for the B.S. in Chemistry

The curriculum for the degree Bachelor of Science in Chemistry permits students to take a number of elective courses in chemistry and other fields, particularly in the junior and senior years. Students may wish to complete a group of elective courses from several specialty areas, called "options," to complement their technical education. Each option will complement the Bachelor's degree in Chemistry and will provide students with expertise in a specific area not covered by the normal undergraduate curriculum. Options are noted on the student's transcript but not on the diploma.

For each of the following options, the student should refer to the previous description of the curriculum for the B.S. in chemistry. Required courses are unchanged, and the courses that should be taken as electives for each option are listed below.

Biochemistry Option

| Units |  
|---|---|
| 03-231/232 Biochemistry I | 9 |
| 03-330 Genetics | 9 |
| 03-438 Physical Biochemistry | 9 |
| 03-344 Experimental Techniques in Biochemistry | 12 |

Polymers Science Option

| Units |  
|---|---|
| 09-500 Organic Chemistry | 9 |
| 09-509 Physical Chemistry of Macromolecules | 9 |
| 39-802 Colloids, Polymers and Surfaces Laboratory II | 9-12 |
| 09-xxx Elective in Polymer Science | 9 |

Elective may be 09-445, Undergraduate Research (polymer project), or an upper level course in polymer science such as 09-545, Polymer Rheology

Colloids, Polymers, and Surfaces Option

(offers jointly with the Department of Chemical Engineering)

| Units |  
|---|---|
| 06-607 Physical Chemistry of Colloids and Surfaces | 9 |
| 06-509 Physical Chemistry of Macromolecules | 9 |
| 06-466 Experimental Colloid and Surface Science | 9 |
| 06-466 Experimental Polymer Science | 9 |

Materials Chemistry Option

| Units |  
|---|---|
| 27-100 Materials in Engineering | 12 |
| 27-201 Perfect Crystals (9 unit half-semester mini course; 6 units lecture, 3 units lab) | 9 |

Two Elective Courses (from list below)

| Units |  
|---|---|
| 27-202 Defects in Materials | 9 units |
| 09-502 Organic Polymer Chemistry | (Fall, Spring, 9 units) |
| 09-545 Polymer Rheology | (Fall, 9 units) |
| 09-445 Undergraduate Research | (in a materials area, Spring or Fall, 9 units) |
| 09-509 Physical Chemistry of Macromolecules | (Fall, 9 units) |
| 39-802 Colloids, Polymers, and Surfaces Laboratory | (Spring, 9 units) |
| 09-511 Solid State Materials | (Spring, 9 units) |
| 27-xxx Approved MSE Course | (Fall or Spring, 9 units) |

Environmental Chemistry Option

| Units |  
|---|---|
| 09-510 Introduction to Green Chemistry | 9 |

Three Elective Courses (from the list below or other approved electives)

| Units |  
|---|---|
| 09-520 Special Topics in Atmospheric Chemistry | 9 |
| 06-630 Atmospheric Chemistry, Air Pollution and Global Change | 12 |
| 12-090 Technology and the Environment | 9 |
| 12-251 Introduction to Environmental Engineering | 9 |
| 12-651 Air Quality Engineering | 9 |
| 12-655 Water Quality Engineering (Lab Recommended) | 9 |
| 12-720 Water Resources Chemistry | 12 |
| 19-420 Chemical Technologies, the Environment, and Society | 9 |
| 19-422 Radiation, Health, and Policy | 9 |

Only one of the 19-xxx courses can be applied to the Environmental Chemistry Option

Management Option

| Units |  
|---|---|
| 70-101 Introduction to Business Management | 9 |
| 70-121 Accounting I | 9 |
| 70-364 Business Law (or 70-365 International Trade Law) | 9 |
| 73-100 Principles of Economics | 9 |

Computational Chemistry Option

| Units |  
|---|---|
| 15-200 Data Structures | 9 |
| 21-369 Numerical Methods | 9 |
| 09-560 Computational Chemistry | 12 |
| xx-xxx One Upper Level Computational Elective Course* | 9 |

* A list of approved courses for the elective for this option will be maintained and updated periodically by the Department. At the present time the list includes the following courses, but the Department will consider requests for other appropriate courses.

| Units |  
|---|---|
| 03-510 Computational Biology | 12 |
| 03-511 Computational Molecular Biology and Genomics | 9 |
| 03-512 Computational Methods for Biological Modeling and Simulation | 9 |
| 33-211 Introduction to Computational Physics | 9 |
| 15-211 Fundamentals of Data Structures and Algorithms | 12 |
| 09-702 Statistical Mechanics and Dynamics | 12 |
| 09-701 Quantum Chemistry I | 12 |

Note: The Chemistry/Computational Chemistry Track (described later) requires the completion of the two upper level Computer Science courses 15-211 and 15-212, while in the Computational Chemistry Option, 15-200 and 21-369 are taken in place of these two courses. Since both 15-211 and 15-212 are prerequisites for higher level computer science courses, students in the Computational Chemistry Option should note that they are essentially blocked from taking additional courses in the Computer Science Department as senior computing electives. Students who complete 15-211 but not 15-212 may count 15-211 towards the Computational Chemistry Option as the required elective. Students pursuing the Computational Chemistry Option must complete course 15-100 as part of their MCS computing requirement.

A student who completes the recommended courses for any of these options will receive a certificate from the Department of Chemistry as formal evidence of the accomplishment and a notation of this will be made on the student's transcript.

B.S. in Chemistry with Departmental Honors

Outstanding students with an interest in research are encouraged to consider the Honors program by the beginning of the junior year. The program combines a modified B.S. curriculum with close faculty-student contact in an individual research project, concluding with the student presentation and defense of a bachelor's honors thesis in an Honors Committee.

The B.S. in Chemistry with Departmental Honors curriculum follows the general sequence of courses that is listed for the B.S. degree. Students are strongly urged to complete all seven of the Science Core Courses as early as possible. The honors program specifies that one of the two chemistry electives be a 12-unit graduate course, and that of the remaining electives required, at least two be undergraduate research (18 units) and one be 09-455, Honors Thesis (6 units). Students will be encouraged to do more than the minimum amount of research, so stipends from the research advisor are sometimes available for summer B.S. honors research.

At any time before the fall term of the senior year, candidates for the B.S. in chemistry may apply to be admitted for candidacy to the...
Honors B.S. program. To be accepted, students will be expected to have shown excellent performance in class work — normally at least a 3.2 average. An Honors Committee, comprised of the department’s undergraduate advisors and other selected faculty, will monitor and evaluate the progress of the student’s research project. A written and oral progress report to the Honors Committee is required in the fall of the junior and senior year. A written thesis suitable for an Honors B.S. degree is required and should be a clear exposition in proper scientific format of a research project done for at least 18 units of credit in 09-445, Undergraduate Research. In April of the senior year, the Honors Committee will evaluate all theses and will require that each student participate in a public oral presentation or defense of the thesis before it approves the Honors degree. Students completing the B.S. with Departmental Honors in Chemistry will be eligible for MCS Research Honors as well.

Honors B.S./M.S. Program in Chemistry

Outstanding students seeking an advanced degree are encouraged to apply for admission to the B.S./M.S. Honors program as early as they can. They will have the opportunity to earn in four years not only the degree B.S. in Chemistry with Departmental Honors, but also the degree Master of Science in Chemistry. This program is highly research intensive and is not appropriate for all students. Requirements include completing five graduate level courses as electives. (See notes on Honors B.S./M.S. electives.)

The schedule of courses for the B.S./M.S. program generally moves as many courses as possible ahead by one year. When possible, all Science Core Courses should be completed in the freshman year. This gives the student the following advantages: 1) greater perspective in selection of a research advisor, 2) greater maturity in performing independent research, and 3) the possibility of initiating graduate course sequences in the junior year. Students can achieve this accelerated schedule through advanced placement and summer school.

The student is expected to keep the research advisor selected by May of the sophomore year for the duration of the thesis project. Summer independent study for 8 to 12 weeks after the freshman year is recommended and thesis research for 12 weeks after the sophomore and junior years is required. Students normally will be given stipends for their summer work either by their research advisor or by competing for a summer fellowship. A minimum of 3 semesters of undergraduate research is required (normally 10 units/semester) as is participation in group seminars during the junior and senior years. Students must present their research at least twice at the Sigma Xi competition at Meeting of the Minds or the annual Carnegie Mellon undergraduate research symposium. In addition students must meet with the Honors Committee each fall to update the committee on their progress and in the fall of the senior year must prepare a written summary of their research progress to date (5 pages) and their plans for the senior year (1 page). This report must state clearly what stage the work is in; it must be clear which work is complete and ready for publication.

A Thesis Committee will be formed to monitor the progress of each student. The committee shall consist of at least one member of the Honors Committee, the student’s research advisor and a third faculty member agreed upon by the student and advisor. This third member can be from another department or institution and can be tenure track, lecturer track or research track faculty. At the start of the spring semester senior year, the student must submit a draft of the introduction for their thesis and a detailed outline of their methods, results and discussion sections to the department undergraduate program coordinator. This will be distributed by the program coordinator and reviewed by the student’s Thesis Committee.

Each student is required to submit a formal Masters Degree dissertation to the Chemistry Department. In April of the senior year the Honors Committee will evaluate the written thesis and students are required to present their final oral defense of the project before the Thesis Committee. The dissertation, written in proper scientific format should describe the research project in considerable detail and must withstand the scrutiny of the Honors Committee with respect to completeness. It need not be as extensive nor contain the element of student originality characteristic of a Ph.D. thesis; however it must contain results and conclusions that are of a high enough quality to be accepted as a publication in a respected research journal. As for all M.S. degree candidates in the Department, the dissertation must be approved by the faculty member in charge of the work and the Department Head. The final version of the thesis submitted to the Department must be bound in a hard-cover format.

Research productivity is the most important criterion for success at the evaluation points, but QPA is a strong secondary criterion. While we expect that most students will maintain a QPA of 3.5, a minimum of 3.2 must be maintained to remain in the program and will be acceptable only with a strong record of research. Candidates must also maintain a QPA of at least 3.0 in the five graduate level courses required for the degree.

Notes on Honors B.S./M.S. Electives

The B.S./M.S. Honors degree requires the completion of five graduate level courses. These normally are 12-unit courses. However, in order not to penalize interdisciplinary studies which may be essential to a good thesis, up to three of the five required graduate chemistry courses may be advanced undergraduate (9-unit) courses in MCS and/or CIT departments. All advanced undergraduate level courses used to satisfy this requirement must be approved by the Chemistry Department.

Curriculum — B.S. with Departmental Honors / M.S. in Chemistry

Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>03-121 Introduction to Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>09-116 Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>33-111 Physics for Science Students I</td>
<td>12</td>
</tr>
<tr>
<td>76-101 Interpretation and Argument</td>
<td>9</td>
</tr>
<tr>
<td>99-101 Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
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</tbody>
</table>

Sophomore Year

Students interested in majoring in chemistry should consider enrolling in the 3-unit lab course 09-101, Introduction to Experimental Chemistry, in the fall or spring semester of the freshman year. Although not required, the laboratory course is recommended for chemistry majors.

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>09-106 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>21-122 Integration, Differential Equations and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>33-112 Physics for Science Students II</td>
<td>12</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Distribution Course 1</td>
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<tr>
<td>Total</td>
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</table>

Summer Independent Study

Sophomore Year

<table>
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<tr>
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<tr>
<td>09-217 Organic Chemistry I</td>
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<td>09-231 Mathematical Methods for Chemists</td>
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<tr>
<td>09-221 Lab I: Introduction to Chemical Analysis</td>
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<td>09-201 Undergraduate Seminar I</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>09-202 Undergraduate Seminar II</td>
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</tr>
<tr>
<td>09-204 Issues in Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-222 Lab II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-218 Organic Chemistry II***</td>
<td>9</td>
</tr>
<tr>
<td>09-348 Inorganic Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Distribution Course 3</td>
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</tr>
<tr>
<td>Total</td>
<td>44</td>
</tr>
</tbody>
</table>

***A 3-unit course 09-220 Supramolecular Organic Chemistry is offered as an elective to compliment 09-218. (Enrollment Limited)

Summer

12 weeks Honors Research required
Your advisor.

Statistics courses may NOT be used. Also, 70-100 (Introduction to Accounting, finance, management, marketing, production, and economics) can be taken to fulfill the requirement for 09-231. Chemistry section) can be taken to fulfill the requirement for 09-231. (see notes on Honors B.S./M.S. electives)

Distribution of Units for the B.S. with Honors/M.S. Degrees

Minimum Total Chemistry Units (248, See distribution below)

Required Chemistry Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>09-105 Introduction to Modern Chemistry**</td>
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<td>09-106 Modern Chemistry II</td>
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<tr>
<td>09-204 Issues in Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-218 Organic Chemistry II</td>
<td>9</td>
</tr>
<tr>
<td>09-231 Mathematical Methods for Chemists***</td>
<td>9</td>
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<td>09-331 Modern Analytical Instrumentation</td>
<td>9</td>
</tr>
<tr>
<td>09-344 Physical Chemistry (Quantum)</td>
<td>9</td>
</tr>
<tr>
<td>09-345 Physical Chemistry (Thermo)</td>
<td>9</td>
</tr>
<tr>
<td>09-348 Inorganic Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>09-221 Lab I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-222 Lab II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-321 Lab III: Molecular Design and Synthesis</td>
<td>12</td>
</tr>
<tr>
<td>09-322 Lab IV: Molecular Spectroscopy and Dynamics</td>
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<tr>
<td>09-xxx Chemistry Seminars</td>
<td>8</td>
</tr>
<tr>
<td>Undergraduate Research (2 summers also required)</td>
<td>30</td>
</tr>
<tr>
<td>Graduate chemistry courses (see notes on B.S./M.S. electives)</td>
<td>60</td>
</tr>
<tr>
<td>Honors Thesis</td>
<td>15</td>
</tr>
</tbody>
</table>

Other Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>9</td>
</tr>
<tr>
<td>Computer Science</td>
<td>10</td>
</tr>
<tr>
<td>Mathematics</td>
<td>20</td>
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<tr>
<td>Physics</td>
<td>24</td>
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<tr>
<td>Humanities and Social Sciences or Fine arts courses</td>
<td>72</td>
</tr>
<tr>
<td>Computing Skills Workshop</td>
<td>3</td>
</tr>
</tbody>
</table>

Minimum number of units required for degrees: 386

Honors B.S./M.S. Program in Chemical Biology

Program Director: Dr. Bruce Armitage, Department of Chemistry

Our target audience is students with strong interests in careers in the pharmaceutical and biotechnology industries, as well as those who are undecided between such careers and graduate or medical school. They will have the opportunity to earn in 8 to 10 semesters not only the degree B.S. in Chemistry with Departmental Honors, but also the degree Master of Science in Chemical Biology. The program will have a 3-1-1 structure and will combine extensive research experience with Carnegie Mellon faculty and possibly substantial work with an industrial partner through internships and collaborations. Bristol Myers Squibb is already a partner in this program, sponsoring at least one student per year. This program is not appropriate for all students. Requirements include completing five graduate level courses as electives. Given the nature of this degree, the choices of electives are more restricted than the B.S./M.S. in Chemistry and are intended to strengthen the student’s background in chemical biology. (See notes on Honors B.S./M.S. in Chemical Biology electives.)

Like the more general B.S./M.S. program, the schedule of courses for this degree generally moves as many courses as possible ahead by one year. When possible, all Science Core Courses should be completed in the freshman year. This gives the student the following advantages: 1) greater perspective in selection of a research advisor, 2) greater maturity in performing independent research, and 3) the possibility of initiating graduate course sequences in the junior year. Students can achieve this accelerated schedule by advanced placement and summer school.

Interested students with suitable credentials will be encouraged to apply for summer internships to learn the culture and expectations of the pharmaceutical industry as early as possible. In addition, the early internships will provide information to the corporate sponsor to assist in selecting students to sponsor for the M.S. At least one summer internship or one summer of undergraduate research is required for admission to the program.

Formal application to the program will occur during the summer after the sophomore year. Corporate sponsors will set the criteria for their corporate sponsorship. In general, a GPA of 3.5 will be expected with a strong record of research productivity and strong written and oral communication skills. The student is expected to select a research advisor by May of the sophomore year and keep that advisor for the duration of the thesis project. Students with industry sponsorship will select an undergraduate research advisor who will collaborate with an industrial liaison to agree upon a suitable research project and serve as co-advisors. The student will be expected to work with this team of advisors for the duration of their thesis research.

NOTE: The Program Director will provide students with assistance in selecting an appropriate Carnegie Mellon advisor to fit with their interests. Advisors may come from the Department of Chemistry, Biological Sciences, Chemical Engineering, or Biomedical and Health Engineering.

A minimum of 3 semesters of undergraduate research is required (normally 10 units/semester) as is participation in group seminars during the junior and senior years. Students must present their research at least twice at the Sigma Xi competition at Meeting of the Minds, the annual Carnegie Mellon undergraduate research symposium. In addition students must meet with their Advisory Committee each fall to update the committee on their progress and in the fall of the senior year and the fifth year must prepare a written summary of their research progress to date (5 pages) and their plans for the academic year (1 page). This report must state clearly what stage the work is in; it must be clear which work is complete and ready for publication. The Advisory Committee is formed to monitor the progress of the project and offer suggestions and shall consist of at least one member of the departmental Honors Committee, the...
student’s research advisor, his/her industrial mentor and possibly an additional faculty member agreed upon by the student and advisor. This fourth member can be from another department or institution and can be tenure track, lecturer track or research track faculty.

All H&SS/CFA electives and free electives must be completed by the end of the fourth year so that students can focus on their graduate courses and spend at least 20 hours per week in research during the fifth year. Students with a corporate sponsor are expected to spend the spring semester of the fifth year and following summer in full-time research (with pay) working with their industrial co-advisor and writing the thesis. Students without a corporate sponsor may be able to complete their course requirements and thesis in the ninth semester if their research productivity is outstanding. Students who wish to explore this option are encouraged to begin their research/ internships as early as possible.

At the start of their final semester, the student must submit a draft of the introduction for their thesis and a detailed outline of their methods, results and discussion sections to the department undergraduate program coordinator. This will be distributed by the program coordinator and reviewed by the student’s Advisory Committee. In April of the fifth year the Advisory Committee will evaluate the written thesis and students are required to present their final oral defense of the project before the Advisory Committee.

Each student is required to submit a formal Masters Degree dissertation to the Chemistry Department. The dissertation, written in proper scientific format should describe the research project in considerable detail and must withstand the scrutiny of the Advisory Committee with respect to completeness. It need not be as extensive nor contain the element of student originality characteristic of a Ph.D. thesis; however it must contain results and conclusions that are of a high enough quality to be accepted as a publication in a respected research journal. As for all M.S. degree candidates in the Department, the dissertation must be approved by the faculty member in charge of the work and the Department Head. The final version of the thesis submitted to the Department must be bound in a hard-cover format.

Research productivity is the most important criterion for success at the evaluation points, but QPA is a strong secondary criterion. While we expect that most students will maintain a QPA of 3.5, a minimum of 3.2 must be maintained to remain in the program and will be acceptable only with a strong record of research.

Candidates must also maintain a QPA of at least 3.0 in the five graduate level courses required for the degree.

Notes on Honors B.S./M.S. in Chemical Biology Electives

During the junior and senior years, students must complete a sequence of courses to strengthen their background in chemical biology. These are described below.

2 required courses:

- 03-231 Biochemistry
- 03-439 Physical Biochemistry

plus 1 additional course from the following list:

- 03-330 Genetics (note 03-240 is a prerequisite for 03-330)
- 03-240 Cell Biology
- 03-344 Experimental Biochemistry
- 03-740 Advanced Biochemistry
- 42-500 Physiology
- 42-603 Biomaterials

In addition the B.S./M.S. in Chemical Biology degree requires the completion of five graduate level courses. These normally are 12-unit courses. However, in order not to penalize interdisciplinary studies which may be essential to a good thesis, up to three of the five required graduate chemistry courses may be advanced undergraduate (9 unit) courses in MCS and/or CIT departments. All advanced undergraduate level courses used to satisfy this requirement must be approved by the Chemistry Department. Four of the electives must come from the following list. Substitutions must be approved by the Program Director.

- 03-718 Bioorganic Chemistry: Nucleic Acids and Carbohydrates
- 03-719 Bioorganic Chemistry: Amino Acids, Proteins and Combinatorial Chemistry
- 03-721 Bioinorganic Chemistry
- 03-714 Advanced Organic Chemistry
- 03-711 Physical Organic Chemistry
- 03-841 Spectroscopy
- 03-560 Computational Chemistry
- 03-571 Structural Biophysics

Introduction to Magnetic Resonance Principles of Pharmacology (University of Pittsburgh)

Curriculum — B.S. with Departmental Honors / M.S. in Chemical Biology

Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-121 Introduction to Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>09-105 Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>33-111 Physics I for Science Students</td>
<td>12</td>
</tr>
<tr>
<td>76-101 Interpretation and Argument</td>
<td>9</td>
</tr>
<tr>
<td>99-101 Computing Skills Workshop</td>
<td>3</td>
</tr>
</tbody>
</table>

44

Students interested in majoring in chemistry should consider enrolling in the 3-unit lab course 09-101, Introduction to Experimental Chemistry, in the fall or spring semester of the freshman year. Although not required, the laboratory course is recommended for chemistry majors.

Spring

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-106 Modern Chemistry II</td>
</tr>
<tr>
<td>21-122 Integration, Differential Equations and Approximation</td>
</tr>
<tr>
<td>33-112 Physics II for Science Students</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Distribution Course 1</td>
</tr>
</tbody>
</table>

51

An optional 3-unit Freshman Chemistry Seminar, 09-102, is offered to MCS students in the spring semester. Chemistry faculty discuss special topics in modern chemistry.

Summer

Summer internship or summer research recommended.

Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-231 Mathematical Methods for Chemists</td>
<td>9</td>
</tr>
<tr>
<td>09-221 Lab I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>03-231 Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-201 Undergraduate Seminar I</td>
<td>1</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Distribution Course 2</td>
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49

Spring

<table>
<thead>
<tr>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>09-202 Undergraduate Seminar II</td>
</tr>
<tr>
<td>09-204 Issues in Chemistry</td>
</tr>
<tr>
<td>09-222 Lab II: Organic Synthesis and Analysis</td>
</tr>
<tr>
<td>09-218 Organic Chemistry II***</td>
</tr>
<tr>
<td>09-348 Inorganic Chemistry</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Distribution Course 3</td>
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</tbody>
</table>

44

***A 3 unit course 09-220 Supramolecular Organic Chemistry is offered as an elective to compliment 09-218. (Enrollment Limited)

Summer

Summer internship or summer research recommended. Interested students could formally apply to this B.S./M.S. program.

Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>09-301 Undergraduate Seminar III</td>
<td>1</td>
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<tr>
<td>09-321 Lab III: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-344 Physical Chemistry (Quantum)</td>
<td>9</td>
</tr>
<tr>
<td>09-331 Modern Analytical Instrumentation</td>
<td>9</td>
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<tr>
<td>09-445 Undergraduate Research or Program Elective</td>
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<tr>
<td>xx-xxx H&amp;SS/CFA Elective 1 (of 4)**</td>
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50

Spring

<table>
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<tr>
<th>Units</th>
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<tbody>
<tr>
<td>09-302 Undergraduate Seminar IV</td>
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<tr>
<td>09-322 Lab IV: Molecular Spectroscopy and Dynamics</td>
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<td>09-445 Undergraduate Research or Program Elective</td>
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<tr>
<td>xx-xxx Graduate Course (see notes on Honors B.S./M.S. electives)</td>
</tr>
<tr>
<td>09-345 Physical Chemistry (Thermo)</td>
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<td>xx-xxx H&amp;SS/CFA Elective 2 (of 4)**</td>
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53

Summer

Summer internship or undergraduate research required.
Senior Year

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<tbody>
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<td>09-402 Undergraduate Seminar VI</td>
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<tr>
<td>03-438 Physical Biochemistry</td>
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<tr>
<td>09-445 Undergraduate Research</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx Graduate Course</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx H&amp;S/CFA Elective 3 (of 4)*</td>
<td>9</td>
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<tr>
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<td>43</td>
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<table>
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<tbody>
<tr>
<td>09-401 Undergraduate Seminar V</td>
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<tr>
<td>xx-xxx Graduate Course</td>
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<td>xx-xxx Graduate Course</td>
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<tr>
<td>xx-xxx Program Elective</td>
<td>9</td>
</tr>
<tr>
<td>09-445 Undergraduate Research</td>
<td>10</td>
</tr>
<tr>
<td>xxx-xxx H&amp;S/CFA Elective 4 (of 4)*</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>48</td>
</tr>
</tbody>
</table>

Fifth Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxx-xxx Graduate Course</td>
<td>12</td>
</tr>
<tr>
<td>xxx-xxx Graduate Course</td>
<td>12</td>
</tr>
<tr>
<td>09-861 Chemical Research</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>44</td>
</tr>
</tbody>
</table>

Spring

Cooperative semester with corporate sponsor. Thesis research and committee defense.

* Certain non-technical courses from Business Administration, Heinz School, and EPP also may be used. A listing of approved and non-approved courses for the H&S/CFA electives is available at the following web site, www.cmu.edu/mcs/education/edu_HSSPA.html, or see the Mellon College of Science section in this catalog for the Humanities and Social Sciences and Fine Arts Requirements. Accounting, finance, management, marketing, production, and statistics courses may NOT be used. Also, 70-100 (Introduction to Business) and 85-219 (Biological Foundations of Behavior) may NOT be used as electives in the H&S/CFA category. If in doubt, check with your advisor.

Distribution of Units for the B.S. with Honors/M.S. Degrees

Minimum Total Chemistry Units (275, See distribution below)

<table>
<thead>
<tr>
<th>Required Chemistry and Biology Courses</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105 Introduction to Modern Chemistry**</td>
<td>10</td>
</tr>
<tr>
<td>09-106 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>09-204 Issues in Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-218 Organic Chemistry II</td>
<td>9</td>
</tr>
<tr>
<td>09-231 Mathematical Methods for Chemists***</td>
<td>9</td>
</tr>
<tr>
<td>09-331 Modern Analytical Instrumentation</td>
<td>9</td>
</tr>
<tr>
<td>09-344 Physical Chemistry (Quantum)</td>
<td>9</td>
</tr>
<tr>
<td>09-345 Physical Chemistry (Thermo)</td>
<td>9</td>
</tr>
<tr>
<td>09-348 Inorganic Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>09-221 Lab I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-222 Lab II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-321 Lab III: Molecular Design and Synthesis</td>
<td>12</td>
</tr>
<tr>
<td>09-322 Lab IV: Molecular Spectroscopy and Dynamics</td>
<td>12</td>
</tr>
<tr>
<td>03-321 Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-438 Physical Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Program Elective</td>
<td>9</td>
</tr>
<tr>
<td>09-xxx Chemistry Seminars</td>
<td>8</td>
</tr>
<tr>
<td>Undergraduate Research (2 summers also required)</td>
<td>30</td>
</tr>
<tr>
<td>Graduate chemistry courses (see notes on B.S./M.S. electives)</td>
<td>60</td>
</tr>
<tr>
<td>Honors Thesis</td>
<td>15</td>
</tr>
</tbody>
</table>

** 09-107, Honors Chemistry, may be taken instead of 09-105.
*** 21-259, Calculus in Three Dimensions, and an additional Mathematics/Statistics Elective (see Notes on Electives in the B.S. in Chemistry section) can be taken to fulfill the requirement for 09-231.

Other Requirements

<table>
<thead>
<tr>
<th>Biology</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

Computer Science 10
Mathematics 20
Physics 24
Humanities and Social Sciences or Fine Arts courses 72
Computing Skills Workshop 3

Minimum number of units required for degrees: 413

B.S. in Chemistry/Computational Chemistry Track

The use of computers is ubiquitous in chemistry. Theoretical chemists run large “number-crunching” programs on supercomputers to understand molecular properties. Experimental physical chemists use computers to fit data to their models. Organic and inorganic chemists use computers to plan complex sequences of reactions and predict 3D structures and properties of molecules. Analytical chemists use microprocessors to control instruments and robots to perform repetitive processes.

Computer science will play a growing role in chemistry in the future, but very few people without a Ph.D. degree have the background in both fields that is necessary to make an impact. The B.S. in Chemistry/Computational Chemistry Track degree is a response to society’s need for bachelor’s degree scientists who can apply computational sophistication to the practical problems of science. It is simultaneously a response to the large number of students who want not merely to learn computer science, but to apply that expertise in a subject area that gives them an edge in the job market.

As the student builds expertise in chemistry by taking the full B.S. curriculum, elective courses are devoted to mathematics and computer science. This culminates with 09-560, Computational Chemistry, which affords an overview of the areas of overlap of computer science with chemistry.

The degree designation on the transcript of students who complete the requirements for this program is: B.S. in Chemistry/Computational Chemistry Track. The track is not noted on the diploma.

Curriculum — B.S. in Chemistry/Computational Chemistry Track

Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105 Introduction to Modern Chemistry**</td>
<td>10</td>
</tr>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>33-111 Physics I for Science Students</td>
<td>12</td>
</tr>
<tr>
<td>76-101 Interpretation and Argument</td>
<td>9</td>
</tr>
<tr>
<td>99-101 Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>44</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>09-106 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>15-100+ Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>21-122 Integration, Differential Equations and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>33-112 Physics II for Science Students</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx H&amp;S Distribution Course 1</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>51</td>
</tr>
</tbody>
</table>

+ Students with prior programming experience should take 15-111 Intermediate/Advanced Programming. Students can then take 15-211 in the sophomore year. Those who take 15-100 will need to take 15-200 in the fall of the sophomore year to prepare for 15-211.

An optional 3-unit Freshman Chemistry Seminar, 09-102, is offered to MCS students in the spring semester. Chemistry faculty discuss special topics in modern chemistry.

Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-201 Undergraduate Seminar I</td>
<td>1</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-221 Lab I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>21-127 Concepts of Mathematics</td>
<td>9</td>
</tr>
<tr>
<td>15-200 Data Structures</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;S Distribution Course 2</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>49</td>
</tr>
</tbody>
</table>
Others may be used with departmental approval.

These may be chosen from the following list of courses.

Each student in the Computational Chemistry Track is required to complete two upper level mathematics and/or computer science electives. These may be chosen from the following list of courses.

- 09-202 Undergraduate Seminar II
- 09-204 Issues in Chemistry
- 09-222 Lab II: Organic Synthesis and Analysis
- 09-218 Organic Chemistry II
- 21-259 Calculus in Three Dimensions ++
- 15-211 Fundamental Data Structures and Algorithms
- xx-xxx H&SS Distribution Course 3

** 09-231, Mathematical Methods for Chemists can be taken in lieu of 21-259. Note that 09-231 is offered only in the fall.

Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-301 Undergraduate Seminar IIIº</td>
<td>1</td>
</tr>
<tr>
<td>09-321 Lab III: Molecular Design and Synthesis</td>
<td>12</td>
</tr>
<tr>
<td>09-344 Physical Chemistry (Quantum)</td>
<td>9</td>
</tr>
<tr>
<td>09-331 Modern Analytical Instrumentation</td>
<td>9</td>
</tr>
<tr>
<td>15-212 Principles of Programming</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS/CFA Elective 1 (of 4)*</td>
<td>9</td>
</tr>
<tr>
<td>** 09-302 Undergraduate Seminar IVº</td>
<td>1</td>
</tr>
<tr>
<td>09-322 Lab IV: Molecular Spectroscopy and Dynamics</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx Computing Elective</td>
<td>9</td>
</tr>
<tr>
<td>03-121 Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS/CFA Elective 2 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-401 Undergraduate Seminar V</td>
<td>1</td>
</tr>
<tr>
<td>09-560 Computational Chemistry**</td>
<td>12</td>
</tr>
<tr>
<td>09-xxx Chemistry Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS/CFA Elective 3 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

* Note that for this track 09-301 and 302 are not formally required, however you are encouraged to attend. These two courses are required for all other programs in chemistry.

Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-402 Undergraduate Seminar VI</td>
<td>3</td>
</tr>
<tr>
<td>09-348 Inorganic Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx Computing Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS/CFA Elective 4 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-381 Artificial Intelligence: Representation and Problem Solving</td>
<td>9</td>
</tr>
<tr>
<td>15-384 Artificial Intelligence: Robotic Manipulation</td>
<td>9</td>
</tr>
<tr>
<td>15-385 Artificial Intelligence: Computer Vision</td>
<td>9</td>
</tr>
<tr>
<td>15-467 Computer Graphics (or equivalent)</td>
<td>9</td>
</tr>
<tr>
<td>15-xxx Approved Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

++ 09-231, Mathematical Methods for Chemists can be taken in lieu of 21-259. Note that 09-231 is offered only in the fall.

Distribution of Units for the B.S. in Chemistry/Computational Chemistry Track

Minimum Total Chemistry Units (153; See distribution below)

<table>
<thead>
<tr>
<th>Required Chemistry Courses</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105 Introduction to Modern Chemistry**</td>
<td>10</td>
</tr>
<tr>
<td>09-106 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>09-204 Issues in Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-218 Organic Chemistry II</td>
<td>9</td>
</tr>
<tr>
<td>09-331 Modern Analytical Instrumentation</td>
<td>9</td>
</tr>
<tr>
<td>09-344 Physical Chemistry (Quantum)</td>
<td>9</td>
</tr>
<tr>
<td>09-345 Physical Chemistry (Thermo)</td>
<td>9</td>
</tr>
<tr>
<td>09-348 Inorganic Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>09-221 Lab II: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-222 Lab II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-321 Lab III: Molecular Design and Synthesis</td>
<td>12</td>
</tr>
<tr>
<td>09-322 Lab IV: Molecular Spectroscopy and Dynamics</td>
<td>12</td>
</tr>
<tr>
<td>09-560 Computational Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>09-xxx Chemistry Seminars</td>
<td>6</td>
</tr>
<tr>
<td>09-xxx Chemistry Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

** 09-107, Honors Chemistry, may be taken instead of 09-105.

Other Requirements

- Biology | 9
- Computer Science | 43
- Mathematics | 38
- Physics | 24
- Humanities and Social Sciences or Fine Arts courses | 72
- Computing or Math Electives | 18
- Computing Skills Workshop | 3

Minimum number of units for the degree: 360

The above B.S. curriculum recommends an average course load of 37-55 units/semester. The total units will exceed the 360 unit minimum, but students are strongly encouraged to take the extra elective courses in whatever subjects they wish in order to enrich their backgrounds and enhance their educational experience.

B.A. in Chemistry

The curriculum for the B.A. degree provides students with the opportunity to take a substantial number of elective and non-technical courses. Certain chemistry, math, and other technical courses required for the B.S. degree are replaced by free electives, making this degree an ideal choice for those who wish to earn an additional major with one of the departments in the College of Humanities and Social Sciences, College of Fine Arts, or with the Business Administration program. It is not possible to combine the B.A. degree in chemistry with an additional B. A. degree in another department in MCS (e.g. Biological Sciences). Students may earn one or more of the options as described for B.S. degree candidates, providing they complete the courses listed.

The suggested curriculum recommends that the required technical courses be completed at the earliest opportunity, however students have considerable flexibility to postpone these courses in favor of electives, allowing compatibility with the programs of other departments. In designing such programs for a minor or additional major with chemistry, students should note that certain required chemistry courses only are offered in specific semesters, not both. These include the fall-only courses: 09-217 (Organic Chemistry I) and 09-321 (Laboratory III: Molecular Design and Synthesis); and the spring-only courses: 09-214 (Physical Chemistry), 09-218 (Organic...
Chemistry II), 09-348 (Inorganic Chemistry), 09-204 (Issues in Chemistry) and 09-222 (Laboratory II: Organic Synthesis and Analysis). Also, in some cases, a course that is normally scheduled for the fall may be changed to a spring course (or vice versa) due to a departmental curriculum change.

**Curriculum — B.A. in Chemistry**

### Freshman Year

#### Fall (Four Course Schedule) | Units
---|---
09-105 | 10
21-120 | 10
33-111 | 12
76-101 | 9
99-101 | 3

Total: 44 units

Students interested in majoring in chemistry should consider enrolling in the 3-unit lab course 09-101, Introduction to Experimental Chemistry, in the fall or spring semester of the freshman year. Although not required, the laboratory course is recommended for chemistry majors.

#### Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-106</td>
<td>10</td>
</tr>
<tr>
<td>15-100</td>
<td>10</td>
</tr>
<tr>
<td>33-112</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
</tbody>
</table>

Total: 51 units

An optional 3 unit Freshman Chemistry Seminar, 09-102, is offered to MCS students in the spring semester. Chemistry faculty discuss special topics in modern chemistry.

### Sophomore Year

#### Fall

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-201</td>
<td>1</td>
</tr>
<tr>
<td>09-217</td>
<td>9</td>
</tr>
<tr>
<td>09-221</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
</tbody>
</table>

Total: 40 units

#### Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-202</td>
<td>1</td>
</tr>
<tr>
<td>09-204</td>
<td>3</td>
</tr>
<tr>
<td>09-218</td>
<td>9</td>
</tr>
<tr>
<td>09-222</td>
<td>12</td>
</tr>
<tr>
<td>09-214</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
</tbody>
</table>

Total: 43 units

***A 3-unit course 09-220 Supramolecular Organic Chemistry is offered as an elective to complement 09-218. (Enrollment Limited)***

### Junior Year

#### Fall

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-301</td>
<td>1</td>
</tr>
<tr>
<td>09-321</td>
<td>12</td>
</tr>
<tr>
<td>09-xxx</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
</tbody>
</table>

Total: 49 units

#### Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-302</td>
<td>1</td>
</tr>
<tr>
<td>09-348</td>
<td>10</td>
</tr>
<tr>
<td>09-xxx</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
</tbody>
</table>

Total: 47 units

### Senior Year

#### Fall

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-401</td>
<td>1</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>36</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
</tbody>
</table>

Total: 46 units

### Distribution of Units for the B.A. Degree

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-402</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>28</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>9</td>
</tr>
</tbody>
</table>

Total: 40 units

* Certain non-technical courses from Business Administration, Heinz School, and EPP also may be used. A listing of approved and non-approved courses for the H&SS/CFA electives is available at the following web site, www.cmu.edu/mcs/education/edu_HSSFA.html, or see the Mellon College of Science section in this catalog for the Humanities and Social Sciences and Fine Arts Requirements.

Accounting, finance, management, marketing, production, and statistics courses may NOT be used. Also, 70-100 (Introduction to Business) and 85-219 (Biological Foundations of Behavior) may NOT be used as electives in the H&SS/CFA category. If in doubt, check with your advisor.

### Requirements for a Minor in Chemistry

In order for a student to receive the added designation ". . . with a Minor in Chemistry" in conjunction with a B.S. or B.A. degree from another (primary) department, the successful completion of six courses as distributed below is required. Students pursuing the minor must inform the Chemistry Department of their intentions in writing so that the minor designation can be approved prior to graduation. This requires submission of a form for declaring a minor. The form may be obtained in the department office, DH 1317.

#### A. Four Required Core Courses

1. 09-106 Modern Chemistry II
2. 09-221 Laboratory I: Introduction to Chemical Analysis
3. 09-217 Organic Chemistry I
4. Choice of one of the following courses.
   - 09-348 Inorganic Chemistry
   - 09-344 Physical Chemistry (Quantum)
   - 09-345 Physical Chemistry (Thermo)
   - 09-347 Advanced Physical Chemistry**
   - 09-214 Physical Chemistry

## Minimum number of units for the degree: 360

The above B.A. curriculum recommends an average course load of 40-51 units/semester. The total units will exceed the 360 unit minimum, but students are strongly encouraged to take the extra elective courses in whatever subjects they wish in order to enrich their backgrounds and enhance their educational experience.
*Courses in this group that are not used to satisfy Part A core courses (section 4) may be used to satisfy elective course requirements in part B below, if they are not required by the student’s primary department. However the only combination of physical chemistry courses (09-344, 09-345, 09-347 and 09-214) that is allowed is 09-344 and 09-345.

**Enrollment in this course is only open to students majoring in chemical engineering.

B. Two Elective Courses from the following list.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-344</td>
<td>Physical Chemistry (Quantum) or</td>
</tr>
<tr>
<td>09-214</td>
<td>Physical Chemistry</td>
</tr>
<tr>
<td>09-345</td>
<td>Physical Chemistry (Thermo)</td>
</tr>
<tr>
<td>09-348</td>
<td>Inorganic Chemistry</td>
</tr>
<tr>
<td>09-222</td>
<td>Laboratory II: Organic Synthesis and Analysis</td>
</tr>
<tr>
<td>09-321</td>
<td>Laboratory III: Molecular Design and Synthesis</td>
</tr>
<tr>
<td>09-218</td>
<td>Organic Chemistry II</td>
</tr>
<tr>
<td>03-231/232</td>
<td>Biochemistry I</td>
</tr>
<tr>
<td>09-xxx</td>
<td>Approved Upper Level Chemistry Course</td>
</tr>
</tbody>
</table>

Courses in this section (part B above) can not be counted toward the minor if they are required in any way by the student’s primary department or towards an additional major or minor other than as a free elective. For example, students majoring in Biological Sciences can not double count 09-214, 03-231 (or -232), 09-222, or 09-218 toward the elective courses for the minor in chemistry. Chemical engineering majors can not count 03-231 (or -232) or a chemistry course that is used to satisfy that department’s required chemistry or advanced chem/biochem elective. Also, chemical engineering majors can not use 09-344, 09-345 or 09-214 due to the similarity of these courses to courses required by the chemical engineering department. 09-231, Mathematical Methods for Chemists, does not count towards the minor in chemistry. The undergraduate research course, 09-445, cannot be used for the minor.

Other Programs

As part of the undergraduate degree program, chemistry majors have the opportunity to pursue various special programs at Carnegie Mellon to enrich their academic experience. These include but are not limited to: programs with the College of Fine Arts, Humanities and Social Sciences, the H. John Heinz School of Public Policy and Management; Interdisciplinary Majors and Minors including Health Care Policy and Management, and Secondary Education and Teacher Certification. For more details, see the Tailoring Your Education portion of the Mellon College of Science section in this catalog.

Faculty

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATALINA ACHIM</td>
<td>Assistant Professor of Chemistry—Ph.D., Carnegie Mellon; Carnegie Mellon, 2001—</td>
</tr>
<tr>
<td>BRUCE A. ARMITAGE</td>
<td>Associate Professor of Chemistry—Ph.D., University of Arizona; Carnegie Mellon, 1997—</td>
</tr>
<tr>
<td>GUY C. BERRY</td>
<td>University Professor of Chemistry and Polymer Science, Emeritus—Ph.D., University of Michigan; Carnegie Mellon, 1960—</td>
</tr>
<tr>
<td>MARK E. BIER</td>
<td>Associate Research Professor and Director, Center for Molecular Analysis—Ph.D., Purdue University; Carnegie Mellon, 1996—</td>
</tr>
<tr>
<td>EMILLE BOMINAAR</td>
<td>Associate Research Professor—Ph.D., University of Amsterdam (The Netherlands); Carnegie Mellon, 1994—</td>
</tr>
<tr>
<td>AKSEL A. BOTHNER-BY</td>
<td>University Professor of Chemistry, Emeritus—Ph.D., Harvard University; Carnegie Mellon, 1958—</td>
</tr>
<tr>
<td>WILLIAM E. BROWN</td>
<td>Professor of Biological Sciences—Ph.D., University of Minnesota; Carnegie Mellon, 1973—</td>
</tr>
<tr>
<td>ALBERT A. CARETTO JR.</td>
<td>Professor of Chemistry, Emeritus—Ph.D., University of Rochester; Carnegie Mellon, 1959—</td>
</tr>
<tr>
<td>EDWARD F. CASASSA</td>
<td>Professor of Chemistry, Emeritus—Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1956—</td>
</tr>
<tr>
<td>TERRENC E J. COLLINS</td>
<td>Thomas Lord Professor of Chemistry and Director, Institute for Green Oxidation Chemistry—Ph.D., University of Auckland, New Zealand; Carnegie Mellon, 1987—</td>
</tr>
<tr>
<td>JOSEF DADOK</td>
<td>Professor of Chemical Instrumentation, Emeritus—Ph.D., Czechoslovak Academy of Sciences; Carnegie Mellon, 1967—</td>
</tr>
<tr>
<td>NEIL M. DONAHUE</td>
<td>Assistant Professor Chemistry and Chemical Engineering—Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2000—</td>
</tr>
<tr>
<td>REBECCA FREELAND</td>
<td>Associate Dean, Mellon College of Science and Associate Head, Department of Chemistry—Ph.D., Carnegie Mellon; Carnegie Mellon, 1993—</td>
</tr>
<tr>
<td>ANDREW GELLMAN</td>
<td>Lord Professor of Chemical Engineering and Professor of Chemistry—Ph.D., University of California, Berkeley; Carnegie Mellon, 1992—</td>
</tr>
<tr>
<td>SUSAN T. GRAUL</td>
<td>Lecturer—Ph.D., Purdue University; Carnegie Mellon, 1992—</td>
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<tr>
<td>MICHAEL P. HENDRICH</td>
<td>Associate Professor of Chemistry—Ph.D., University of Illinois; Carnegie Mellon, 1994—</td>
</tr>
<tr>
<td>COLIN HORWITZ</td>
<td>Research Professor—Ph.D., Northwestern University; Carnegie Mellon, 1993—</td>
</tr>
<tr>
<td>MORTON KAPLAN</td>
<td>Professor of Chemistry—Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1970—</td>
</tr>
<tr>
<td>PAUL J. KAROL</td>
<td>Professor of Chemistry—Ph.D., Columbia University; Carnegie Mellon, 1969—</td>
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<tr>
<td>ROBERT L. KAY</td>
<td>Professor of Chemistry, Emeritus—Ph.D., University of Toronto; Carnegie Mellon, 1963—</td>
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<tr>
<td>HYUNG J. KIM</td>
<td>Professor of Chemistry and Head, Department of Chemistry—Ph.D., State University of New York at Stony Brook; Carnegie Mellon, 1992—</td>
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<tr>
<td>TOMASZ KOWALEWSKI</td>
<td>Assistant Professor of Chemistry—Ph.D., Polish Academy of Sciences: Carnegie Mellon, 2000—</td>
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<tr>
<td>MARIA KURNIKOVA</td>
<td>Assistant Professor of Chemistry—Ph.D., Pittsburgh; Carnegie Mellon, 2003—</td>
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<tr>
<td>MIGUEL LLINAS</td>
<td>Professor of Chemistry—Ph.D., University of California at Berkeley; Carnegie Mellon, 1976—</td>
</tr>
<tr>
<td>DANITH LY</td>
<td>Assistant Professor of Chemistry—Ph.D., Georgia Tech; Carnegie Mellon, 2001—</td>
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<tr>
<td>KRZYSZTOF MATYJASZEWSKI</td>
<td>University Professor and J. C. Warner Professor of Natural Sciences and Director, Center for Macromolecular Engineering—Ph.D., Polish Academy of Sciences; Carnegie Mellon, 1985—</td>
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<tr>
<td>RICHARD D. McCulloUGH</td>
<td>Professor of Chemistry and Dean, Mellon College of Science—Ph.D., Johns Hopkins University; Carnegie Mellon, 1990—</td>
</tr>
<tr>
<td>ECKARD MUNCK</td>
<td>Professor of Chemistry—Ph.D., Technical University of Darmstadt (Germany); Carnegie Mellon, 1990—</td>
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<tr>
<td>GARY D. PATTERSON</td>
<td>Professor of Chemistry—Ph.D., Stanford University; Carnegie Mellon, 1984—</td>
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<tr>
<td>LINDA A. PETEANU</td>
<td>Associate Professor of Chemistry—Ph.D., University of Chicago; Carnegie Mellon, 1992—</td>
</tr>
<tr>
<td>STUART W. STALEY</td>
<td>Professor of Chemistry—Ph.D., Yale University; Carnegie Mellon, 1986—</td>
</tr>
<tr>
<td>ROBERT F. STEWART</td>
<td>Professor of Chemistry—Ph.D., California Institute of Technology; Carnegie Mellon, 1978—</td>
</tr>
<tr>
<td>KAREN H. STUMP</td>
<td>Teaching Professor and Director of Undergraduate Studies and Director of Laboratories—M.S., Carnegie Mellon University; Carnegie Mellon, 1983—</td>
</tr>
<tr>
<td>CHARLES H. VAN DYKE</td>
<td>Associate Professor of Chemistry—Ph.D., University of Pennsylvania; Carnegie Mellon, 1963—</td>
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<tr>
<td>LYNN WALKER</td>
<td>Associate Professor of Chemical Engineering and Chemistry, Ph.D.—University of Delaware; Carnegie Mellon, 1997—</td>
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<tr>
<td>GARRY F. P. WARNOCK</td>
<td>Associate Teaching Professor—Ph.D., University of Minnesota; Carnegie Mellon, 1997—</td>
</tr>
<tr>
<td>NEWELL WASHBURN</td>
<td>Assistant Professor of Chemistry—Ph.D., University of California, Berkeley; Carnegie Mellon, 2004—</td>
</tr>
<tr>
<td>DAVID YARON</td>
<td>Associate Professor of Chemistry—Ph.D., Harvard University; Carnegie Mellon, 1992—</td>
</tr>
</tbody>
</table>

Department of Chemistry 303
Department of Mathematical Sciences

Roy A. Nicolaides, Head
Russell C. Walker, Associate Head
Office: Wean Hall 6113

Mathematics provides much of the language and quantitative underpinnings of the natural and social sciences, and mathematical scientists have been responsible for the development of many of the most commonly used tools in business management as well as for laying the foundation for computational and computer science. The name of the Department of Mathematical Sciences reflects its tradition of outstanding research and teaching of applicable mathematics relating to these areas. Indeed, the Department is consistently ranked among the top 15 departments of Applied Mathematics and Mathematical Sciences. We also note that our Logic group was ranked number 11 nationally. These research strengths are reflected in the variety of options that the Department provides for its undergraduate majors.

The Department offers a B.S. in Mathematics degree and the B.S. in Mathematical Sciences degree with concentrations in Mathematics, Operations Research, Statistics, Discrete Mathematics and Logic, and Computational and Applied Mathematics.

The B.S. in Mathematics curriculum is the least structured of our programs in recognition of the wide variety of interests that can be productively coupled with the study of mathematical sciences. It can be an appropriate choice for students planning for graduate study in mathematics or seeking to design their curriculum to take advantage of the many opportunities for a second major from another department in the University.

The Operations Research Concentration prepares students to enter an area expected to be among the growth occupations over the next decade. Mathematicians with a background in operations research are especially valuable in such diverse activities as project planning, production scheduling, market forecasting and finance. Such applications are found in virtually all industrial and governmental settings.

The Statistics Concentration prepares students to contribute to a wide variety of research areas. Applications range from experimental design and data analysis in the physical and social sciences, medicine and engineering, to modelling and forecasting in business and government, to actuarial applications in the financial and insurance industries. This is also a useful second major for students planning for graduate study and research in subject areas requiring a strong statistical background.

The Discrete Mathematics and Logic Concentration is designed to provide the necessary mathematical background for students who want to participate in the modern developments flowing from the computer. This concentration includes a strong component of computer science.

Finally, the Computational and Applied Mathematics Concentration provides the background needed to support the computational and mathematical analysis needs of a wide variety of businesses and industries and is well suited to students with an interest in the physical sciences and engineering.

The Department places great emphasis on the advising of students. The Department offers special opportunities for the exceptionally well-prepared and intellectually ambitious student.

The first year of calculus is offered in a flexible format to allow placement of entering students appropriate for their background. In addition to the standard sequence 21-120 followed by 21-122, 21-123 allows students to start half-way through 21-122.

Mathematical Science majors are required to complete an introductory computer science course, either 15-100 or 15-111. Students who plan to take further computer science courses must complete 15-111.

Finally, a joint program with the Heinz School of Public Policy and Management leads to the degree Bachelor of Science in Computational Finance.

These programs are described in the catalog section on Interdisciplinary programs.

Curricula

For each concentration, we provide a list of the requirements and a suggested schedule that takes prerequisites into account. A Mathematical Science, Statistics, or Computer Science Elective refers to a course from any of the Departments of Mathematical Sciences, Statistics or Computer Science. The only restrictions on these electives are that a mathematical sciences course must be beyond the calculus sequence and a statistics course must have at least 36-225 as a prerequisite.

The Bachelor of Science and Arts program allows a student to combine mathematics with any of the five schools in the College of Fine Arts.

The Science and Humanities Scholars program includes an option shared with the Statistics Department in the Humanities and Social Sciences College that leads to a BS in Mathematics and Statistics.

Mathematical Studies

Following the Analysis sequence, we offer 21-235/236 Mathematical Studies I/II. This pair of intensive courses is team taught with a typical enrollment of about 20 students, allowing for close contact with faculty. Mathematical Studies provides an excellent preparation for graduate study, with many of the participants taking graduate courses as early as their Junior year. Admission to Mathematical Studies is by invitation, and interested students should apply during the Spring of their Freshman year.

Honors Degree Program

This demanding four-year curriculum qualifies the student for two degrees: The Bachelor of Science and the Master of Science in Mathematical Sciences. This program typically includes the Mathematical Studies sequence, the Master of Science degree may be earned together with a Bachelor of Science from another department.

Interdisciplinary Programs

Several interdisciplinary options enable a student to combine mathematics with other disciplines.

The Bachelor of Science and Arts program allows a student to combine mathematics with study in any of the five schools in the College of Fine Arts.

The Science and Humanities Scholars program includes an option shared with the Statistics Department in the Humanities and Social Sciences College that leads to a BS in Mathematics and Statistics.

Finally, a joint program with the Heinz School of Public Policy and Management leads to the degree Bachelor of Science in Computational Finance.

These programs are described in the catalog section on Interdisciplinary programs.

Special options within the Department

The Department offers special opportunities for the exceptionally well-prepared and intellectually ambitious student. These options are available to students from any department in the University.

Analysis

For selected Freshmen entering the University, we offer 21-131/132 Analysis I/II, a more rigorous version of the first two semesters of calculus. Typically, a student choosing the Analysis Option has mastered the operational aspects of calculus and now seeks a deeper conceptual understanding.
Mathematics Degree

This program is the most flexible available to our majors. The flexibility to choose eight electives within the major plus seven humanities courses and seven free electives allows the student to design a program to suit his or her individual needs and interests. The requirements for the Mathematics Degree are:

Mathematical Sciences

21-120 Differential and Integral Calculus
21-122 Integration, Differential Equations and Approximation
21-127 Concepts of Mathematics
21-201 Undergraduate Colloquium
21-228 Discrete Mathematics (or 21-301 or 21-484)
21-341 Linear Algebra I
21-259 Calculus in Three Dimensions
21-260 Differential Equations
21-355 Principles of Real Analysis I
21-356 Principles of Real Analysis II
21-373 Algebraic Structures

five Mathematical Sciences electives

Other courses

15-100 Introductory/Intermediate Programming
36-225 Introduction to Probability and Statistics I or 21-325

three Mathematical Sciences, Statistics, or Computer Science electives

MCS humanities, social science, and science core (114 units)

seven free electives

Suggested Schedule

Freshman Year

Fall

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
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<tr>
<td>33-111 Physics for Science Students I</td>
<td>12</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>03-121 Modern Biology</td>
<td>9</td>
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<tr>
<td>76-101 Interpretation and Argument</td>
<td>9</td>
</tr>
<tr>
<td>99-101 Computer Skills Workshop</td>
<td>3</td>
</tr>
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<td></td>
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</table>

Spring

21-122 Integration, Differential Equations and Approximation | 10 |
21-127 Concepts of Mathematics                              | 9  |
33-112 Physics for Science Students II                     | 12 |
09-105 Intro to Modern Chemistry                           | 10 |
xx-xxx Mathematical Sciences, or Computer Science Elective  | 9  |
xx-xxx H&SS Elective                                       | 9  |

Sophomore Year

Fall

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>21-228 Discrete Mathematics (or 21-301 or 21-484)</td>
<td>9</td>
</tr>
<tr>
<td>21-341 Linear Algebra I</td>
<td>9</td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>21-201 Undergraduate Colloquium</td>
<td>1</td>
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<tr>
<td>xx-xxx Mathematical Sci, Statistics, or Computer Sci Elective</td>
<td>9</td>
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<tr>
<td>xx-xxx H&amp;SS Elective</td>
<td>9</td>
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<tr>
<td>xx-xxx Elective</td>
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Spring

21-260 Differential Equations                      | 9    |
21-201 Undergraduate Colloquium                    | 1    |
xx-xxx Calculus in Three Dimensions                | 9    |
xx-xxx H&SS Elective                               | 9    |
xx-xxx Elective                                    | 9    |

Junior Year

Fall

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>21-355 Principles of Real Analysis I</td>
<td>9</td>
</tr>
<tr>
<td>36-225 Introduction to Probability and Statistics I (or 21-325)</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Mathematical Sci, Statistics, or Computer Sci Elective</td>
<td>9</td>
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<tr>
<td>xx-xxx H&amp;SS Elective</td>
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<tr>
<td>xx-xxx Elective</td>
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</table>

Spring

21-356 Principles of Real Analysis II             | 9    |
21-373 Algebraic Structures                     | 9    |
21-xxx Mathematical Sciences Elective           | 9    |
xx-xxx H&SS Elective                            | 9    |
xx-xxx Elective                                | 9    |

Senior Year

Fall

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-xxx Mathematical Sciences Elective</td>
<td>9</td>
</tr>
<tr>
<td>21-xxx Mathematical Sciences Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Elective</td>
<td>9</td>
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<tr>
<td>xx-xxx Elective</td>
<td>9</td>
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</table>

Spring

21-xxx Mathematical Sciences Elective           | 9    |
21-xxx Mathematical Sciences Elective           | 9    |
xx-xxx Mathematical Sci, Statistics, or Computer Sci Elective | 9    |
xx-xxx H&SS Elective                            | 9    |
xx-xxx Elective                                | 9    |

Minimum number of units for the degree: 360

Students preparing for graduate study in mathematics should consider the following courses as Mathematical Sciences electives, choosing among them according to the desired area of graduate study:

21-301 Combinatorics
21-342 Linear Algebra II
21-371 Functions of a Complex Variable
21-372 Partial Differential Equations
21-374 Field Theory
21-465 Topology and Geometry
21-470 Selected Topics in Analysis
21-476 Ordinary Differential Equations
21-484 Graph Theory
21-600 Mathematical Logic I
21-602 Introduction to Set Theory
21-620 Real Analysis
21-621 Introduction to Lebesgue Integration
21-651 General Topology
21-660 Numerical Analysis I

Note that courses 21-600 and above carry graduate credit. 600 level courses are designed as transitional courses to graduate study. A student preparing for graduate study should also consider undertaking an independent work. The Department offers 21-499 Undergraduate Research Topic and 21-599 Undergraduate Reading and Research for this purpose.

Operations Research Concentration

An operations research professional employs quantitative and computational skills toward enhancing the function of an organization or process. Students choosing this concentration will develop problem-solving abilities in mathematical and statistical modelling and computer-based simulation in areas such as network design, transportation scheduling, allocation of resources and optimization. In addition to courses in Mathematical Sciences and Statistics, a basic background in economics and accounting is included. Since problems in business and industry are often solved by teams, the program also includes a group project to be undertaken in the Senior year.

The requirements for the concentration in Operations Research are:

Mathematical Sciences

21-120 Differential and Integral Calculus
21-122 Integration, Differential Equations and Approximation
21-127 Concepts of Mathematics
21-201 Undergraduate Colloquium
21-218 Discrete Mathematics (or 21-484)
21-214 Matrix Algebra
21-259 Calculus in Three Dimensions
21-260 Differential Equations
21-292 Operations Research I
21-355 Principles of Real Analysis I
21-369 Numerical Methods
21-393 Operations Research II
Statistics Concentration

Statistics is concerned with the process by which inferences are made from data. Statistical methods are essential to research in a wide variety of scientific disciplines. For example, principles of experimental design that assist chemists in improving their yields also help poultry farmers grow bigger chickens. Similarly, time series analysis is used to better understand radio waves from distant galaxies, hormone levels in the blood, and concentrations of pollutants in the atmosphere. This diversity of application is an exciting aspect of the field, and it is one reason for the current demand for well-trained statisticians.

The courses 36-225/226 Introduction to Probability and Statistics I/II taken in the Junior year serve as the basis for all further statistics courses. The course 21-325 is a more mathematical alternative to 36-225.

The Statistics Concentration is jointly administered by the Department of Mathematical Sciences and the Department of Statistics. The Department of Statistics considers applications for the master’s program from undergraduates in the Junior year. Students who are accepted are expected to finish their undergraduate studies, using some electives in the Senior year to take courses recommended by the Department of Statistics. This will ensure a strong background to permit completion of the master’s program in one year beyond the baccalaureate. The requirements for the Statistics Concentration are:
### Depth Electives

The detailed curriculum below includes five depth electives. These are to be chosen from among the following including at least one statistics course.

- **Fundamental Data Structures and Algorithms**
- **Principles of Programming**
- **Introduction to Mathematical Finance**
- **Projects in Applied Mathematics**
- **Topics in Applied Mathematics**
- **Discrete-Time Finance**
- **Algebraic Structures**
- **Continuous-Time Finance**
- **Graph Theory**
- **Statistics Topic**
- **Topic in Statistics**
- **Independent Study**

### Other Courses

- **15-100** Introductory/Intermediate Programming
- **15-200** Advanced Programming/PRACTICUM
- **73-100** Principles of Economics

MCS humanities, social science, and science core (114 units, including 73-100) four free electives

### Suggested Schedule

#### Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>33-111 Physics for Science Students I</td>
<td>12</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>03-121 Modern Biology</td>
<td>9</td>
</tr>
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<td>76-101 Interpretation and Argument</td>
<td>9</td>
</tr>
<tr>
<td>99-101 Computing Skills Workshop</td>
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</table>

**Total for Fall:** 53 units

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>21-122 Integration, Differential Equations and Approximation</td>
<td>10</td>
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<tr>
<td>33-112 Physics for Science Students II</td>
<td>12</td>
</tr>
<tr>
<td>09-105 Intro to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx Concepts of Mathematics</td>
<td>9</td>
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<tr>
<td>xx-xxx H&amp;SS Elective</td>
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</table>

**Total for Spring:** 50 units

#### Sophomore Year

<table>
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<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-228 Discrete Mathematics or (21-301)</td>
<td>9</td>
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<tr>
<td>21-241 Matrix Algebra</td>
<td>9</td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>21-201 Undergraduate Colloquium</td>
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<tr>
<td>73-100 Principles of Economics</td>
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**Total for Fall:** 37 units

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<tbody>
<tr>
<td>15-200 Advanced Programming/PRACTICUM</td>
<td>9</td>
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<tr>
<td>21-260 Differential Equations</td>
<td>9</td>
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<tr>
<td>21-292 Operations Research I</td>
<td>9</td>
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<tr>
<td>21-201 Undergraduate Colloquium</td>
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<tr>
<td>xx-xxx H&amp;SS Elective</td>
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<tr>
<td>xx-xxx Elective</td>
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**Total for Spring:** 46 units

#### Junior Year

<table>
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<tr>
<th>Fall</th>
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<tbody>
<tr>
<td>21-369 Numerical Methods</td>
<td>9</td>
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<tr>
<td>36-225 Introduction to Probability and Statistics I (or 21-325)</td>
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<tr>
<td>xx-xxx Depth Elective</td>
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<tr>
<td>xx-xxx Depth Elective</td>
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<tr>
<td>xx-xxx H&amp;SS Elective</td>
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**Total for Fall:** 45 units

<table>
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<tbody>
<tr>
<td>21-355 Principles of Real Analysis I</td>
<td>9</td>
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<tr>
<td>36-235 Introduction to Probability and Statistics II</td>
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<tr>
<td>36-410 Introduction to Probability Models</td>
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<td>xx-xxx H&amp;SS Elective</td>
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**Total for Spring:** 45 units

#### Senior Year

<table>
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<tbody>
<tr>
<td>21-393 Operations Research II</td>
<td>9</td>
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<tr>
<td>36-401 Modern Regression</td>
<td>9</td>
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<td>xx-xxx H&amp;SS Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
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</tbody>
</table>

**Total for Fall:** 45 units

<table>
<thead>
<tr>
<th>Spring</th>
<th></th>
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<tbody>
<tr>
<td>36-402 Topic in Data Analysis</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Depth Analysis</td>
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<tr>
<td>xx-xxx Depth Analysis</td>
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</tr>
<tr>
<td>xx-xxx H&amp;SS Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

**Total for Spring:** 45 units

### Minimum number of units required for the degree: 360

### Discrete Mathematics and Logic Concentration

This concentration will enable the student to develop mathematical skills in the areas of discrete mathematics and mathematical logic while simultaneously preparing the student for graduate study in mathematics, computer science or related disciplines. Both discrete mathematics and logic have strong ties with theoretical computer science, philosophy and computer engineering. This concentration is particularly recommended for students planning careers in computer science or engineering who wish to improve their understanding of the mathematical foundation of recent and future technological advancements in these fields.

The requirements for the Discrete Mathematics and Logic Concentration are:

#### Mathematical Sciences and Computer Science: (122 units)

- **15-111** Intermediate/Advanced Programming
- **15-211** Fundamental Data Structures and Algorithms
- **15-212** Principles of Programming
- **21-120** Differential and Integral Calculus (or 21-131 Analysis I)
- **21-122** Integration, Differential Equations and Approximation (or 21-132 Analysis II)
- **21-127** Concepts of Mathematics
- **21-201** Undergraduate Colloquium
- **21-291** Basic Logic
- **21-301** Combinatorics
- **21-341** Linear Algebra I
- **21-355** Principles of Real Analysis I
- **21-373** Algebraic Structures
- **21-484** Graph Theory

#### Discrete Mathematics and Logic

Three of the following: (27 to 36 units)

- **21-229** Set Theory
- **21-373** Field Theory
- **21-441** Number Theory
- **80-410** Recursion and Hierarchies
- **21-602** Introduction to Set Theory
### Computer Science electives: (18 units)
Any two courses at the 300 level or above. The following are specifically suggested:
- 15-312 Foundations of Programming Languages
- 15-451 Algorithms, Design and Analysis
- 15-453 Formal Languages and Automata
- 17-631 Models of Software Systems

Students pursuing this concentration who minor in Computer Science must take two additional Computer Science courses at the 300 level or above to avoid excessive double counting.

### Technical Electives: (36 units)
Any four Mathematical Sciences courses at the 300 level or above, or from the following list:

- 21-259 Calculus in Three Dimensions
- 21-260 Differential Equations
- 21-292 Operations Research I
- 36-217 Probability Theory and Random Processes
- 80-405 Game Theory
- 80-411 Proof Theory
- 80-481 Formal Semantics

### Other Courses:
- MCS Humanities, Science and Computer Skills Core: (114 units) Free Electives: (Sufficient to meet minimum requirement of 360 units.)

### Suggested Schedule

#### Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>33-111 Physics for Science Students I</td>
<td>12</td>
</tr>
<tr>
<td>15-111 Intermediate/Advanced Programming</td>
<td>10</td>
</tr>
<tr>
<td>76-101 Interpretation and Argument</td>
<td>9</td>
</tr>
<tr>
<td>99-101 Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-122 Integration, Differential Equations and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>33-112 Physics for Science Students II</td>
<td>12</td>
</tr>
<tr>
<td>09-105 Intro to Modern Chemistry</td>
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<td><strong>Total</strong></td>
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#### Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>15-211 Fundamental Data Structures and Algorithms</td>
<td>12</td>
</tr>
<tr>
<td>21-301 Combinatorics</td>
<td>9</td>
</tr>
<tr>
<td>21-341 Linear Algebra I</td>
<td>9</td>
</tr>
<tr>
<td>21-201 Undergraduate Colloquium</td>
<td>1</td>
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<tr>
<td>03-121 Modern Biology</td>
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<td>xx-xxx Humanities Elective</td>
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<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
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<tbody>
<tr>
<td>15-212 Principles of Programming</td>
<td>12</td>
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<tr>
<td>xx-xxx Discrete Math/Logic</td>
<td>9</td>
</tr>
<tr>
<td>21-201 Undergraduate Colloquium</td>
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<tr>
<td>xx-xxx Technical Elective</td>
<td>9</td>
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<tr>
<td>xx-xxx Humanities Elective</td>
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<tr>
<td>xx-xxx Humanities Elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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#### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>15-xxx Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>21-300 Basic Logic</td>
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<tr>
<td>21-355 Principles of Real Analysis I</td>
<td>9</td>
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<tr>
<td>xx-xxx Humanities Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
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<tr>
<td><strong>Total</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-xxx Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>21-373 Algebraic Structures</td>
<td>9</td>
</tr>
<tr>
<td>21-484 Graph Theory</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Humanities Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45</strong></td>
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</table>

#### Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx-xxx Discrete Math/Logic</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Technical Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Humanities Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx-xxx Discrete Math/Logic</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Technical Elective</td>
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<td>xx-xxx Humanities Elective</td>
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<tr>
<td>xx-xxx Elective</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

### Minimum number of units required for degree: **360**

#### Computational and Applied Mathematics Concentration

This concentration is designed to prepare students for careers in business or industry requiring significant skills in computation and problem solving. Beginning at the level of quantifying or modelling a problem, students will develop skills in appropriate techniques for carrying the effort through to an effective solution. The free electives allow the student to develop an interest in a related area by completing a minor in another department, such as Engineering Studies, Economics, Information Systems or Business Administration.

The requirements for the Computational and Applied Mathematics Concentration are:

### Mathematical Sciences: (101 Units)

- 21-120 Differential and Integral Calculus
- 21-122 Integration, Differential Equations and Approximation
- 21-127 Concepts of Mathematics
- 21-201 Undergraduate Colloquium
- 21-228 Discrete Mathematics (or 21-301 or 21-484)
- 21-241 Matrix Algebra
- 21-259 Calculus in Three Dimensions
- 21-260 Differential Equations
- 21-320 Symbolic Programming Methods
- 21-355 Principles of Real Analysis I
- 21-356 Principles of Real Analysis II (or 21-357)
- 21-369 Numerical Methods

### Five of the following distribution courses:

- A minimum of 45 units
- 15-211 Fundamental Data Structure and Algorithms
- 21-292 Operations Research I
- 21-370 Mathematics of Finance
- 21-371 Functions of a Complex Variable
- 21-372 Partial Differential Equations
- 21-380 Introduction to Mathematical Modeling
- 21-393 Operations Research II
- 21-476 Ordinary Differential Equations
- 21-470 Selected Topics in Analysis
Topics have included (a student may take more than one):

- Calculus of Variations
- Finite Difference Equations
- 21-660 Introduction to Numerical Analysis I
- 21-690 Methods of Optimization
- 21-xxx Mathematical Science Elective
- 36-410 Elementary Applied Probability

Other Courses: (19 units)

- 15-111 Intermediate/Advance Programming
- 36-225 Introduction to Probability and Statistics I (or 21-325)

MCS humanities, science and computer skills course (114 units)

Free electives: (sufficient to meet minimum of 360 units.)

### Suggested Schedule

#### Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
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<tr>
<td>33-111 Physics for Science Students I</td>
<td>12</td>
</tr>
<tr>
<td>15-111 Intermediate/Advanced Programming</td>
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</tr>
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</tr>
<tr>
<td>99-101 Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>

Spring

- 21-122 Integration, Differential Equations and Approximation 10
- 21-127 Concepts of Mathematics 9
- 33-112 Physics for Science Students II 12
- 09-105 Intro to Modern Chemistry 10
- xx-xxx Humanities Elective 9
| **Total** | **50** |

#### Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>03-121 Modern Biology</td>
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<tr>
<td>21-241 Matrix Algebra</td>
<td>9</td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>21-201 Undergraduate Colloquium</td>
<td>1</td>
</tr>
<tr>
<td>xx-xxx Humanities Elective</td>
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<tr>
<td>xx-xxx Elective</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>46</strong></td>
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</table>

Spring

- 21-228 Discrete Mathematics (or 21-301 or 21-484) 9
- 21-260 Differential Equations 9
- 21-201 Undergraduate Colloquium 1
- xx-xxx Distribution Course 9
- xx-xxx Humanities Elective 9
| xx-xxx Elective | 9 |
| **Total** | **46** |

#### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>21-320 Symbolic Programming Methods</td>
<td>9</td>
</tr>
<tr>
<td>21-355 Principles of Real Analysis I</td>
<td>9</td>
</tr>
<tr>
<td>36-225 Introduction to Probability and Statistics I (or 21-325)</td>
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<td>xx-xxx Humanities Elective</td>
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<tr>
<td>xx-xxx Elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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</tr>
</tbody>
</table>

Spring

- 21-356 Principles of Real Analysis II 9
- 21-369 Numerical Methods 9
- xx-xxx Distribution Course 9
- xx-xxx Humanities Elective 9
| xx-xxx Elective | 9 |
| **Total** | **45** |

### Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>xx-xxx Distribution Course</td>
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<tr>
<td>xx-xxx Distribution Course</td>
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<td>xx-xxx Humanities Elective</td>
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<tr>
<td><strong>Total</strong></td>
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</tr>
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</table>

### Minimum units required for degree: 360

### Double Major Requirements

All degrees offered by the Department are available as a second major to students majoring in other departments. Interested students should contact the Department for further information and guidance. In general the requirements for a second major include all the required courses except the MCS core, free electives and 21-201 Undergraduate Colloquium.

### The Minor in Mathematical Sciences

The Minor includes six courses. 21-127 Concepts of Mathematics is a prerequisite for 21-228 and recommended for 21-241. The minimum preparation required for 21-355 Principles of Real Analysis I is 21-120/122 or equivalent courses. Students planning to include 21-373 Algebraic Structures as a Mathematical Sciences Elective should choose 21-341 Linear Algebra I, 21-241 and 21-341 cannot both count toward the minor.

21-127 Concepts of Mathematics
21-228 Discrete Mathematics (or 21-301 or 21-484)
21-241 Matrix Algebra (or 21-341)
21-355 Principles of Real Analysis I
21-3xx Mathematical Sciences Elective
21-3xx Mathematical Sciences Elective

To avoid excessive double counting, the two Mathematical Science Electives may not also count toward the student’s major.

A student who completes the Mathematical Studies sequence plus two recommended electives (typically 21-470 Topics in Analysis and 21-374 Field Theory) will receive a Minor in Mathematical Sciences. Excluded as acceptable electives are the following: 21-105, 21-111, 21-112, 21-120, 21-122, 21-259, and 21-260, and courses intended for H&SS or undergraduate business students, such as 21-110, 21-256 and 21-257.

### Minor in Discrete Mathematics and Logic

This minor develops the fundamentals of discrete mathematics and logic necessary to understand the mathematical foundations of many computer related disciplines. Required courses are:

21-300 Basic Logic
21-301 Combinatorics
21-341 Linear Algebra I
21-484 Graph Theory

Two of the following:

21-229 Set Theory
21-374 Field Theory
21-441 Number Theory
21-602 Introduction to Set Theory
21-603 Introduction to Model Theory
21-610 Algebra I
21-700 Mathematical Logic II
The Honors Degree Program

This demanding program leads to an M.S. in Mathematical Sciences, normally in four years, in addition to the student's B.S. degree. The key element in the program is usually the Mathematical Studies sequence. Admission to the Honors Program, in the Junior year, requires an application. In the application process the Department will hold to the same high standards which apply to admission to any graduate program.

Honors Program Requirements:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-901 Master Degree Research</td>
<td>18</td>
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<tr>
<td>Five graduate mathematics courses</td>
<td>60</td>
</tr>
</tbody>
</table>

Each student in the honors degree program will have a thesis advisor in addition to his or her academic advisor. In practice, the student must start thinking about the thesis as early as possible. For this reason we include some thesis work, 3 units of 21-901 Master Degree Research, in the Fall semester of the Senior year to allow for exploratory work under supervision. The actual thesis work is then planned for the final semester with 15 units of 21-901 Master Degree Research.

The five graduate course must include at least one course from each of the following areas:

- **Analysis**, e.g., Measure and Integration, Complex Analysis, Functional Analysis
- **Algebra, Logic, Geometry and Topology**, e.g., Mathematical Logic I, Algebra I, General Topology, Discrete Mathematics, Commutative Algebra
- **Applied Mathematics**, e.g., Introduction to Continuum Mechanics, Probability Measures, Probability Theory, Graphs and Network Flows, Ordinary Differential Equations, Methods of Optimization, Introduction to Numerical Analysis I

Faculty

- PETER B. ANDREWS, Professor of Mathematics — Ph.D., Princeton University; Carnegie Mellon, 1963—.
- EGNAL BALAS, Thomas Lord University Professor of Operations Research — Ph.D., University of Brussels; Carnegie Mellon, 1968—.
- ALBERT A. BLANK, Professor of Mathematics, Emeritus — Ph.D., New York University; Carnegie Mellon, 1969—.
- TOM BOHMAN, Assistant Professor of Mathematical Sciences — Ph.D., Rutgers University; Carnegie Mellon, 1998—.
- DEBORAH BRANDON, Associate Teaching Professor of Mathematical Sciences— Ph.D., Carnegie Mellon University; Carnegie Mellon, 1991—.
- CHARLES V. COFFMAN, Professor of Mathematics, Emeritus — Ph.D., Johns Hopkins University; Carnegie Mellon, 1962—.
- GERARD CORNUJOLS, University Professor of Operations Research and Mathematics — Ph.D., Cornell University; Carnegie Mellon, 1978—.
- JAMES CUMMINGS, Associate Professor of Mathematical Sciences — Ph.D., Cambridge University; Carnegie Mellon, 1996—.
- TIMOTHY FLAHERTY, Lecturer in Mathematical Sciences — Ph.D., University of Pittsburgh, Carnegie Mellon, 1999—.
- IRENE M. FONSECA, Mellon College of Science Professor of Mathematical Sciences — Ph.D., University of Minnesota; Carnegie Mellon, 1987—.
- ALAN M. FRIEZE, Professor of Mathematical Sciences and Computer Science — Ph.D., University of London; Carnegie Mellon, 1987—.
- JAMES M. GREENBERG, Professor of Mathematical Sciences — Ph.D., Brown University; Carnegie Mellon, 1995—.
- RAMI GROSSBERG, Associate Professor of Mathematics — Ph.D., Hebrew University of Jerusalem; Carnegie Mellon, 1988—.
- MORTON E. GURTIN, Alumni Professor of Mathematical Sciences, Emeritus — Ph.D., Brown University; Carnegie Mellon, 1966—.
- DAVID HANDRON, Lecturer in Mathematical Sciences — Ph.D., Rice University; Carnegie Mellon, 1999—.
- DAVID C. HEATH, Orion Hoch Professor of Mathematical Sciences — Ph.D., University of Illinois; Carnegie Mellon, 1997—.
- WILLIAM J. HRUSA, Professor of Mathematical Sciences — Ph.D., Brown University; Carnegie Mellon, 1982—.
- DAVID KINDERLEHRER, Professor of Mathematical Sciences — Ph.D., University of California at Berkeley; Carnegie Mellon, 1990—.
- DMITRY KRAMKOV, Associate Professor of Mathematical Sciences — Ph.D., Steklov Mathematical Institute; Carnegie Mellon, 2000—.
- JOHN P. LEHOCZKY, Professor of Statistics and Mathematical Sciences; Dean, College of Humanities and Social Science — Ph.D., Stanford University; Carnegie Mellon, 1969—.
- GIOVANNI LEONI, Associate Professor of Mathematical Sciences — Ph.D., University of Minnesota; Carnegie Mellon, 2002—.
- RICHARD C. MACCAMY, Professor of Mathematics, Emeritus — Ph.D., University of California at Berkeley; Carnegie Mellon, 1956—.
- JOHN MACKEY, Lecturer in Mathematical Sciences — Ph.D., University of Hawaii; Carnegie Mellon, 2003—.
- VICTOR J. MIZE, Professor of Mathematics — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1959—.
- RICHARD A. MOORE, Professor of Mathematics, Emeritus — Ph.D., Washington University; Carnegie Mellon, 1956—.
- ROY A. NICOLAIDES, Professor of Mathematical Sciences; Head, Department of Mathematical Sciences — Ph.D., University of London; Carnegie Mellon, 1984—.
- WALTER NOLL, Professor of Mathematics, Emeritus — Ph.D., Indiana University; Carnegie Mellon, 1956—.
- MARION L. OLIVER, Associate Teaching Professor of Mathematical Sciences — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2004—.
- DAVID R. OWEN, Professor of Mathematics — Ph.D., Brown University; Carnegie Mellon, 1967—.
- ROBERT L. PEYO, Professor of Mathematical Sciences— Ph.D., University of California at Berkeley; Carnegie Mellon, 2004—.
- OLEG PIKHURKO, Assistant Professor of Mathematical Sciences, — Ph.D., Cambridge University, Carnegie Mellon, 2003—.
- AGOSTON PISZTORA, Assistant Professor of Mathematical Sciences — Ph.D. ETH Zurich, Carnegie Mellon, 1996—.
- RAVITA RAMANAN, Associate Professor of Mathematical Sciences — Ph.D., Brown University; Carnegie Mellon, 2003—.
- JOHN W. SCHAFFER, Professor of Mathematical Sciences — Ph.D., Indiana University; Carnegie Mellon, 1983—.
- JUAN J. SCHAEFFER, Professor of Mathematics — Ph.D., Universitt Zurich; Carnegie Mellon, 1968—.
- ERNEST SCHIMMERLING, Associate Professor of Mathematical Sciences — Ph.D., University of California at Los Angeles; Carnegie Mellon, 1998—.
- DANA SCOTT, Hillman University Professor of Computer Science, Philosophy, and Mathematical Logic, Emeritus — Ph.D., Princeton University; Carnegie Mellon, 1981—.
- ROBERT F. SEKERKA, University Professor of Physics and Mathematics — Ph.D., Harvard University; Carnegie Mellon, 1969—.
- STEVEN E. SHREVE, Professor of Mathematical Sciences — Ph.D., University of Illinois; Carnegie Mellon, 1980—.
- CLIFFORD D. SMITH, Zeev Nehari Visiting Assistant Professor — Ph.D., Rutgers University; Carnegie Mellon, 2002—.
- RICHARD STATMAN, Professor of Mathematical Sciences and Computer Science — Ph.D., Stanford University; Carnegie Mellon, 1984—.
- SHLOMO TAASAN, Professor of Mathematical Sciences — Ph.D., Weizmann Institute; Carnegie Mellon 1994—.
- LUC TARTAR, University Professor of Mathematical Sciences — Ph.D., University of Paris; Carnegie Mellon, 1987—.
- GERALD L. THOMPSON, IBM Professor of Systems and Operations Research, Emeritus — Ph.D., Columbia University; Carnegie Mellon,
1959—.

KATHERINE THOMPSON, Zeev Nehari Visiting Assistant Professor —
Ph.D., University of East Anglia; Carnegie Mellon, 2003—.

JOHN TOLLE, Lecturer of Mathematical Sciences — Ph.D., University of
Kentucky; Carnegie Mellon, 1996—.

REHA TÜTÜNCÜ, Associate Professor of Mathematical Sciences —
Ph.D., Cornell University; Carnegie Mellon, 1996—.

RUSSELL C. WALKER Teaching Professor of Mathematical Sciences;
Associate Head, Department of Mathematical Sciences — D.A.,
Carnegie Mellon University; Carnegie Mellon, 1984—.

NOEL S. WALKINGTON, Professor of Mathematical Sciences — Ph.D.,
University of Texas at Austin; Carnegie Mellon, 1989—.

WILLIAM O. WILLIAMS, Professor of Mathematical Sciences — Ph.D.,
Brown University; Carnegie Mellon, 1966—.

OSWALD WYLER, Professor of Mathematics, Emeritus — Sc.D., Swiss
Federal Institute of Technology; Carnegie Mellon, 1965—.
Department of Physics

Fred Gilman, Head
Office: Wean Hall 7325
Kunal Ghosh, Assistant Head for Undergraduate Affairs
Office: Wean Hall 6319
Hilary Homer, Student Programs Coordinator
Student Programs Office: Wean Hall 7319
http://info.phys.cmu.edu/

Physics, one of the basic sciences, has its origin in the irrepressible human curiosity to explore and understand the natural world. This fundamental urge to discover has led to the detailed understanding of a remarkable variety of physical phenomena. Our knowledge now encompasses the large-scale movement of galaxies, the minute motions within atoms and nuclei, and the complex structure of the assemblies of molecules that make life possible. The spectacular expansion of our comprehension of the physical world forms an impressive part of the intellectual and cultural heritage of our times. The opportunity to add to this heritage is an important source of motivation for young physicists. The application of discoveries in physics to the solution of complex modern technological problems offers a vast field in which physicists make decisive contributions. The interplay of pure and applied physics has always been fruitful and today ensures many rewarding career opportunities for physics students.

Carnegie Mellon's undergraduate curriculum in physics has been carefully designed to provide a firm knowledge of the basic principles of physics, an appreciation of a wide range of physical problems of current interest, and the capacity to formulate and solve new problems. In addition to classwork and problem solving, the curriculum includes studying physical phenomena in the laboratory. Physics students are strongly encouraged to go beyond the formal theoretical and experimental course work and become involved in research projects under the guidance of individual faculty members.

Students may choose from a variety of degree options:

- B.S. in Physics
- B.A. in Physics
- B.S. in Physics with Tracks in:
  - Applied Physics
  - Astrophysics
  - Biological Physics
  - Chemical Physics
  - Computational Physics

The objectives and requirements for each of these options are described in the paragraphs below. Each allows considerable latitude in the choice of electives.

Through the judicious choice of elective courses, a double major program combining physics and another discipline can be readily achieved. A minor in physics is also offered for those students who major in other disciplines. The student, with the help of their faculty advisors, can easily build a program that aims at specific career objectives.

The Department maintains an active and wide-ranging program of advising. Beyond aiding in academic planning, Department advisors can also assist students in finding research work during the academic year, technical jobs and internships for the summer, as well as planning and executing the necessary steps for gaining employment or continuing their studies beyond the bachelor's degree. Whether students follow a standard curriculum or not, the student should consult their academic advisor at least once every semester.

B.S. in Physics

B.S. degree candidates can choose not only from a wide variety of intermediate and advanced topics in physics, but also from a range of material in other science or engineering fields. The B.S. degree provides a solid foundation for students wishing to go on to graduate work in physics or any of a large number of fields in pure or applied science or engineering, for which a sound grasp of physics and mathematics is essential. This program also provides excellent preparation for careers in teaching, for work in industrial or governmental research and development, or for other employment in business or industry with a significant scientific component.

Requirements

<table>
<thead>
<tr>
<th>Physics Courses</th>
<th>Units</th>
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<tbody>
<tr>
<td>33-104 Experimental Physics (1)</td>
<td>9</td>
</tr>
<tr>
<td>33-110 Physics I for Science Students</td>
<td>12</td>
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<tr>
<td>or 33-131 Matter and Interactions I</td>
<td>12</td>
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<tr>
<td>33-112 Physics II for Science Students</td>
<td>12</td>
</tr>
<tr>
<td>or 33-132 Matter and Interactions II</td>
<td>12</td>
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<tr>
<td>33-201, 202, 301, 302, 401, 402 Undergraduate Colloquium I to VI (1 unit each)</td>
<td>6</td>
</tr>
<tr>
<td>33-211 Physics III: Modern Essentials</td>
<td>10</td>
</tr>
<tr>
<td>33-228 Electronics</td>
<td>10</td>
</tr>
<tr>
<td>33-231 Physical Analysis</td>
<td>9</td>
</tr>
<tr>
<td>33-232 Mathematical Methods of Physics</td>
<td>9</td>
</tr>
<tr>
<td>33-234 Quantum Physics</td>
<td>10</td>
</tr>
<tr>
<td>33-331 Physical Mechanics I</td>
<td>10</td>
</tr>
<tr>
<td>33-332 Physical Mechanics II</td>
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</tr>
<tr>
<td>33-340 Modern Physics Laboratory</td>
<td>10</td>
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<tr>
<td>33-341 Thermal Physics I</td>
<td>10</td>
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<tr>
<td>33-338 Intermediate Electricity and Magnetism I</td>
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<tr>
<td>33-339 Intermediate Electricity and Magnetism II</td>
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</table>

Physics Electives - at least 18 units (2)(3) 18

Minimum Total Physics Units (4) 165

Mathematics Courses

<table>
<thead>
<tr>
<th>Mathematics Courses</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>21-120 Differential and Integral Calculus</td>
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</tr>
<tr>
<td>21-122 Integration, Differential Equations and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
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Mathematics Elective (at least 9 units) (5) 9

Total Mathematics Units (4) 38

Mellon College of Science Core (7)

<table>
<thead>
<tr>
<th>Mellon College of Science Core</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>03-121 Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>09-105 Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>99-101 Computing Skills Workshop</td>
<td>3</td>
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Total MCS Core 32

Humanities, Social Sciences, or Fine Arts Courses (4)(6)

<table>
<thead>
<tr>
<th>Technical Electives (4)(6)</th>
<th>Free electives (5)(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>27</td>
</tr>
<tr>
<td>26</td>
<td></td>
</tr>
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</table>

The minimum number of units required for this degree: 360

Notes:

(1) Experimental Physics must be taken no later than the fall semester of the sophomore year.

(2) Qualifying electives in physics are listed below.

(3) Students planning to undertake graduate study in physics should consider taking Advanced Quantum Physics I and II (33-445, 33-446).

(4) Any excess units earned in physics or mathematics courses count towards the technical units, and excess technical or H&S/FA units count towards free elective units.

(5) Chosen from 21-228 or any 21-3xx or 21-4xx course except 21-350.

(6) The MCS core courses may be taken in any order, but must be finished by the end of the junior year.

(7) Humanities, Social Sciences and Fine Arts (H&S/FA) requirements follow the Mellon College of Science guidelines.

(8) Technical electives are any courses in MCS, SCS, Statistics, and CIT.

(9) A free elective is any Carnegie Mellon course. However, a maximum of 9 units of physical education and/or military science may be taken as free electives.
Qualifying Electives In Physics for the B.S. Degree

Fall and Spring Units

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>33-350</td>
<td>Undergraduate Research</td>
<td>Var.</td>
</tr>
<tr>
<td>33-451</td>
<td>Senior Research</td>
<td>9</td>
</tr>
<tr>
<td>33-458</td>
<td>Special Problems in Computational Physics</td>
<td>9</td>
</tr>
<tr>
<td>33-499</td>
<td>Supervised Reading</td>
<td>Var.</td>
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Fall Only

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-224</td>
<td>Stars, Galaxies and the Universe</td>
<td>9</td>
</tr>
<tr>
<td>33-241</td>
<td>Introduction to Computational Physics</td>
<td>9</td>
</tr>
<tr>
<td>33-353</td>
<td>Intermediate Optics</td>
<td>12</td>
</tr>
<tr>
<td>33-441</td>
<td>03-439 Introduction to Biophysics</td>
<td>9</td>
</tr>
<tr>
<td>33-445</td>
<td>Advanced Quantum Physics I</td>
<td>9</td>
</tr>
<tr>
<td>33-467</td>
<td>Astrophysics of Stars and the Galaxy</td>
<td>9</td>
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Spring Only

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-114</td>
<td>Physics of Musical Sound</td>
<td>9</td>
</tr>
<tr>
<td>33-342</td>
<td>Thermal Physics II</td>
<td>10</td>
</tr>
<tr>
<td>33-446</td>
<td>Advanced Quantum Physics II</td>
<td>9</td>
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<tr>
<td>33-449</td>
<td>Quantum Mechanics I</td>
<td>12</td>
</tr>
<tr>
<td>33-466</td>
<td>Extragalactic Astrophysics and Cosmology</td>
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</table>

Fall Only (Alternate Years)

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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Spring Only (Alternate Years)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>33-444</td>
<td>Introduction to Nuclear &amp; Particle Physics (2005, 2007)</td>
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Graduate Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>33-755</td>
<td>Quantum Mechanics I</td>
<td>12</td>
</tr>
<tr>
<td>33-756</td>
<td>Quantum Mechanics II</td>
<td>12</td>
</tr>
<tr>
<td>33-758</td>
<td>Quantum Computation</td>
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<tr>
<td>33-759</td>
<td>Introduction to Theoretical Physics</td>
<td>12</td>
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<tr>
<td>33-761</td>
<td>Classical Electrodynamics I</td>
<td>12</td>
</tr>
<tr>
<td>33-762</td>
<td>Classical Electrodynamics II</td>
<td>12</td>
</tr>
<tr>
<td>33-765</td>
<td>Statistical Mechanics</td>
<td>12</td>
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<tr>
<td>33-766</td>
<td>Quantum Mechanics III</td>
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<td>33-770</td>
<td>Quantum Mechanics IV</td>
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<tr>
<td>33-771</td>
<td>Quantum Mechanics V</td>
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<tr>
<td>33-777</td>
<td>Introductory Astrophysics</td>
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<tr>
<td>33-779</td>
<td>Nuclear and Particle Physics I</td>
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<tr>
<td>33-870</td>
<td>Nuclear and Particle Physics II</td>
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</tr>
<tr>
<td>33-783</td>
<td>Theory of Solids I</td>
<td>12</td>
</tr>
</tbody>
</table>

Notes

(10) Only one of the three courses – 33-350 (at least 9 units), 33-451, and 33-499 – may be used as a qualifying physics elective. Any exception to this rule needs prior approval from the Department.

(11) Prior approval from the Department is needed for 33-114 to be a qualifying course.

B.S. in Physics – Sample Schedule

First Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>33-311</td>
<td>Physics I for Science Students</td>
<td>12</td>
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<tr>
<td>or</td>
<td>33-131</td>
<td>Matter and Interactions I</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>15-100</td>
<td>Introductory Programming</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>09-105</td>
<td>Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>76-101</td>
<td>Interpretation and Argument (MCS Core 1 of 8)</td>
<td>9</td>
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Spring

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33-112</td>
<td>Physics II for Science Students</td>
<td>12</td>
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<tr>
<td>or</td>
<td>33-132</td>
<td>Matter and Interactions II</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>33-104</td>
<td>Experimental Physics</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>21-122</td>
<td>Integration, Differential Equations and</td>
<td>10</td>
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<tr>
<td></td>
<td></td>
<td>Approximation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>xx-xxx</td>
<td>Humanities, Social Sciences, or Fine Arts Course</td>
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Sophomore Year

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>Fall</td>
<td>33-231</td>
<td>Physical Analysis</td>
<td>9</td>
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<tr>
<td></td>
<td>33-211</td>
<td>Physics III: Modern Essentials</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>33-201</td>
<td>Undergraduate Colloquium I</td>
<td>1</td>
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<tr>
<td></td>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>09-105</td>
<td>Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>xx-xxx</td>
<td>H&amp;S/FA Course (MCS Core 3 of 8)</td>
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Spring

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33-234</td>
<td>Quantum Physics</td>
<td>10</td>
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<tr>
<td></td>
<td>33-228</td>
<td>Electronics</td>
<td>10</td>
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<td></td>
<td>33-202</td>
<td>Undergraduate Colloquium II</td>
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<tr>
<td></td>
<td>03-121</td>
<td>Modern Biology</td>
<td>9</td>
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<tr>
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<td>xx-xxx</td>
<td>H&amp;S/FA Course (MCS Core 4 of 8)</td>
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Junior Year

<table>
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<th>Semester</th>
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<th>Course Title</th>
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<tbody>
<tr>
<td>Fall</td>
<td>33-341</td>
<td>Thermal Physics I</td>
<td>10</td>
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<tr>
<td></td>
<td>33-339</td>
<td>Intermediate Electricity and Magnetism I</td>
<td>10</td>
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<tr>
<td></td>
<td>33-332</td>
<td>Physical Mechanics I</td>
<td>10</td>
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<tr>
<td></td>
<td>xx-xxx</td>
<td>Undergraduate Colloquium III</td>
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<tr>
<td></td>
<td>xx-xxx</td>
<td>Mathematics Elective</td>
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<tr>
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<td>xx-xxx</td>
<td>H&amp;S/FA Course (MCS Core 5 of 8)</td>
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Spring

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>33-340</td>
<td>Modern Physics Laboratory</td>
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<td>33-339</td>
<td>Intermediate Electricity and Magnetism II</td>
<td>10</td>
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<tr>
<td></td>
<td>33-332</td>
<td>Physical Mechanics II</td>
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<td>33-302</td>
<td>Undergraduate Colloquium IV</td>
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<td>xx-xxx</td>
<td>Elective (1 of 8)(Physics, Technical, or Free)</td>
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<td>H&amp;S/FA Course (MCS Core 6 of 8)</td>
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Senior Year

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<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Fall</td>
<td>xx-xxx</td>
<td>Elective (2 of 8) (Physics, Technical, or Free)</td>
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<tr>
<td></td>
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<td>Elective (3 of 8) (Physics, Technical, or Free)</td>
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<td></td>
<td>xx-xxx</td>
<td>Elective (4 of 8) (Physics, Technical, or Free)</td>
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<tr>
<td></td>
<td>xx-xxx</td>
<td>Elective (5 of 8) (Physics, Technical, or Free)</td>
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<tr>
<td></td>
<td>33-401</td>
<td>Undergraduate Colloquium V</td>
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<tr>
<td></td>
<td>xx-xxx</td>
<td>H&amp;S/FA Course (MCS Core 7 of 8)</td>
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Spring

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>xx-xxx</td>
<td>Elective (6 of 8)(Physics, Technical, or Free)</td>
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<tr>
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<td>xx-xxx</td>
<td>Elective (7 of 8) (Physics, Technical, or Free)</td>
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<td></td>
<td>xx-xxx</td>
<td>Elective (8 of 8) (Physics, Technical, or Free)</td>
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<tr>
<td></td>
<td>33-402</td>
<td>Undergraduate Colloquium VI</td>
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<tr>
<td></td>
<td>xx-xxx</td>
<td>H&amp;S/FA Course (MCS Core 8 of 8)</td>
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</tbody>
</table>

B.A. in Physics

With fewer mathematics and technical elective requirements and more free electives, the B.A. degree offers an enhanced opportunity for students to combine the physics degree with intensive work in other non-technical areas.

The requirements for the B.A. degree are the same as those listed above for the B.S. degree with the following changes:

- No units of technical electives are required.
- No units of mathematics elective are required.
- Free electives now account for 62 units.

The minimum number of units required for this degree is 360.

With the extra units in free electives, a student may, for example, double major with a department in the College of Humanities and Social Sciences, the College of Fine Arts, or Business Administration.
B.S. in Physics / Applied Physics Track

The B.S. in Physics/Applied Physics Track is designed primarily for the student who wants to prepare for a career path that takes advantage of the diverse and expanding opportunities for employment in industrial and government laboratories with a B.S. degree. The program provides a solid foundation in the concepts of physics, as well as giving the student the experience and understanding of the application of these concepts.

The track is intended to enhance computing and laboratory skills, and to introduce the application of physics to those subjects of particular interest to the student. Since the possible subject areas for study are so varied, the track will be tailored to each student’s needs within the framework described below. To that end, the student will first meet with the Track Advisor to discuss interests and career goals and to choose computing, laboratory and applications electives that fulfill the requirements of the track.

The requirements for this track are the same as those listed above for the B.S. degree with the following changes:

Additions to the requirements listed for the B.S. in Physics:
- 33-448 Introduction to Solid State Physics (9 units)
- One course (at least 9 units) which strengthens the student’s ability to use the computer as a tool in the research environment
- Two courses (at least 18 units), at least one of them in another department, which broaden the student’s laboratory skills
- Two courses (at least 18 units), at least one of them in another department, which give the student experience in applying basic physics principles to a variety of problems
- One research course (at least 9 units) - may be taken as either of the following two courses:
  - 33-350 Undergraduate Research
  - 33-451 Senior Research

The minimum number of units required for this degree is 360.

B.S. in Physics / Astrophysics Track

The B.S. in Physics/Astronomy Track provides an option for those Physics majors who either want to specialize in this subfield or plan careers in astronomy or astrophysics. Career paths may include postgraduate training in astronomy or astrophysics or proceeding directly to jobs in these fields. The program provides a thorough foundation in the core physics program with electives concentrating in astrophysics.

The requirements for this track are the same as those listed above for the B.S. degree with the following changes:

Additions to the requirements listed for the B.S. in Physics:
- 33-224 Stars, Galaxies and the Universe
- 33-467 Astrophysics of Stars and the Galaxy
- 33-466 Extragalactic Astrophysics and Cosmology
- One research course (at least 9 units) - may be taken as either of the following two courses:
  - 33-350 Undergraduate Research
  - 33-451 Senior Research

The topic in the research course must be in Astrophysics to be approved by the Track Advisor (under special circumstances, research for pay may count toward this requirement, though it cannot be counted toward the units required for graduation).

Modifications from the requirements listed for the B.S. in Physics:
- No units of Physics Electives are required
- Only 9 units of Technical Electives are required

The minimum number of units required for this degree is 360.

B.S. in Physics / Biological Physics Track

The B.S. in Physics/Biological Physics Track combines a rigorous foundation in undergraduate physics with courses in Biological Physics and Chemistry. It is particularly suitable for students preparing for post-baccalaureate careers in the expanding areas of biological and medical physics or for graduate study in biophysics. The program is sufficiently flexible that it can be readily adapted to the requirements of individual students. The student will first meet with the Track Advisor to discuss interests and career goals and then choose electives which fulfill the requirements of the track.

The Biological Physics Track includes a number of courses which are also requirements for the pre-medical program. Students interested in both the Biological Physics Track and the pre-medical program should consult with both the Track Advisor in the Physics Department and the Director of the Health Professions Program for help in planning their programs.

The requirements for this track are the same as those listed above for the B.S. degree with the following changes:

Additions to the requirements listed for the B.S. in Physics:
- 33-441/03-439 Introduction to Biophysics
- 03-231 Biochemistry I
- 09-217 Organic Chemistry I
- Two courses (at least 18 units) from the following list:
  - 03-124 Modern Biology Laboratory
  - 03-130 Biology of Organisms or 42-500 Physiology
  - 03-232 Biochemistry II
  - 03-438 Physical Biochemistry
  - 03-533 NMR in Biomedical Sciences
  - 03-534 Biological Imaging and Fluorescence Spectroscopy

Modifications from the requirements listed for the B.S. in Physics:
- 33-332 Physics Mechanics II is NOT required
- No units of Physics Electives are required
- No units of Mathematics Electives are required
- No units of Technical Electives are required

The minimum number of units required for this degree is 360.

B.S. in Physics / Chemical Physics Track

The B.S. in Physics/Chemical Physics Track is designed for students wishing to have a strong grounding in physics along with a specialization in physical chemistry and/or chemical physics. It is particularly suitable for those students planning on graduate studies in physics with an emphasis on chemical physics or chemistry. The program is sufficiently flexible that it can be readily adapted to the requirements of individual students. The student will first meet with the Track Advisor to discuss interests and career goals and then choose electives that fulfill the requirements of the track.

The Chemical Physics Track incorporates a number of courses which are also requirements for the pre-medical program. Students interested in both the Chemical Physics Track and the pre-medical program should consult with both the Physics Department advisor and the Director of the Health Professions Program for help in planning their programs.

The requirements for this track are the same as those listed above for the B.S. degree with the following changes:

Additions to the requirements listed for the B.S. in Physics:
- 09-106 Modern Chemistry II
- 09-344 Physical Chemistry I (Quantum)
- 09-345 Physical Chemistry II (Thermodynamics)
• Three courses (at least 27 units) from the following list:

- 09-217 Organic Chemistry I
- 09-218 Organic Chemistry II
- 09-221 Laboratory I: Introduction to Chemical Analysis
- 09-322 Laboratory IV: Molecular Spectroscopy and Dynamics
- 09-348 Inorganic Chemistry
- 09-441 Nuclear and Radiochemistry
- 09-445 Undergraduate Research (9-12 units)
- 09-509 Physical Chemistry of Macromolecules
- 09-511 Solid State Materials Chemistry

Modifications from the requirements listed for the B.S. in Physics:
- 33-332 Physics Mechanics II is NOT required
- No units of Physics Electives are required
- No units of Technical Electives are required

The minimum number of units required for this degree is 360.

**B.S. in Physics / Computational Physics Track**

The B.S. in Physics/Computational Physics Track is intended to fill the increasing demand for physics graduates who are skilled in computational and numerical techniques which are used in the analysis of physical problems and in subjects ranging from control and real-time programming to software engineering and compiler and operating systems design. The degree provides the student with a rigorous grounding in physics as well as in the foundations and practice of computer use as applied to scientific problems. Work is done on machines ranging from high level workstations through supercomputers.

The degree program includes additional courses from the Mathematics and Computer Science Departments as well as special courses in computational physics from the Physics Department. The program is sufficiently flexible that it can be readily adapted to the requirements of individual students. The student will first meet with the Track Advisor to discuss interests and career goals and then choose electives that fulfill the requirements of the track.

The requirements for this track are the same as those listed above for the B.S. degree with the following changes:

Additions to the requirements listed for the B.S. in Physics:
- 33-241 Introduction to Computational Physics
- 33-456 Advanced Computational Physics
- 21-127 Concepts of Mathematics
- 21-369 Numerical Methods
- 15-211 Fundamental Data Structures and Algorithms
- 15-212 Principles of Programming

Modifications from the requirements listed for the B.S. in Physics:
- No units of Physics Electives are required
- No units of Mathematics Electives are required
- No units of Technical Electives are required
- Only 20 units of Free Electives are required

The minimum number of units required for this degree is 360.

**A Double Major or a Dual Degree in Physics with a Degree in another Department**

Physics may be taken as a second major or for a second degree, with another department granting the primary degree. The rules of the Physics Department for these two options are distinct, as discussed below.

**Double Major**

In order to receive a Double Major in another subject and Physics — with a B.S. or B.A., alone or with any track — all requirements of the Physics degree and the particular physics track, as listed in the previous sections, must be fulfilled except:

- No units of Mathematics Elective are required
- No units of Technical Electives are required
- No units of Free Electives are required
- No H&S/FA courses are required
- The following courses in the MCS core are not required:
  - 03-121, 09-105, 99-101. However, 15-100 is required.

**Dual Degree**

In order to receive a Dual Degree in another subject and Physics with a B.S. or B.A. alone or with any track — all requirements of the Physics degree and the particular physics track, as listed in the previous sections, must be fulfilled. The non-technical requirements will be waived if the student's home department is not Physics and that department has a similar set of required courses. Also, the number of units required is 90 more than the total units required by the department requiring the fewer total units.

**The Minor in Physics**

The Minor in Physics is designed to provide a solid foundation in physics at the introductory level, followed by elective courses which will familiarize the student with areas of modern physics, and the concepts and techniques employed therein. The sequence consists of two introductory level courses followed by five electives chosen from the list below. The choice of electives requires prior approval by the Department of Physics, and should be made in close consultation with the Physics Department faculty advisor. The Department intends to be flexible and accommodate the student's specific interests. The minor is open to all students of the university, although students with non-calculus based majors should be aware of the mathematics requirements for many physics courses (21-120, 122, 259).

The Physics minor requires seven courses of at least 9 units each, of which four are required and three are electives.

**Required Courses**

**I. Introductory Physics I**

Choose one course:
- 33-106 Physics I for Engineering Students
- 33-111 Physics I for Science Students
- 33-131 Matter and Interactions I

**II. Introductory Physics II**

Choose one course:
- 33-107 Physics II for Engineering Students
- 33-112 Physics II for Science Students
- 33-132 Matter and Interactions II

**III. Modern Physics**

- 33-211 Physics III: Modern Essentials

**IV. Laboratory Experience**

- 33-104 Experimental Physics

**Elective Courses**

Choose three courses from among the following list:

- 33-114 Physics of Musical Sound
- 33-224 Stars, Galaxies and the Universe
- 33-225 Quantum Physics and Structure of Matter
- 33-228 Electronics
- 33-231 Physical Analysis
- 33-232 Mathematical Methods of Physics
- 33-234 Quantum Physics
- 33-241 Introduction to Computational Physics
- 33-331 Physical Mechanics I
- 33-332 Physical Mechanics II
- 33-338 Intermediate Electricity and Magnetism I
- 33-339 Intermediate Electricity and Magnetism II
- 33-340 Modern Physics Laboratory
- 33-341 Thermal Physics I
- 33-342 Thermal Physics II
- 33-350 Undergraduate Research
- 33-353 Intermediate Optics
33-444 Introduction to Nuclear and Particle Physics
33-445 Advanced Quantum Physics I
33-446 Advanced Quantum Physics II
33-448 Introduction to Solid State Physics
33-451 Senior Research
33-456 Advanced Computational Physics
33-458 Special Problems in Computational Physics
33-466 Extragalactic Astrophysics and Cosmology
33-467 Astrophysics of Stars and the Galaxy
33-650 General Relativity

Any one course from among: 33-350 Undergraduate Research. 33-451 Senior Research, 33-499 Supervised Reading.

Any substitution of these requirements for the minor must be pre-approved in writing by the Physics Department.

Faculty

ROY A. BRIERE, Assistant Professor of Physics — Ph.D., University of Chicago; Carnegie Mellon, 1999—.

RUPERT CROFT, Assistant Professor of Physics — Ph.D., Oxford University; Carnegie Mellon, 2001—.

TIZIANA DIMATTEO, Assistant Professor of Physics — Ph.D., University of Cambridge; Carnegie Mellon, 2004—.

RANDALL M. FEENSTRA, Professor of Physics — Ph.D., California Institute of Technology; Carnegie Mellon, 1995—.

THOMAS A. FERGUSON, Professor of Physics — Ph.D., University of California at Los Angeles; Carnegie Mellon, 1985—.

GREGG B. FRANKLIN, Professor of Physics, Associate Dean for Graduate Affairs, Mellon College of Science — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1984—.

STEPHEN GAROFF, Professor of Physics — Ph.D., Harvard University; Carnegie Mellon, 1988—.

KUNAL GHOSH, Principal Lecturer, Assistant Head for Undergraduate Affairs, Department of Physics — Ph.D., Iowa State University; Carnegie Mellon, 2001—.

FREDERICK J. GILMAN, Buhl Professor of Physics, Head, Department of Physics — Ph.D., Princeton University; Carnegie Mellon, 1995—.

RICHARD E. GRIFFITHS, Professor of Physics — Ph.D., University of Leicester, U.K.; Carnegie Mellon, 1996—.

ROBERT B. GRIFFITHS, University Professor & Otto Stern Professor of Physics — Ph.D., Stanford University; Carnegie Mellon, 1964—.

RICHARD F. HOLMAN, Professor of Physics — Ph.D., Johns Hopkins University; Carnegie Mellon, 1987—.

LEONARD S. KISSLINGER, Professor of Physics — Ph.D., Indiana University; Carnegie Mellon, 1969—.

GEORGE KLEIN, Senior Lecturer — Ph.D., New York University; Carnegie Mellon, 1993—.

MICHAEL J. LEVINE, Professor of Physics — Ph.D., California Institute of Technology; Carnegie Mellon, 1998—.

LING-FONG LI, Professor of Physics — Ph.D., University of Pennsylvania; Carnegie Mellon, 1974—.

BARRY B. LUOKKALA, Principal Lecturer — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1990—.

SARA A. MAJETICH, Professor of Physics — Ph.D., University of Georgia; Carnegie Mellon, 1990—.

CURTIS A. MEYER, Professor of Physics — Ph.D., University of California, Berkeley; Carnegie Mellon, 1993—.

COLIN J. MORNINGSTAR, Assistant Professor of Physics — Ph.D., University of Toronto; Carnegie Mellon, 2000—.

JOHN F. NAGLE, Professor of Physics and Biological Sciences — Ph.D., Yale University; Carnegie Mellon, 1967—.

MANFRED PAULINI, Associate Professor of Physics — Ph.D., University of Erlangen, Germany; Carnegie Mellon, 2000—.

JEFFREY B. PETERSON, Associate Professor of Physics — Ph.D., University of California, Berkeley; Carnegie Mellon, 1993—.

BRIAN P. QUINN, Professor of Physics — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1988—.

IRA Z. ROTHSTEIN, Associate Professor of Physics — Ph.D., University of Maryland at College Park; Carnegie Mellon, 1997—.

JAMES S. RUSS, Professor of Physics — Ph.D., Princeton University; Carnegie Mellon, 1967—.

REINHARD A. SCHUMACHER, Professor of Physics — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1987—.

ROBERT F. SEKERKA, University Professor of Physics and Mathematics — Ph.D., Harvard University; Carnegie Mellon, 1969—.

ROBERT M. SUTER, Professor of Physics — Ph.D., Clark University; Carnegie Mellon, 1981—.

ROBERT H. SWENDSEN, Professor of Physics, — Ph.D., University of Pennsylvania; Carnegie Mellon, 1984—.

STEPHANIE TRISTRAM-NAGLE, Senior Research Biologist — Ph.D., University of California, Berkeley; Carnegie Mellon, 1982—.

HELmut Vogel, Professor of Physics — Ph.D., University of Erlangen-Nuremberg; Carnegie Mellon, 1983—.

MICHAEL WIDOM, Professor of Physics — Ph.D., University of Chicago; Carnegie Mellon, 1985—.

Emeritus Faculty

LUC BERGER, Professor Emeritus of Physics — Ph.D., University of Lausanne, Switzerland; Carnegie Mellon, 1960—.

RICHARD M. EDELSTEIN, Professor Emeritus of Physics — Ph.D., Columbia University; Carnegie Mellon, 1960—.

ARNOLD ENGler, Professor Emeritus of Physics — Ph.D., University of Berne, Switzerland; Carnegie Mellon, 1962—.

JOHN G. FETKOVICH, Professor Emeritus of Physics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1959—.

Simeon A. FRIEDBERG, Professor Emeritus of Physics — D.Sc., Carnegie Institute of Technology; Carnegie Mellon, 1953—.

Truman Kohman, Adjunct Emeritus Professor of Physics — Ph.D., University of Wisconsin; Carnegie Mellon, 1948—.

Robert W. Kraemer, Professor Emeritus of Physics — Ph.D., Johns Hopkins University; Carnegie Mellon, 1965—.

John A. Rayne, Professor Emeritus of Physics — Ph.D., University of Chicago; Carnegie Mellon, 1963—.

Robert T. Schuchacher, Professor Emeritus of Physics — Ph.D., University of Illinois; Carnegie Mellon, 1957—.

Raymond A. Sorenson, Professor Emeritus of Physics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1961—.

Ned S. Vander Veen, Professor Emeritus of Physics — Ph.D., Princeton University; Carnegie Mellon, 1961—.

Lincoln Wolfenstein, University Professor Emeritus of Physics — Ph.D., University of Chicago; Carnegie Mellon, 1948—.

Hugh D. Young, Professor of Physics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1956—.

Joint Appointments and Courtesy Appointments

Shelley Anna, Assistant Professor, Mechanical Engineering — Ph.D., Harvard University; Carnegie Mellon, 2003—.

David Greve, Professor, Electrical and Computer Engineering — Ph.D., Lehigh University; Carnegie Mellon, 1982—.

Morton Kaplan, Professor, Chemistry — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1970—.

Michael E. McHenry, Professor, Materials Science and Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1989—.

Benoit Morel, Adjunct Senior Lecturer, Engineering and Public Policy — Ph.D., University of Geneva, Switzerland; Carnegie Mellon, 1993—.

Robert White, Director, Data Storage Systems Center, Electrical and Computer Engineering — Ph.D., Stanford University; Carnegie Mellon, 1993—.

Jian-Gang Zhou, Professor of Electrical and Computer Engineering — Ph.D., University of California San Diego; Carnegie Mellon, 1997—.
Carnegie Mellon University founded one of the first Computer Science departments in the world in 1965. Today, the Computer Science Department forms the centerpiece of the School of Computer Science, and is joined by the Center for Automated Learning and Discovery, the Entertainment Technology Center, the Human-Computer Interaction Institute, the Institute for Software Research, International, the Language Technologies Institute, and the Robotics Institute. Together, these units make the School of Computer Science a world leader in research and education.

The B.S. program in Computer Science combines a solid core of Computer Science courses with the ability to gain substantial depth in another area through a required minor in a second subject. In addition, the curriculum provides numerous choices for science and humanities courses. As computing is a discipline with strong links to many fields, this provides students with unparalleled flexibility to pursue allied (or non-allied) interests. The curriculum’s mathematics and statistics component ensures that students have the formal tools to remain current as technologies and systems change, rather than be limited by a narrow focus on programming alone. At the same time, students gain insight into the practical issues of building and maintaining systems by participating in intensive project-oriented courses. Due to the tremendous number of ongoing research projects within the School, many students obtain part-time or summer jobs, or receive independent study credit, working on research while pursuing their undergraduate degree. Students seeking a research/graduate school career may pursue an intensive course of research, equivalent to four classroom courses, culminating in the preparation of a senior research honors thesis.

Students apply to, and are directly admitted into, the undergraduate program in Computer Science and, upon successful completion, are awarded a Bachelor of Science in Computer Science. Sufficiently prepared students from other Carnegie Mellon colleges are eligible to apply for internal transfer to the School of Computer Science and will be considered for transfer if space is available. Computation-oriented programs are also available within the Departments of Biology, Chemistry, Physics, Electrical and Computer Engineering, Information Systems, Philosophy, Psychology, and Design. Also, a double major in Human-Computer Interaction is available through the College of Humanities & Social Sciences.

**Curriculum — B.S. in Computer Science**

### Computer Science

- **15-111** Intermediate/Advanced Programming (students with no prior programming experience take 15-100 & 15-200)
- **15-113** Systems Skills in C (mini)
- **15-128** Freshman Immigration Course
- **15-211** Fundamental Data Structures and Algorithms
- **15-212** Principles of Programming
- **15-213** Introduction to Computer Systems
- **15-251** Great Theoretical Ideas in Computer Science I
- **15-451** Algorithm Design and Analysis

#### One Applications course:

- **15-381** Artificial Intelligence: Representation & Problem Solving
- **15-384** Robotic Manipulation
- **15-385** Computer Vision
- **15-415** Database Applications
- **15-462** Computer Graphics
- **16-362** Mobile Robot Programming Laboratory
- xx-xxx others as appropriate

#### One Fundamentals of Algorithms course:

- **15-351** Great Theoretical Ideas in Computer Science II
- **15-354** Computational Discrete Mathematics
- **21-301** Combinatorics
- **21-373** Algebraic Structures
- **21-484** Graph Theory
- xx-xxx others as appropriate

One Fundamentals of Programming course:

- **15-312** Foundations of Programming Languages
- **15-399** Constructive Logic
- **15-453** Formal Languages and Automata
- **17-651** Models of Software Systems
- **21-300** Basic Logic
- **80-310** Logic and Computation
- **80-311** Computability and Incompleteness
- xx-xxx others as appropriate

One Systems Programming course:

- **15-410** Operating System Design and Implementation
- **15-418** Parallel Computer Architecture and Programming
- **15-441** Computer Networks
- **18-447** Introduction to Computer Architecture
- xx-xxx others as appropriate

Two Computer Science electives

**Mathematics/Statistics**

- **21-120** Differential & Integral Calculus
- **21-122** Integration, Differential Equations, and Approximation
- **21-127** Concepts of Mathematics
- **21-241** Matrix Algebra (or 21-341, Linear Algebra)

One of the following Probability courses:

- **36-217** Probability Theory and Random Processes or
- **36-225** Introduction to Probability and Statistics I or
- **36-625** Probability and Mathematical Statistics I

**Engineering and Natural Sciences**

Four engineering or science courses are required, of which at least one must have a laboratory component and at least two must be from the same department. At present, courses meeting the lab requirement are:

- **09-101** Introduction to Experimental Chemistry (this 3 unit lab together with 09-105, Introduction to Modern Chemistry, satisfies the lab requirement; 09-101 may be taken concurrently with or subsequent to 09-105)
- **27-100** Materials in Engineering
- **33-104** Experimental Physics (must be taken concurrently with or subsequent to 33-106/111, Physics I for Science Students)
- **85-310** Research Methods in Cognitive Psychology

The following courses cannot be used to satisfy the Engineering and Natural Sciences requirement:

- **09-103** Atoms, Molecules, and Chemical Change
- **09-104** Fundamental Aspects of Organic Chemistry and Biochemistry
- **12-090** Technology and the Environment
- **18-202** Mathematical Foundations of Electrical Engineering
- **33-100** Basic Experimental Physics
- **33-115** Energy and Environmental Issues
- **33-124** Introduction to Astronomy

**Computer Skills Workshop**

The following course is required of all students to familiarize them with the campus computing environment:

- **99-101** Computer Skills Workshop

**Required Minor**

A sequence of courses prescribed by the requirements of the particular department. Completion of a second major (or double degree) also satisfies this requirement. If permitted by the minor or second major department, courses taken in satisfaction of the minor or second major may also count toward any category other than
Computer Science.

Humanities and Arts Requirements

All candidates for the bachelor’s degree must complete a minimum of 72 units offered by the College of Humanities & Social Sciences and/ or the College of Fine Arts. Carnegie Mellon is currently engaged in a university-wide examination of general education under the rubric of General Education. The School of Computer Science fully supports this examination and expects that when this university-wide examination concludes, our general education requirements will be different than they are in this catalog. For now, the general education courses for SCS students are to meet the following distribution requirements:

A. Writing Requirement (9 units)

Complete one of the following:

76-101 Interpretation and Argument
82-085 Reading and Writing in a Multi-Cultural Setting (intended for students who speak English as a second language)

B. Breadth Requirement (27 units)

Complete three courses, one each from Category 1, Category 2, and Category 3:

Category 1: Cognition, Choice and Behavior

80-130 Introduction to Ethics
80-150 Nature of Reason
80-180 Nature of Language
80-181 Language and Thought
80-221 Philosophy of Social Science
80-230 Ethical Theory
80-241 Ethical Judgments in Professional Life
80-242 Conflict, Dispute Resolution
80-270 Philosophy of Mind
80-271 Philosophy and Psychology
85-100 Introduction to Intelligence in Humans, Animals, and Machines
85-102 Introduction to Psychology
85-211 Cognitive Psychology
85-221 Principles of Child Development
85-241 Social Psychology
85-251 Introduction to Personality
85-261 Abnormal Psychology
88-120 Reason, Passion and Cognition

Category 2: Economic, Political and Social Institutions

36-303 Sampling, Survey and Society
70-332 Business, Society and Ethics
73-100 Principles of Economics
79-223 Protest and Dissent in American History
79-231 Crime and Punishment
79-335 Drug Use and Drug Policy
79-345 American Environmental History: Critical Issues
79-350 Theories of International Relations
80-135 Introduction to Political Philosophy
80-136 Social Structure, Public Policy and Ethical Dilemmas
80-235 Political Philosophy
80-236 Philosophy and the Law
80-243 Environment Management and Ethics
80-341 Computers, Society, and Ethics
88-104 Decision Processes in American Political Institutions
88-110 Experiments with Economic Principles
88-205 Comparative Politics

Category 3: Cultural Analysis

57-173 Survey of Western Music History
65-250 Introduction to Religion
70-342 Managing Across Cultures
76-227 Comedy
76-232 African-American Studies
76-241 Introduction to Gender Studies
79-104 Introduction to World History
79-113 Culture and Identity in American Society
79-201 Introduction to Anthropology
79-206 Development of American Culture
79-207 Development of European Culture
79-208 Theory and Practice in Anthropology
79-218 The Roots of Rock & Roll
79-241 African-American History I
79-242 African-American History II
79-270 Chinese Culture and Society
79-368 Poverty, Charity, and Welfare
79-384 Medicine and Society
80-100 What Philosophy Is
80-151 God in the West
80-250 Ancient Philosophy
80-251 Modern Philosophy
80-253 Continental Philosophy
80-254 Analytic Philosophy
80-255 Pragmatism
80-261 Aesthetics of Mass Art
82-273 Introduction to Japanese Language and Culture
82-294 Topics in Russian Language and Culture
82-303 French Culture
82-304 Francophone World
82-325 Introduction to German Studies
82-333 Introduction to Chinese Language and Culture
82-342 Spain: Language and Culture
82-343 Latin America: Language and Culture
82-344 US Latinos: Language and Culture
82-345 Hispanic Literary and Cultural Studies

B. Breadth Requirement (27 units)

Complete three courses, one each from Category 1, Category 2, and Category 3:

Category 1: Cognition, Choice and Behavior

80-130 Introduction to Ethics
80-150 Nature of Reason
80-180 Nature of Language
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80-230 Ethical Theory
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80-270 Philosophy of Mind
80-271 Philosophy and Psychology
85-100 Introduction to Intelligence in Humans, Animals, and Machines
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85-241 Social Psychology
85-251 Introduction to Personality
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80-235 Political Philosophy
80-236 Philosophy and the Law
80-243 Environment Management and Ethics
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57-173 Survey of Western Music History
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82-294 Topics in Russian Language and Culture
82-303 French Culture
82-304 Francophone World
82-325 Introduction to German Studies
82-333 Introduction to Chinese Language and Culture
82-342 Spain: Language and Culture
82-343 Latin America: Language and Culture
82-344 US Latinos: Language and Culture
82-345 Hispanic Literary and Cultural Studies

C. Humanities and Arts Electives (36 units)

Complete 4 non-technical courses of at least 9 units each from the Department of Business Administration or from any of the departments in the College of Humanities & Social Sciences or the College of Fine Arts. Some of the courses taught in these units are considered technical courses and may not be used to satisfy this requirement. The complete list of currently acceptable and not acceptable courses can be found at www.csd.cs.cmu.edu/education/ bscs/hss.html.

Free Electives

A free elective is any Carnegie Mellon course. However, a maximum of nine units of physical education and/or military science (ROTC) courses may used toward fulfilling graduation requirements.

Summary of Degree Requirements:

<table>
<thead>
<tr>
<th>Area</th>
<th>Courses</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science</td>
<td>1 mini + 12</td>
<td>130</td>
</tr>
<tr>
<td>Math/Statistics</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>Engineering/Science</td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>Humanities/Arts</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>Minor/Free Electives</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>Computer Skills Workshop</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Humanities and Arts Electives</td>
<td>(36 units)</td>
<td>360</td>
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Suggested Course Sequence:

Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>15-111 Intermediate/Advanced Program</td>
<td>10</td>
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<td>15-128 Freshman Immigration Course</td>
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<tr>
<td>21-120 Differential &amp; Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-127 Concepts of Mathematics</td>
<td>9</td>
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<tr>
<td>76-101 Interpretation and Argument</td>
<td>9</td>
</tr>
<tr>
<td>99-101 Computer Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx Science/Engineering Course</td>
<td>9</td>
</tr>
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<td><strong>Total</strong></td>
<td><strong>51</strong></td>
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Spring

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<tr>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>15-211 Fundamental Data Structures and Algorithms</td>
</tr>
<tr>
<td>15-251 Great Theoretical Ideas in Computer Science</td>
</tr>
<tr>
<td>21-122 Integration, Differential Equations, and Approximation</td>
</tr>
<tr>
<td>xx-xxx Science/Engineering Course</td>
</tr>
<tr>
<td>xx-xxx Humanities and Arts Elective</td>
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<tr>
<td><strong>Total</strong></td>
</tr>
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Sophomore Year

<table>
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<tr>
<th>Fall</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>15-113 Systems Skills in C</td>
<td>5</td>
</tr>
<tr>
<td>15-212 Principles of Programming</td>
<td>12</td>
</tr>
<tr>
<td>36-217 Probability Theory and Random Processes</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Science/Engineering Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Humanities and Arts Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Minor Requirement / Free Elective</td>
<td>9</td>
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<tr>
<td><strong>Total</strong></td>
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Spring

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>15-213 Introduction to Computer Systems</td>
</tr>
<tr>
<td>15-xxx Computer Science Elective</td>
</tr>
<tr>
<td>21-241 Matrix Algebra</td>
</tr>
<tr>
<td>xx-xxx Science/Engineering Course</td>
</tr>
<tr>
<td>xx-xxx Humanities and Arts Elective</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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Junior Year

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<tr>
<th>Fall</th>
<th>15-xxx</th>
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Spring

| 15-451 | Algorithm Design and Analysis | 9 |
| xx-xxx | Computer Science Elective | 9 |
| xx-xxx | Humanities and Arts Elective | 9 |
| xx-xxx | Minor Requirement / Free Elective | 9 |

Senior Year

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Minimum number of units required for the degree: 360

Suggested Options

The flexibility in the curriculum allows many different schedules, of which the above is only one possibility. For those students looking for some additional guidance in navigating their elective options, we offer the following recommendations of elective choices that might be made for particular concentrations.

Artificial Intelligence

| 15-381 | Artificial Intelligence: Representation and Problem Solving |
| 15-384/5 | Robotic Manipulation / Computer Vision |
| 15-681 | Artificial Intelligence: Machine Learning |
| 80-300 | Minds, Machines, and Knowledge |
| 80-316 | Probability and AI |
| 85-211 | Cognitive Psychology |
| 85-213 | Human Information Processing and Artificial Intelligence |
| 85-419 | Introduction to Parallel Distributed Processing |

Cognitive Modeling

| 05-432 | Cognitive Modeling and Intelligent Tutoring Systems |
| 05-811 | Cognitive Modeling for HCI |
| 85-211 | Cognitive Psychology |
| 85-213 | Human Information Processing and Artificial Intelligence |
| 85-392 | Human Expertise |
| 85-412 | Cognitive Modeling |

Computer Systems

| 15-410 | Operating System Design and Implementation |
| 15-411 | Compiler Design |
| 15-412 | Operating System Practicum |
| 15-441 | Computer Networks |
| 18-240 | Fundamentals of Computer Engineering |
| 18-447 | Introduction to Computer Architecture |

Entrepreneurship

| 15-390 | Entrepreneurship for Computer Science |
| 15-391 | Technology Consulting in the Community |

Graphics/Virtual Reality

| 05-331 | Building Virtual Worlds |
| 15-462 | Computer Graphics |
| 15-463 | Rendering and Image Processing |
| 15-493 | Special Topic: Computer Game Programming |
| 15-505 | Special Topic: Animation Art and Technology |

Human-Computer Interaction

| 05-410 | Introduction to Human-Computer Interaction Methods |

Additionally, students who are interested in Human-Computer Interaction are encouraged to look at the description of the Double Major in Human-Computer Interaction on page 97 of the Undergraduate Catalog.

Language Technologies

| 11-741 | Information Retrieval |
| 11-751 | Speech Recognition |
| 15-482 | Human Language Technologies |
| 80-180 | Nature of Language |

Additionally, students who are interested in Language Technologies are encouraged to look at the description of the Minor in Linguistics on page 222 of the Undergraduate Catalog.

Robotics

| 16-362 | Mobile Robot Programming Laboratory |
| 16-363 | Advanced Mobile Robot Programming |
| 24-354 | General Robotics |

Additionally, students who are interested in Robotics are encouraged to look at the description of the Minor in Robotics on page 104 of the Undergraduate Catalog.

Scientific Computation

| 21-259 | Calculus in Three Dimensions |
| 21-260 | Differential Equations |
| 21-320 | Symbolic Programming Methods |
| 21-369 | Numerical Methods |
| 36-410 | Introduction to Probability Modeling |

Additionally, students who are interested in Scientific Computation are encouraged to look at the description of the Minor in Scientific Computing on page 288 in the Undergraduate Catalog as well as the following discipline-specific Computational Science courses:

| 03-310 | Introduction to Computational Biology |
| 09-560 | Molecular Modeling and Computational Chemistry |
| 33-241 | Introduction to Computational Physics |

Software Systems

| 15-312 | Foundations of Programming Languages |
| 15-410 | Operating System Design and Implementation |
| 15-411 | Compiler Design |
| 15-415 | Database Applications |
| 15-441 | Computer Networks |

Theory

| 15-312 | Foundations of Programming Languages |
| 15-453 | Formal Languages and Automata |
| 15-85x | Graduate Theory course |
| 21-301 | Combinatorial Analysis |
| 21-341 | Linear Algebra |
| 21-356 | Principles of Real Analysis I |
| 21-373 | Algebraic Structures |
| 21-484 | Applied Graph Theory |
| 21-600 | Mathematical Logic I |

Graduate School Preparation

Students considering going on to graduate school in Computer Science should take a wide variety of Computer Science and Mathematics courses, as well as consider getting involved in independent research. Additionally, graduate CS courses can be taken with permission of the instructor.

Senior Research Thesis

The goal of the Senior Research Thesis Program is to introduce students to the breadth of tasks involved in independent research, including library work, problem formulation, experimentation, and writing and speaking. In particular, students present a brief midterm progress report each semester, present a public poster session in December, present an oral summary in the year-end university-wide Undergraduate Research Symposium and submit a written thesis in May. Students work closely with faculty advisors to plan and carry out their projects. Projects span the entire senior year, and students receive 18 units of academic credit each semester. Nine of these 18 can be counted toward CS elective requirements, and nine as free elective credits; hence, for most students, the thesis program...
replaces two courses per semester.

**Computer Science as a Secondary Concentration**

The School of Computer Science offers both a Double Major and a Minor in Computer Science.

**Double Major in Computer Science**

The following courses are required for the Double Major in Computer Science:

**Prerequisites:**
- 15-111 Intermediate/Advanced Programming (students with no prior programming experience take 15-100 & 15-200)
- 15-113 System Skills in C (mini)
- 21-120 Differential & Integral Calculus
- 21-122 Integration, Differential Equations, and Approximation
- 21-127 Concepts of Mathematics
- 21-241 Matrix Algebra (or 21-341, Linear Algebra)

**Double Major requirements:**
- 15-211 Fundamental Data Structures and Algorithms
- 15-212 Principles of Programming
- 15-213 Introduction to Computer Systems
- 15-251 Great Theoretical Ideas in Computer Science I
- 15-451 Algorithm Design and Analysis

One Applications course:
- 15-381 Artificial Intelligence: Representation and Problem Solving
- 15-384 Robotic Manipulation
- 15-385 Computer Vision
- 15-415 Database Applications
- 16-362 Mobile Robot Programming Laboratory

One Fundamentals of Algorithms course:
- 15-351 Great Theoretical Ideas in Computer Science II
- 15-354 Computational Discrete Mathematics
- 21-301 Combinatorics
- 21-373 Algebraic Structures
- 21-484 Graph Theory

One Fundamentals of Programming course:
- 15-312 Foundations of Programming Languages
- 15-399 Constructive Logic
- 15-453 Formal Languages and Automata
- 17-651 Models of Software Systems
- 21-300 Basic Logic
- 80-310 Logic and Computation
- 80-311 Computability and Incompleteness

One Systems Programming course:
- 15-410 Operating System Design and Implementation
- 15-418 Parallel Computer Architecture and Programming
- 15-441 Computer Networks
- 18-447 Introduction to Computer Architecture

Two Computer Science electives

One of the following Probability courses:
- 36-217 Probability Theory and Random Processes
- 36-225 Introduction to Probability and Statistics I
- 36-625 Probability and Mathematical Statistics I

**Minor in Computer Science**

The following courses are required for the Minor in Computer Science:

**Prerequisites:**
- 15-111 Intermediate/Advanced Programming (students with no prior programming experience take 15-100 & 15-200)
- 21-127 Concepts of Mathematics

**Minor requirements:**
- 15-211 Fundamental Data Structures and Algorithms
- 15-212 Principles of Programming

One software project course chosen from:
- 15-410 Operating System Design and Implementation

**Two Computer Science electives at the 300-level or higher**

**Double-Counting Restriction**

In order to avoid excessive double-counting, students pursuing a Double Major or Minor in Computer Science must complete at least 6 courses in their home department, of at least 9 units each, none of which are required by (or are cognates for requirements in) the Computer Science major.

**School of Computer Science (SCS) Academic Standards and Actions**

**Grading Practices**

Grades given to record academic performance in SCS are detailed under Grading Practices on page 54 of the Undergraduate Catalog.

**Dean’s List**

SCS recognizes each semester those undergraduates who have earned outstanding academic records by naming them to the Dean’s List. The criterion for such recognition is a quality point average of at least 3.75 while completing a minimum of 36 factorable units and earning no incomplete grades.

**Academic Actions**

In the first year, quality point averages below 1.75 in either semester invoke an academic action. For all subsequent semesters an academic action will be taken if the semester quality point average or the cumulative quality point average (excluding the first year) is below 2.00.

**Probation:** The action of probation will be taken in the following cases:
1. One semester of the first year is below 1.75 QPA;
2. The semester QPA of a student in good standing beyond the first year falls below 2.00.

The term of probation is one semester as a full-time student. First year students are no longer on probation at the end of the second semester if the second semester’s QPA is 1.75 or above. Students in the third or subsequent semester of study are no longer on probation at the end of one semester if the semester QPA and cumulative QPA (excluding the first year) are 2.00 or above.

**Probation Continued:** A student who has had one semester on probation and is not yet meeting minimum requirements but whose record indicates that the standards are likely to be met at the end of the next semester of study is occasionally continued on probation. This action is normally taken only when a student’s semester QPA is above 2.0 but their cumulative QPA is not yet above 2.0.

**Suspension:** A student who does not meet minimum standards at the end of one semester of probation will be suspended.
- A first year student will be suspended if the QPA from each semester is below 1.75.
- A student on probation in the third or subsequent semester of study will be suspended if the semester QPA is below 2.00.

The minimum period of suspension is one academic year (two semesters). At the end of that period a student may return to school (on probation) by:
1. Receiving permission in writing from the assistant dean for undergraduate education,
2. Completing a Return from Leave form from the Registrar’s Office, and
3. Providing transcripts and clearance forms if the student has been in a degree program at another college or university. Academic credit earned in such circumstances will not transfer back to Carnegie Mellon.

Students who have been suspended or have withdrawn are required to absent themselves from the campus (including residence halls and fraternity and sorority houses) within a maximum of two days after
the action and to remain off the campus for the duration of the time specified. This action includes debarment from part-time or summer courses at the university for the duration of the period of the action. Although suspended students may not hold student jobs, students on academic suspension may, under certain circumstances, have a non-student job with the university. Students on disciplinary or administrative suspension may not.

**Drop:** This is a permanent severance. A student who has been suspended and who fails to meet minimum standards after returning to school is dropped.

Students who have been dropped are required to absent themselves from the campus (including residence halls and fraternity and sorority houses) within a maximum of two days after the action.

The relation indicated above between probation, suspension and drop is normal, not binding. In unusual circumstances, the College Council may suspend or drop a student without prior probation.

**Transfer into SCS**

Undergraduate students admitted to colleges at CMU other than SCS and wishing to transfer into SCS during their first year should consult with the Assistant Dean for Undergraduate Education. In general, no undergraduate student will be considered for transfer until after having completed 15-211, Fundamental Data Structures and Algorithms. At that time, the decision to allow transfer will be made based on availability of space in the student’s class and the student’s academic performance.

**Procedure for transfer of students from another university into SCS:**

A student first applies through the Office of Admission. If the Office of Admission believes the applicant is acceptable, the student’s record is sent to SCS for evaluation. Extremely few external transfers are admitted.

**Graduation Requirements**

1. A requirement for graduation is the completion of the program specified for a degree with a cumulative quality point average of 2.00 or higher for all courses taken after the first year.

2. Students must be recommended for a degree by the faculty of SCS.

3. A candidate for the bachelor’s degree must complete at the University a minimum of four semesters of full-time study, or the equivalent of part-time study, comprising at least 180 units of course work.

4. Students will be required to have met all financial obligations to the university before being awarded a degree.

**Modification of Graduation Requirements:** A student may seek permission to modify graduation requirements by petition to the SCS College Council.

**Research and Teaching Faculty**

**VICTOR ADAMCHIK,** Associate Teaching Professor — Ph.D., Byelorussian State University; Carnegie Mellon, 2000—.

**ANASTASSIA AILAMAKI,** Assistant Professor — Ph.D., University of Wisconsin; Carnegie Mellon, 2001—.

**JONATHAN ALDRICH,** Assistant Professor — Ph.D., University of Washington; Carnegie Mellon, 2003—.

**VINCENT ALEVEN,** Systems Scientist — Ph.D., University of Pittsburgh; Carnegie Mellon, 1997—.

**OMEAD AMIDI,** Senior Systems Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1996—.

**DAVID ANDERSEN,** Assistant Professor— Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2005—.

**JOHN ANDERSON,** Walter VanDyke Bingham Professor — Ph.D., Stanford University; Carnegie Mellon, 1978—.

**DIMITRIOS APOSTOLOPoulos,** Senior Systems Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1998—.

**CHRISTOPHER ATKESON,** Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2000—.

**SIMON BAKER,** Research Scientist — Ph.D., Columbia University; Carnegie Mellon, 2000—.

**JOHN BARES,** Associate Research Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1993—.

**ZIV BAR-JOSEPH,** Assistant Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2003—.

**HANS BERLINER,** Research Professor, Emeritus — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1974—.

**ALAN BLACK,** Research Scientist — Ph.D., University of Edinburgh; Carnegie Mellon, 1999—.

**GUY BLELOCH,** Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1988—.

**AVRIM BLUM,** Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1991—.

**LENORE BLUM,** Distinguished Career Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1999—.

**MANUEL BLUM,** Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1999—.

**DAVID BOURNE,** Principal Systems Scientist — M.S., University of Pennsylvania; Carnegie Mellon, 1980—.

**DANIEL BOYARSKI,** Professor — AIGA Professor — M.F.A., Indiana University; Carnegie Mellon, 1982—.

**VLADIMIR BRAJovic,** Research Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1996—.

**STEPHEN BROOKES,** Associate Professor — Ph.D., University College, Oxford; Carnegie Mellon, 1981—.

**RALF BROWN,** Systems Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1993—.

**RANDEL BRYANT,** President’s Professor; Dean, School of Computer Science— Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1984—.

**JAMIE CALLAN,** Associate Professor — Ph.D., University of Massachusetts; Carnegie Mellon, 1999—.

**JAIME CARBONELL,** Allen Newell Professor; Director, Language Technologies Institute — Ph.D., Yale University; Carnegie Mellon, 1979—.

**KATHLEEN CARLEY,** Professor — Ph.D., Harvard University; Carnegie Mellon, 1984—.

**JACOBO CARRASQUEL,** Associate Teaching Professor — M.S., Carnegie Mellon University; Carnegie Mellon, 1984—.

**JEFFREY CARROLL,** Lecturer — Ph.D., University of Wisconsin-Madison; Carnegie Mellon, 2000—.

**HOWIE CHOSET,** Associate Professor — Ph.D., California Institute of Technology; Carnegie Mellon, 1996—.

**MICHAEL CHRISTEL,** Senior Systems Scientist — Ph.D., Georgia Institute of Technology; Carnegie Mellon, 1997—.

**EDMUND CLARKE,** Fore Systems Professor of Computer Science — Ph.D., Cornell University; Carnegie Mellon, 1982—.

**STEVEN COCHRAN,** Senior Systems Scientist — Ph.D., University of Southern California; Carnegie Mellon, 1991—.

**WILLIAM COHEN,** Associate Research Professor — Ph.D., Rutgers University; Carnegie Mellon, 2003—.

**ROBERT COLLINS,** Associate Research Professor — Ph.D., University of Massachusetts; Carnegie Mellon, 1998—.

**ERIC COOPER,** Distinguished Service Professor — Ph.D., University of California at Berkeley; Carnegie Mellon, 1985—.

**ALBERT CORBETT,** Associate Research Professor — Ph.D., University of Oregon; Carnegie Mellon, 1999—.

**TOM CORTINA,** Lecturer— Ph.D., Polytechnic University; Carnegie Mellon, 2004—.

**LORRIE CRANOR,** Associate Research Professor — Ph.D., Washington University; Carnegie Mellon, 2004—.

**KARL CRY, Assistant Professor — Ph.D., Cornell University; Carnegie Mellon, 1998—.**

**STEVE CROSS,** Associate Research Professor — Ph.D., University of Illinois; Carnegie Mellon, 1994—.

**ROGER DANNENBERG,** Associate Research Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1982—.
MARK DERTHICK, Research Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000—.
ANIND DEY, Assistant Professor — Ph.D., Georgia Institute of Technology; Carnegie Mellon, 2004—.
ANTHONY DiGIOIA, Associate Research Professor — M.D., Harvard Medical School; Carnegie Mellon, 1999—.
JOHN DOLAN, Systems Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1997—.
WILLIAM EDDY, Professor — Ph.D., Yale University; Carnegie Mellon, 1976—.
ALEXEI EFROS, Assistant Professor — Ph.D., University of California at Berkeley; Carnegie Mellon, 2004—.
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MAXINE ESKENAZI, Systems Scientist — Ph.D., University of Paris; Carnegie Mellon, 1995—.
SCOTT FAHLMAN, Research Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1978—.
CHRISTOS FALOUTSOS, Professor — Ph.D., University of Toronto; Carnegie Mellon, 1998—.
DAVID FARBER, Distinguished Career Professor — M.S., Stevens Institute of Technology; Carnegie Mellon, 2003—.
GARY FEDDER, Professor — Ph.D., University of California at Berkeley; Carnegie Mellon, 1994—.
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JODI FORLIZZI, Assistant Professor — M.Des., Carnegie Mellon University; Carnegie Mellon, 2000—.
ROBERT FREDERKING, Senior Systems Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1989—.
SUSAN FUSSELL, Systems Scientist — Ph.D., Columbia University; Carnegie Mellon, 1997—.
KAIGHAM GABRIEL, Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1997—.
DAVID GARLAN, Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1990—.
GARTH GIBSON, Associate Professor — Ph.D., University of California, Berkeley; Carnegie Mellon, 1990—.
CLARK GLYMOUR, Alumni University Professor — Ph.D., Indiana University; Carnegie Mellon, 1985—.
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GEOFFREY GORDON, Research Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2001—.
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TUOMAS SANDHOLM, Associate Professor — Ph.D., University of Massachusetts, Amherst; Carnegie Mellon, 2001—.

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RICHARD SCHEINES, Associate Professor — Ph.D., University of Pittsburgh; Carnegie Mellon, 1990—.

HAGEN SCHEMPF, Principal Systems Scientist — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1990—.

WILLIAM SCHERLIS, Professor — Ph.D., Stanford University; Carnegie Mellon, 1989—.

JEFF SCHNEIDER, Associate Research Professor — Ph.D., University of Rochester; Carnegie Mellon, 1998—.

HENRY SCHNEIDERMAN, Research Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000—.

TANYA SCHLUTZ, Research Scientist — Ph.D., University of Karlsruhe; Carnegie Mellon, 2000—.

DANA SCOTT, Hillman University Professor — Ph.D., Princeton University; Carnegie Mellon, 1981—.

STEVEN SEO, Assistant Professor — Ph.D., University of Wisconsin; Carnegie Mellon, 1998—.

TEDDY SEIDENFELD, Herbert A. Simon Professor — Ph.D., Columbia University; Carnegie Mellon, 1985—.

MICHAEL SHAMOS, Principal Systems Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1985—.

MARY SHAW, Alan Perlis Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1971—.

JIANBO SHI, Research Scientist — Ph.D., University of California, Berkeley; Carnegie Mellon, 1999—.

JANE SIEGEL, Senior Systems Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1993—.

MEL SIEGEL, Senior Research Scientist — Ph.D., University of Colorado; Carnegie Mellon, 1982—.

DANIEL SIEWIOREK, Buhl Professor, Director HCI Institute — Ph.D., Stanford University; Carnegie Mellon, 1972—.

REID SIMMONS, Research Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1988—.

SANJIV SINGH, Associate Research Professor — Ph.D., Carnegie Mellon, 1987—.
Mellon University; Carnegie Mellon, 1995—.

DONALD SLATER, Lecturer — B.S., Pennsylvania State University; Carnegie Mellon, 2000—.

DANIEL SLEATOR, Professor — Ph.D., Stanford University; Carnegie Mellon, 1985—.

STEPHEN SMITH, Research Professor — Ph.D., University of Pittsburgh; Carnegie Mellon, 1984—.

PETER SPIRTES, Professor — Ph.D. University of Pittsburgh; Carnegie Mellon, 1982—.

THOMAS STAHOVICH, Associate Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1996—.

PETER STEENKISTE, Professor — Ph.D., Stanford University; Carnegie Mellon, 1987—.

MARK STEHLIK, Teaching Professor; Assistant Dean for Undergraduate Education — B.S., Pace University; Carnegie Mellon, 1982—.

ANTHONY STENTZ, Research Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1989—.

GEORGE STETTEN, Research Scientist — Ph.D., University of North Carolina, Chapel Hill; Carnegie Mellon, 1999—.

SCOTT STEVENS, Senior Systems Scientist — Ph.D., University of Nebraska; Carnegie Mellon, 1987—.

KLAS SUTNER, Teaching Professor — Ph.D., University of Munich; Carnegie Mellon, 1995—.

LATANYA SWEENEY, Assistant Professor — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1998—.

KATIA SYCARA, Research Professor — Ph.D., Georgia Institute of Technology; Carnegie Mellon, 1987—.

SCOTT THAYER, Systems Scientist — Ph.D., University of Tennessee; Carnegie Mellon, 2000—.

CHARLES THORPE, Research Professor; Dean, Qatar Campus — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1984—.

JAMES TOMAYKO, Teaching Professor — D.A., Carnegie Mellon University; Carnegie Mellon, 1985—.

DAVID TOURETZKY, Research Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1984—.

MANUELA VELOSO, Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1987—.

HOWARD WACHTLAR, Alumni Research Professor of Computer Science — M.S., University of Maryland; Carnegie Mellon, 1967—.

DIETER WALTERMANN, Senior Systems Scientist — Ph.D., University of Texas, Austin; Carnegie Mellon, 1991—.

ALEXANDER WAIHEL, Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1986—.

LARRY WASSERMAN, Professor - Ph.D., University of Toronto; Carnegie Mellon, 1988—.

LEE WEISS, Research Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1983—.

DAVID WETTERGREEN, Associate Research Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000—.

RED WHITTAKER, Fredkin Research Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1989—.

JEANNETTE WING, Professor; Computer Science Department Head — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1985—.

JIE YANG, Research Scientist — Ph.D., University of Akron; Carnegie Mellon, 1997—.

YIMING YANG, Professor — Ph.D., Kyoto University; Carnegie Mellon, 1996—.

HUI ZHANG, Associate Professor — Ph.D., University of California, Berkeley; Carnegie Mellon, 1995—.
The Tepper School of Business (TSB) at Carnegie Mellon University conducts educational programs not only at the undergraduate level (see p. 185 for the program in Economics and p. 233 for the program in Business Administration) but also at the masters, doctoral, and executive levels. The school attracts students of outstanding promise and produces professional leaders who are prepared to manage in a rapidly changing marketplace. From its inception more than 40 years ago, TSB has been at the forefront of innovation in management education. The school’s pioneering pedagogical achievements in scientific problem solving and interdisciplinary teamwork have been adopted by many prestigious business schools. TSB’s commitment to excellence has consistently earned the school a ranking among the top business schools in the nation.

The undergraduate and masters students in TSB gain a solid foundation in the fundamental scientific disciplines of economics, the behavioral sciences, and the management sciences. The program emphasizes the functional areas of accounting, information systems, finance, marketing, production management, and human resources management. In addition, students attain analytical problem-solving skills, computing skills, and written and oral communication skills. The curriculum culminates in the application of knowledge to real-world problems, so that students can integrate and apply what they have learned. TSB is not content with teaching traditional approaches but develops innovative courses and programs.

At TSB, research and education are closely related. The outstanding faculty of TSB develops new ideas and brings results of its research to the students, demonstrating the importance of critical thinking and of a continuing search for excellence. TSB has a strong and active faculty that confronts both applied problems and fundamental issues of long-range concern. The faculty is particularly renowned for cutting-edge work in operations research, economics, management information systems, finance, accounting, marketing, and operations management/production. TSB alumni have a remarkable track record of success and leadership in management and management education. They are represented internationally in the ranks of the Fortune 500 companies, as heads of dynamic entrepreneurial ventures, and as leading faculty members in Americas top academic institutions. Moreover, TSB alumni provide a strong network for new graduates.

3-2 Program for Carnegie Mellon Students

All Carnegie Mellon undergraduates with outstanding academic performance are eligible to apply to the Tepper School of Business for TSB’s prestigious MBA program. Students who are accepted bypass their senior year as undergraduates and earn both their bachelors degree and their MBA degree in five years. Applicants to the 3-2 program are evaluated not only on their academic achievement but also on their maturity, commitment, sense of direction, and interpersonal and communications skills. Their experiences in summer internships and their extracurricular activities are also evaluated. Admission to the MBA program is highly competitive, and 3-2 applicants compete with the entire applicant pool for spaces in the program. Students interested in the 3-2 program should read the MBA catalog, available from the TSB Admissions Office (TSB Room 149-C). They should also talk with their individual departments concerning completion of their undergraduate requirements.
BRYAN R. ROUTLEDGE, Associate Professor of Finance — Ph.D., University of British Columbia; Carnegie Mellon, 1995—.

ALAN SCHELLER-WOLF, Associate Professor of Manufacturing and Operations Management — Columbia University; Carnegie Mellon, 1996—.

NICOLA SECOMANDI, Assistant Professor of Operations Management and Manufacturing – Ph.D., University of Houston; Carnegie Mellon, 2003—.

DUANE J. SEPPI, Head, Master of Science in Computational Finance; Professor of Financial Economics — Ph.D., University of Chicago; Carnegie Mellon, 1986—.

HOLGER SIEG, Associate Professor of Economics — Ph.D., Carnegie Mellon; Carnegie Mellon, 2001—.

PATRICK SILEO, Director, BA/BS in Economics Program and Associate Teaching Professor of Economics — Ph.D., Carnegie Mellon; Carnegie Mellon, 2000—.

TAL SIMONS, Visiting Assistant Professor of Organizational Behavior and Theory — Ph.D., Cornell University; Carnegie Mellon, 2002-03.

VISHAL SINGH, Assistant Professor of Marketing — Ph.D. Northwestern University; Carnegie Mellon, 2002—.

MARVIN A. SIRBU, Professor of Engineering and Public Policy, Industrial Administration, and Electrical and Computer Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1985—.

SANDRA A. SLAUGHTER, Associate Professor in Information Systems — Ph.D., University of Minnesota; Carnegie Mellon, 1995—.

MICHAEL D. SMITH, Assistant Professor of Management Information Systems (Heinz School and TSB) — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2000—.

FALLAW B. SOWELL, Associate Professor of Economics — Ph.D., Duke University; Carnegie Mellon, 1988—.

CHESTER S. SPATT, Mellon Bank Professor of Finance and Director, Center for Financial Markets — Ph.D., University of Pennsylvania; Carnegie Mellon, 1979—.

STEPHEN E. SPEAR, Professor of Economics — Ph.D., University of Pennsylvania; Carnegie Mellon, 1982—.

KANNAN SRIVIVASAN, H. J. Heinz II Professor of Management, Marketing and Information Systems and Director, Center for E-Business Innovation (eBI) — Ph.D., University of California, Los Angeles; Carnegie Mellon, 1986—.

SANJAY SRIVASTAVA, Associate Dean, Intellectual Strategy; Alumni Professor of Economics and Finance and Director, Financial Analysis and Securities Trading (FAST) Program — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1982—.

ANTHONY P. STANTON, Director, Graphic Media Management Program; Associate Teaching Professor of Graphic Media Management — Ph.D., University of Minnesota; Carnegie Mellon, 1996—.

BAOHONG SUN, Associate Professor of Marketing — Ph.D., University of Southern California; Carnegie Mellon, 1997—.

SRIDHUR R. TAYUR, The Ford Distinguished Research Chair Professor and Professor of Operations Management and Manufacturing — Ph.D., Cornell University; Carnegie Mellon, 1991—.

CHRIS I. TELMER, Associate Professor of Financial Economics — Ph.D., Queens University (Canada); Carnegie Mellon, 1992—.

FRENKEL TER HOFSTEDE, Assistant Professor of Marketing — Ph.D., Wageningen University; Carnegie Mellon, 1999—.

GERALD L. THOMPSON, Emeritus Professor of Systems and Operations Research — Ph.D., University of Michigan; Carnegie Mellon, 1959—.

JOHN R. THORNE, Emeritus David T. and Lindsay J. Morgenthaler Professor of Entrepreneurship— M.S.I.A., Carnegie Institute of Technology; Carnegie Mellon, 1972—.

MICHAEL A. TRICK, The Bosch Professorship; Professor of Operations Research and President, Carnegie Bosch Institute for Applied Studies in International Management — Ph.D., Georgia Institute of Technology; Carnegie Mellon, 1988—.

DAVID E. TUNGATE, Associate Teaching Professor of Law – LL.B. University of Illinois School of Law; Carnegie Mellon, 1991—.

LAURIE R. WEINGART, Professor of Organizational Behavior and Theory — Ph.D., Northwestern University; Carnegie Mellon 1989—.

JEFFREY R. WILLIAMS, Professor of Business Strategy — Ph.D., University of Michigan; Carnegie Mellon, 1977—.

RICHARD O. YOUNG, Associate Teaching Professor in Management Communication — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1985—.


**Part-Time Faculty**

CAROLYN HESS ABRAHAM, Adjunct Professor of Business Management — M.B.A., Columbia University Graduate School of Business; Carnegie Mellon, 1990—.

THOMAS N. CANFIELD, Adjunct Professor of Entrepreneurship — M.B.A., Harvard University; Carnegie Mellon, 1983-.

BABS BAILEY CARRYER, Adjunct Professor of Entrepreneurship — MPM, Carnegie Mellon; Carnegie Mellon, 1998—.

SANJAY CHOPRA, Adjunct Professor of E-Commerce — MSIA (MBA), Carnegie Mellon; Carnegie Mellon, 2001—.

CARL A. COHEN, Adjunct Professor of Law — J.D., University of Pittsburgh; Carnegie Mellon, 2003—.

LLOYD CORDER, Adjunct Professor of Marketing — Ph.D., University of Pittsburgh; Carnegie Mellon, 2000—.

ROBERT F. CULBERTSON III, Adjunct Professor of Entrepreneurship — MSIA and MS Engineering, Carnegie Mellon; Carnegie Mellon, 1999—.

SAM DEEP, Adjunct Professor of Management and Strategy — MBA, University of Pittsburgh; Carnegie Mellon, 1998—.

ROB DILLON, Adjunct Professor of Graphic Communications — B.A., University of Pittsburgh; Carnegie Mellon, 2001—.

CLIFFORD T. EARLY, Adjunct Professor of Law — J.D. University of Pittsburgh; Carnegie Mellon, 2000—.

THOMAS F. FAUGHT, JR., Adjunct Professor of Business Strategy — MBA, Harvard Business School; Carnegie Mellon, 2001—.

ANDREW HANNAH, Adjunct Professor of Entrepreneurship — MBA, University of Pittsburgh; Carnegie Mellon, 2002—.

JOSEPH S. HORNACK, Adjunct Professor of Law — J.D., Rutgers, The State University of New Jersey; Carnegie Mellon, 1990—.

ROBERT E. KELLEY, Adjunct Professor of Organizational Behavior and Theory — Ph.D. Columbia University; Carnegie Mellon, 1981—.

DAVID LANCIA, Adjunct Professor of Taxation — M.S., Robert Morris College; Carnegie Mellon, 2000—.

HANS LANGE, Adjunct Professor of Consulting — MBA, Harvard University; Carnegie Mellon, 1991—.

JOHN LANKFORD, Adjunct Professor of Marketing — MBA, The University of Michigan; Carnegie Mellon, 1998—.

PETER ORESICK, Adjunct Professor of Graphic Communication — MFS in Writing, University of Pittsburgh; Carnegie Mellon, 2001—.

MICHAEL J. POCHAN, Adjunct Professor of Entrepreneurship — MSIA, Carnegie Mellon; Carnegie Mellon, 1999—.

VESNA PRASNIKAR, Visiting Professor of Strategy — Ph.D., University of Pittsburgh; Carnegie Mellon, 2000—.

NORMAN ROBERTSON, Adjunct Professor of Economics — B.Sc., University of London; Carnegie Mellon, 1985—.

PETER J. ROMAN, Adjunct Professor of Marketing — BSBA, Providence College; Carnegie Mellon, 2002—.

FREDERICK H. RUETER, Adjunct Professor of Economics — Ph.D., Carnegie Mellon; Carnegie Mellon, 1988—.

RICHARD P. SIMMONS, Distinguished Adjunct Professor of Business Management — B.S., Massachusetts Institute of Technology; Carnegie Mellon, 2002—.

JOEL STERN, Adjunct Professor of Finance — MBA, University of Chicago; Carnegie Mellon, 1996—.

DAVE WATTERSON, Adjunct Professor of Graphic Communications — B.A., Carnegie Mellon; Carnegie Mellon, 2002—.

TIMOTHY J. ZAK, Adjunct Professor of Operations Management and Manufacturing — MBA, New York University; Carnegie Mellon, 2002—.
Undergraduate Business Administration Program

Milton Cofield, Executive Director

The Business Administration Program, a unit of the Tepper School of Business, is intended for undergraduate students interested in a broadly-based undergraduate management education. The academic requirements are flexible enough to accommodate students pursuing a wide variety of goals. The BA curriculum has six basic elements: core functional business courses, core economics courses, core mathematics and computing courses, breadth requirements, depth requirements, and unrestricted electives.

Students can meet the depth requirement in one of two ways: (1) by completing one of several BA Tracks which are designed to give a deeper understanding of various management-related areas; (2) by doing an approved minor with an outside department (a double major can substitute for a minor).

BA students are encouraged to spend a semester abroad to gain international experience. Carnegie Mellon’s Office of International Education maintains an extensive library of programs in international locations.

Upon graduation, students are prepared to begin professional work in all areas of management. Historically, about 40-50% of the BA program graduates eventually obtain an MBA. Additionally, many students go on to law school or further study in any of several academic disciplines such as economics and computational finance.

For students who are majors in other departments of the university, the BA Program offers a second major and a minor program. Students interested in studies in management are invited to discuss these possibilities with BA Program advisors. Further information can be obtained from the BA office, located in the Tepper School of Business, room 137.

BA Major Requirements

To receive a degree in Business Administration, students must complete at least 364 units, consisting of three basic core sequences, as well as breadth, depth and general elective requirements.

Curriculum Overview

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Business Core</td>
<td>111</td>
</tr>
<tr>
<td>Economics Core</td>
<td>36</td>
</tr>
<tr>
<td>Mathematics/Computing Core</td>
<td>50</td>
</tr>
<tr>
<td>Breadth Requirement *</td>
<td>81</td>
</tr>
<tr>
<td>Depth Requirement *</td>
<td>54</td>
</tr>
<tr>
<td>General Electives *</td>
<td>32</td>
</tr>
<tr>
<td>** Total: 364 **</td>
<td></td>
</tr>
</tbody>
</table>

These requirements break down as follows:

Functional Business Core

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-100 Introduction to Business</td>
<td>9</td>
</tr>
<tr>
<td>70-122 Introduction to Accounting</td>
<td>9</td>
</tr>
<tr>
<td>70-201 Professional and Service Projects</td>
<td>9</td>
</tr>
<tr>
<td>70-311 Organizational Behavior</td>
<td>9</td>
</tr>
<tr>
<td>70-332 Business and Society</td>
<td>9</td>
</tr>
<tr>
<td>70-340 Business Communications</td>
<td>9</td>
</tr>
<tr>
<td>70-345 Oral Communications</td>
<td>9</td>
</tr>
<tr>
<td>70-371 Production and Operations Management</td>
<td>9</td>
</tr>
<tr>
<td>70-381 Marketing</td>
<td>9</td>
</tr>
<tr>
<td>70-391 Finance</td>
<td>9</td>
</tr>
<tr>
<td>70-401** Management Game</td>
<td>12</td>
</tr>
<tr>
<td>70-451 Management Information Systems</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total: 111</strong></td>
<td></td>
</tr>
</tbody>
</table>

* Approximately, depending on student’s course selection (i.e., some students may select courses such as language courses that provide more units).

** or Business Leadership and Strategy (70-440), 12 units.

Economics Core

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-100* Principles of Economics</td>
<td>9</td>
</tr>
<tr>
<td>73-200 Macroeconomics</td>
<td>9</td>
</tr>
<tr>
<td>73-251 Economic Theory</td>
<td>9</td>
</tr>
<tr>
<td>70-208** Regression and Forecasting</td>
<td>9</td>
</tr>
<tr>
<td>** or Econometrics (73-261)</td>
<td></td>
</tr>
</tbody>
</table>

Mathematics/Computing Core Units

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-100 Intro/Inter Programming</td>
<td>10</td>
</tr>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-255** Multivariate Analysis and Approximation</td>
<td>9</td>
</tr>
<tr>
<td>21-257* Models and Methods of Optimization</td>
<td>9</td>
</tr>
<tr>
<td>70-207 Probability and Statistics for Business</td>
<td>9</td>
</tr>
<tr>
<td>99-101 or 99-102 Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>** or Calculus in 3-D (21-259)</td>
<td></td>
</tr>
<tr>
<td>** or Operations Research (21-292)</td>
<td></td>
</tr>
</tbody>
</table>

Breadth Requirements

The categories used to define the BA Program’s breadth requirements are those given by the BA General Education Program (see the end of this section).

Required:

79-104 Introduction to World History
76-101 Interpretation and Argument

Choose 1 from each category:

- Science & Technology;
- Cognition, Choice & Behavior;
- Political & Social Institutions.

Choose 1 from each, plus a 3rd from either:

Creative Production & Reflection;
Cultural Analysis.

Choose 1 from: any of the above categories.

Depth Requirements

The depth requirement may be satisfied by completing either of the following: (1) a BA Track (see below); (2) a BA approved minor with another department (a double major can substitute for a minor). A BA Track consists of a menu of courses (both required and elective) of which the student must complete, in most cases, six (54 units). Since the particular courses may vary, students should contact the BA office for an up-to-date list of BA Tracks and their associated courses.

Students must consult with a BA track advisor for approval of their track selection. Presently, BA offers the following Tracks:

- Computing and Information Technology
- Entrepreneurship
- Finance
- General Management
- Graphic Media Management
- International Management
- Manufacturing Management and Consulting
- Marketing

Unrestricted Electives

BA Students must complete a total of at least 364 units in order to graduate. Thus, in addition to the courses in the Functional Business Core, the Economics Core, the Mathematics/Computing Core, the Breadth requirements, and the Depth requirement (one track or approved minor), students must complete additional general electives of their choosing. Normally, students must do 32-36 units of general electives, depending on their other course selection. Students may use at most 9 units of Pass/Fail credit towards their graduation requirement. BA students must complete at least 364 units in order to graduate.
Suggested Curriculum

What follows is a suggested curriculum for BA students. Students are strongly encouraged to meet with a BA advisor to plan ahead and ensure that normal progress towards a degree is being made. Be careful to observe any prerequisite and corequisite requirements for each course. These are given in the course descriptions found at the back of this catalog.

First Year

<table>
<thead>
<tr>
<th>Term</th>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>21-120</td>
<td>Calculus</td>
</tr>
<tr>
<td></td>
<td>70-100</td>
<td>Introduction to Business</td>
</tr>
<tr>
<td></td>
<td>70-104</td>
<td>Business History</td>
</tr>
<tr>
<td></td>
<td>76-101</td>
<td>Interpretation and Argument *</td>
</tr>
<tr>
<td></td>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
<tr>
<td></td>
<td>99-101 or 102</td>
<td>Computing Skills Workshop</td>
</tr>
<tr>
<td>Spring</td>
<td>21-256</td>
<td>Multivariate Analysis and Approximation</td>
</tr>
<tr>
<td></td>
<td>73-100</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td></td>
<td>79-104</td>
<td>Introduction to World History *</td>
</tr>
<tr>
<td></td>
<td>15-100</td>
<td>Intro/Inter Programming</td>
</tr>
<tr>
<td></td>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
</tbody>
</table>

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* Or breadth (general education) course; BA students will take either 76-101 or 79-104 in the fall and the other in the spring of the first year

Sophomore Year

<table>
<thead>
<tr>
<th>Term</th>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>21-257*</td>
<td>Models and Methods of Optimization</td>
</tr>
<tr>
<td></td>
<td>70-122</td>
<td>Introduction to Accounting</td>
</tr>
<tr>
<td></td>
<td>70-207</td>
<td>Probability &amp; Statistics for Business</td>
</tr>
<tr>
<td></td>
<td>73-200</td>
<td>Macroeconomics</td>
</tr>
<tr>
<td></td>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
</tbody>
</table>

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Spring **

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-208</td>
<td>Regression &amp; Forecasting</td>
</tr>
<tr>
<td>70-311</td>
<td>Organizational Behavior</td>
</tr>
<tr>
<td>70-340</td>
<td>Business Communications</td>
</tr>
<tr>
<td>73-251</td>
<td>Economic Theory</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
</tbody>
</table>

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*or Operations Research I (21-292), offered in spring semesters only.

** Business majors must complete 70-201, Professional and Service Projects, by the end of the junior year. Transfer students must complete the course within two years after entering the BA Department. The course involves career-related and service activities in which the student participates over a period lasting as long as four semesters. Students should not register until the semester in which they expect to complete their activities. This course will not be counted when determining whether or not business majors are carrying a full load.

Junior Year

<table>
<thead>
<tr>
<th>Term</th>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>70-371</td>
<td>Production and Operations Management</td>
</tr>
<tr>
<td></td>
<td>70-381</td>
<td>Marketing</td>
</tr>
<tr>
<td></td>
<td>70-391</td>
<td>Finance</td>
</tr>
<tr>
<td></td>
<td>70-451</td>
<td>Management Information Systems</td>
</tr>
<tr>
<td></td>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
</tbody>
</table>

45

Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-332</td>
<td>Business and Society</td>
</tr>
<tr>
<td>70-345</td>
<td>Oral Communications</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Depth course</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Depth course</td>
</tr>
</tbody>
</table>

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Additional Major/Minor Requirements

Students from other departments may complete either an additional major or a minor in Business Administration as follows:

Requirements for an Major in Business Administration

Students seeking an additional major in BA are required to complete all of the courses in each of the three core sequences: Functional Business Core; except 70-100 or 70-101 Economics Core; Mathematics/Computing Core.

Requirements for a Dual Degree in Business Administration

Students seeking a dual degree in BA must meet all the requirements for the additional major including the breadth courses and a depth track or an approved minor or additional major that is not part of their first degree. Their total units completed must be at least 90 more than the requirements for the first degree.

Minor in Business Administration

Requirements (See Business Administration Department for substitutions):

Prerequisite Courses:

- One of the following:
  - 36-201, 207, 220, 226, 247, or 310
  - 73-100 Principles of Economics
  - 21-257 Models and Methods of Optimization
  - 21-292 Operations Research I

Choose 2:

- 70-122 Introduction to Accounting
- 70-311 Organizational Behavior
- 70-451 Management Information Systems*

Choose 2:

- 70-371 Production and Operations Management [prerequisites: (21-257 or 21-292), (70-207 or 36-202 or 36-220 or 36-226 or 36-247 or 36-310)]
- 70-381 Marketing
- 70-391 Finance [prerequisites: 70-122, (21-257 or 21-292), (70-207 or 36-202 or 36-220 or 36-226 or 36-247 or 36-310)]

Any 70-xxx or 73-xxx course (200 level or above). **

* Students majoring in IS or CS may not select 70-451 but may make an alternative selection with a BA advisor.
Minor in Management (CFA students only)

Requirements (See Business Administration Department for substitutions):

73-100 Principles of Economics
70-101 Introduction to Business Management*
70-311 Organizational Behavior

Choose 1 of the following:

70-122 Introduction to Accounting
70-332 Business, Society and Ethics
70-340 Business Communications
70-381 Marketing

Choose 2:

Any 70-xxx or 73-xxx course (200 level or above).**

*Open to first and second year students only; other students must select an alternative course with a BA advisor.

**except 70-393, 70-394, 70-401, 70-440.

International Management Minor

Prerequisite: 9 units

73-100 Principles of Economics

Introductory Business Courses: 18 units

70-122 Introduction to Accounting
and
70-381 Marketing
or
70-332 Business, Society and Ethics

Required: 39 units

70-342 Managing Across Cultures
70-365 International Trade Law
70-430 International Management
70-480 International Marketing
70-508 Independent Study in International Management (3 units minimum). This involves cultural preparation for the experience abroad.

Experience Abroad:

At least one semester of study abroad, or a substantial internship abroad (e.g., 1 summer or 1 semester), or both. Study abroad should provide substantial immersion in the culture. The country used for the study abroad may not be the student’s home country. Contact the minor advisor for assistance.

Language Requirement:

Demonstrated proficiency in a language other than English, to the satisfaction of the track advisor. (This may be, but is not necessarily, the same language used during the experience abroad.) Proficiency may be demonstrated in three ways:

1. Long-term residence in a country that requires knowledge and regular use of the language (normally the case for international students);
2. Successful completion of at least one semester of courses taught in the language in a country where it is spoken, or employment that requires knowledge of this language.
3. Completion of a Modern Languages Department minor or major or it’s equivalent.

Non-Carnegie Mellon Courses

Students may only count two courses taken outside of Carnegie Mellon towards the minor. Students must petition the minor advisor in advance of taking the course. Credit for an approved course will be awarded upon receipt of a transcript indicating a grade of C or better.

Business Administration General Education ("Breadth") Course Categories

[Note: one course required in each category; one additional course required in either "Creative Production and Reflection" or "Cultural Analysis"; one additional course also required in any category]

World History (one course required):

79-104 Introduction to World History

Writing/Expression (one course required):

76-101 Interpretation and Argument
80-085 Reading and Writing in a Multicultural Setting (for non-native speakers of English)

Science and Technology (one course required):

(check catalog for pre- and co-requisites)

03-121 Modern Biology
03-122 Organismic Botany
03-124 Modern Biology Laboratory
03-125 Evolution and the History of Life
03-130 Biology of Organisms
03-240 Cell Biology
06-100 Introduction to Chemical Engineering
09-103 Atoms, Molecules and Chemical Change (non-major)
09-104 Fundamental Aspects of Organic Chemistry and Biochemistry (non-major)
09-105 Introduction to Modern Chemistry
09-106 Modern Chemistry II
12-100 Introduction to Civil and Environmental Engineering
15-211 Fundamental Structures of Computer Science I (prerequisites: 15-127, 21-127)
15-212 Fundamental Structures of Computer Science II (prerequisite: 15-211)
18-100 Introduction to Electrical and Computer Engineering
19-101 Introduction to Engineering and Public Policy
24-101 Fundamentals of Mechanical Engineering
27-100 Materials in Engineering
33-102 Concepts of Modern Physics
33-xxx Physics I for Engineering Students
33-xxx Physics II for Engineering Students
33-xxx Physics I for Science Students
33-xxx Physics II for Science Students
33-114 Physics of Musical Sound
33-115 Energy and Environmental Issues (non-major)
33-124 Introduction to Astronomy
66-210 Science and Technology for the Environment

Cognition, Choice and Behavior (one course required):

80-110 Nature of Mathematical Reasoning
80-150 The Nature of Reason
80-180 The Nature of Language
80-181 Language and Thought
80-242 Conflict and Dispute Resolution
80-305 Rational Choice
85-100 Introduction to Intelligence in Humans, Animals, and Machines
85-102 Introduction to Psychology
85-211 Cognitive Psychology
85-213 Human Information Processing and Artificial Intelligence
85-219 Biological Foundation of Behavior
85-221 Child Development
85-241 Social Psychology
85-251 Personality
85-261 Abnormal Psychology
88-120 Reason, Passion, and Social Cognition

Political and Social Institutions (one course required):

36-203 Sampling, Surveys, and Society (prerequisite: 36-202 or 70-208)
79-231 American Foreign Policy: 1945 to Present
79-333 History of Biomedical Research
79-335 Drug use and Drug Policy
79-350 Theories of International Relations
Creative Production and Reflection
(Some of the courses in this category are offered for fewer than 9 units. Students must take a minimum of 9 units to fulfill the requirement in this category. BA students are encouraged to select language courses to meet this requirement.)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>48-095</td>
<td>Architecture for Non-Majors</td>
</tr>
<tr>
<td>51-261/262</td>
<td>Communications Design Fundamentals</td>
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<tr>
<td>51-263</td>
<td>Industrial Design Fundamentals</td>
</tr>
<tr>
<td>54-187/188</td>
<td>Introduction to Playwriting (6 units)</td>
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<tr>
<td>57-117</td>
<td>Choral Ensemble for Non-majors (6 units; audition required)</td>
</tr>
<tr>
<td>57-118</td>
<td>Instrumental Ensemble for Non-majors (6 units; audition required)</td>
</tr>
<tr>
<td>62-102/103</td>
<td>Modern Dance Workshop (6 units)</td>
</tr>
<tr>
<td>62-161/162</td>
<td>Photography, Video and Filmmaking</td>
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<tr>
<td>62-248</td>
<td>Music in American Society</td>
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<tr>
<td>70-240</td>
<td>Business Acting (same as 54-191/192 Acting for Non-Majors)</td>
</tr>
<tr>
<td>76-206</td>
<td>The Craft of Creative Writing</td>
</tr>
<tr>
<td>76-211</td>
<td>Books You Should Have Read by Now</td>
</tr>
<tr>
<td>76-245</td>
<td>Shakespeare: Histories and Tragedies</td>
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<tr>
<td>80-120</td>
<td>Reflections on Science</td>
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<tr>
<td>80-130</td>
<td>Introduction to Ethics</td>
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<tr>
<td>80-211</td>
<td>Arguments and Inquiry</td>
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<td>80-241</td>
<td>Professional Ethics</td>
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<tr>
<td>80-242</td>
<td>Conflict and Dispute Resolution</td>
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<tr>
<td>80-243</td>
<td>Business Ethics</td>
</tr>
<tr>
<td>80-244</td>
<td>Management, Environment and Ethics</td>
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<tr>
<td>80-270</td>
<td>Philosophy of Mind</td>
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<tr>
<td>80-280</td>
<td>Introduction to Linguistic Analysis</td>
</tr>
<tr>
<td>82-xxx</td>
<td>Any course in the Department of Modern Languages</td>
</tr>
</tbody>
</table>

Cultural Analysis (one course required):
(check catalog for prerequisites)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>76-201</td>
<td>Literature and the Social</td>
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<tr>
<td>76-227</td>
<td>Comedy</td>
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<tr>
<td>76-230</td>
<td>19th Century American Literature and Culture</td>
</tr>
<tr>
<td>79-113</td>
<td>Culture and Identity in American Social Life</td>
</tr>
<tr>
<td>79-201</td>
<td>Introduction to Anthropology</td>
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<tr>
<td>79-203</td>
<td>Introduction to Social History</td>
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<tr>
<td>79-204</td>
<td>Twentieth Century America</td>
</tr>
<tr>
<td>79-205</td>
<td>Twentieth Century Europe: Collapse and Renewal</td>
</tr>
<tr>
<td>79-206</td>
<td>Development of American Culture</td>
</tr>
<tr>
<td>79-207</td>
<td>Development of European Culture</td>
</tr>
<tr>
<td>79-216</td>
<td>Music and Counter Culture in the 1950s/1960s</td>
</tr>
<tr>
<td>79-217</td>
<td>The Roots of Rock and Roll</td>
</tr>
<tr>
<td>79-219</td>
<td>The Holocaust in Historical Perspective</td>
</tr>
<tr>
<td>79-220</td>
<td>Early Christianity</td>
</tr>
<tr>
<td>79-223</td>
<td>Protest and Dissent in American History</td>
</tr>
<tr>
<td>79-225</td>
<td>Religions of Asia</td>
</tr>
<tr>
<td>79-228</td>
<td>The American Built Environment, Part I: 1000-1800</td>
</tr>
<tr>
<td>79-230</td>
<td>Technology in American Society</td>
</tr>
<tr>
<td>79-232</td>
<td>Vietnam: America's Lost War</td>
</tr>
<tr>
<td>79-241</td>
<td>African-American History I</td>
</tr>
<tr>
<td>79-242</td>
<td>African-American History II</td>
</tr>
<tr>
<td>79-250</td>
<td>Europe’s Two Revolutions</td>
</tr>
<tr>
<td>79-253</td>
<td>The Caribbean: History and Culture</td>
</tr>
<tr>
<td>79-255</td>
<td>Irish History</td>
</tr>
<tr>
<td>79-259</td>
<td>Native American History: 19th and 20th Centuries</td>
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<tr>
<td>79-260</td>
<td>Mayan America</td>
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<tr>
<td>79-270</td>
<td>Chinese Culture and Society</td>
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<tr>
<td>79-271</td>
<td>Modern China</td>
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<tr>
<td>79-290</td>
<td>Modern Latin America</td>
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<tr>
<td>79-301</td>
<td>Ritual Performance and Time</td>
</tr>
<tr>
<td>79-302</td>
<td>The Arts in Society: French Modernism</td>
</tr>
<tr>
<td>79-307</td>
<td>The Anthropology of Europe</td>
</tr>
<tr>
<td>79-325</td>
<td>Arts and Religion</td>
</tr>
<tr>
<td>79-326</td>
<td>Other People's Lives: Biography, Autobiography, Microhistory</td>
</tr>
<tr>
<td>79-329</td>
<td>Sex, Population, Birth Control</td>
</tr>
<tr>
<td>79-331</td>
<td>Crime and Punishment in American History</td>
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<tr>
<td>79-340</td>
<td>History of Modern Warfare</td>
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<tr>
<td>79-345</td>
<td>American Environmental History</td>
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<td>79-348</td>
<td>Gifts, Commodities, and Money</td>
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<td>79-352</td>
<td>The Arab-Israeli Conflict: War and Peace</td>
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<tr>
<td>79-356</td>
<td>African History: Earliest Times to the Origins of the Slave Trade</td>
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<tr>
<td>79-370</td>
<td>Gender and Science</td>
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<td>79-374</td>
<td>Women in Modern India</td>
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<td>79-375</td>
<td>Children and Childhood in America</td>
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<tr>
<td>79-379</td>
<td>Women in American History</td>
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<tr>
<td>79-392</td>
<td>The Family</td>
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<td>79-395</td>
<td>The Arts in Pittsburgh</td>
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<tr>
<td>79-397</td>
<td>Religion and Politics in the Middle East</td>
</tr>
<tr>
<td>80-100</td>
<td>What Philosophy Is</td>
</tr>
<tr>
<td>80-151</td>
<td>God in the West</td>
</tr>
<tr>
<td>80-180</td>
<td>The Nature of Language</td>
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<tr>
<td>80-181</td>
<td>Language and Thought</td>
</tr>
<tr>
<td>82-4xx</td>
<td>(Any 400-level Modern Language course)</td>
</tr>
</tbody>
</table>

Two additional Breadth (general education) requirements:
One additional course from either “Creative Production and Reflection” or “Cultural Analysis”
One additional course from any of the Breadth (general education) categories.

Business Administration Academic Standards and Actions

Grading
Grading regulations for undergraduate students are detailed on p. 48-49.

Withdrawing from Courses
The Department of Business Administration follows the Carnegie Mellon policies on withdrawing from courses:

1. Students who wish to withdraw from a course must do so before the published university deadline. After that date, students are allowed to withdraw from a course following Carnegie Mellon University policies, with permission of a BA advisor.

2. A student carrying a full-time course load (defined as at least 36 factorable units) as of the 10th regularly-scheduled day of classes may not drop below 36 units after that day without the permission of their academic advisor.

College Academic Actions
Students carrying either a full-time course load (defined as 36 or more factorable units) or a part-time course load (defined as fewer than 36 factorable units) are subject to BA academic actions.

Dean’s List
Students who receive a semester QPA of 3.50 or higher (while taking at least 36 factorable units and receiving no incompletes) will be placed on the Dean’s List for that semester; students who receive a semester QPA of 3.75 or higher (while taking at least 36 factorable units and receiving no incompletes) will be placed on the Dean’s List with High Honors for that semester.

Other Actions
Students are subject to academic action if they fail to meet minimal progress toward their degree. Minimal progress is defined as achieving a semester QPA of at least 2.00 while passing at least 36 units of factorable coursework. Students who begin a semester enrolled in 36 or more units and later drop below 36 units are subject to academic action regardless of their semester QPA.

Probation
Probation occurs when a student’s semester or cumulative record fails to meet the minimal standards listed above. Students are removed from probation if they complete at least 36 factorable units and raise their cumulative QPA above a 2.00 (minus the first year if that is higher). Probation may be continued if the student’s cumulative record does not meet minimum standards but their semester record suggests that they may do so by the end of the next semester.

Suspension
If a student fails to meet minimal standards at the end of the probation semester, they will be suspended. Suspension is for a minimum of one year and the student is required to follow University procedures for departing from campus. At the end of the year, the student may make a written request to return to Carnegie Mellon. This request must include transcripts for any courses taken at other colleges or universities during the suspension and letters of reference...
from any place of employment during that period. If their request is approved it is their responsibility to file a “Return from Leave of Absence Form” with the HUB. Students return from suspension on probation.

Drop

A student that fails to meet minimum standards at any point after returning from a suspension is subject to a drop action. A drop action is a permanent severance; the student is required to follow University procedures for departing from campus and may not enroll again in the future.

The typical progression of academic actions is Probation, Suspension, or Drop but one or more of these steps may be bypassed in an unusual case.

Other Regulations Affecting Student Status

Carrying an Overload

A BA student must have attained a QPA of at least 3.00 in the previous semester to carry an overload (defined as more than 48 units). If a student carrying an overload is in severe academic difficulty during the semester, the department may withdraw the student from the overload course.

Adding and Dropping Courses

The last date to add courses is the one stipulated for each semester on the University Calendar, usually 10 days after the beginning of the semester for full-semester courses.

The last date to drop courses is the date stipulated on the University Calendar each semester, usually about two weeks after mid-semester grades are due in the Registrar’s Office for full-semester courses. A student must follow university regulations to drop any course after the university drop deadline; no course may be dropped for any reason after the last day of classes. In any case, a full-time student is expected to maintain a load of at least 36 units. A student may withdraw from the college (and from the university) following university procedures for student leave (see p. 33). Exceptions to the above regulations will be granted only upon approval of a petition to the Business Administration Program.

Transferring to Business Administration from Other Colleges at Carnegie Mellon

Undergraduate students may transfer to the Business Administration program on a space available/academic performance basis. First year students, however, may not be considered for transfer until spring mid-semester grades are posted. We do not accept transfer students from other universities.

Non-Carnegie Mellon Courses

Students may receive credit for courses taken outside of Carnegie Mellon if they successfully petition the BA Department in advance for permission. Students must take these courses for a letter grade. Credit (but not the grade) will transfer for courses with a grade of C or higher. Students may not receive credit for more than five non-CMU courses during their undergraduate career. With the written permission of the BA Program, students may receive credit for courses taken at other institutions. Students must receive a grade equivalent to at least a “C” at a four-year institution and at least a “B” at a two-year institution. Students must take Functional Business Core, Economics Core and Mathematics/Computing Core classes at a four-year institution. The Department makes exceptions for students studying abroad and students on suspension may petition to take up to five courses during their suspension.

Academic Advising

Students are required to meet with a BA advisor at least once each semester to ensure that they are making normal progress towards their degree. In addition, students following a BA track should meet with their track advisor at least once each semester. It is the individual student’s responsibility to make sure that he or she fulfills the requirements for graduation.

The College Honors Program

Business Students with outstanding academic records (a minimum overall QPA of 3.50) may undertake an Honors Thesis. The topic is of the student’s choice but must have some original aspect in the question being explored, the data set, or in the methods that are used. It must also be of sufficient academic rigor to meet the approval of a faculty advisor with expertise in the project’s area. Students should identify a topic and faculty advisor in the spring of their junior year so that they may begin research the following summer. During their senior year students earn 18 units of credit through independent study and graduate with “College Honors” if the resulting thesis paper is of sufficient quality.

Graduation Requirements

In order to graduate with the Bachelor of Science in Business Administration, students must meet all requirements specified for the program with a cumulative quality point average of at least 2.00 for all courses taken after the first year.

Students must also meet all university residence requirements and meet all financial obligations to the university before being awarded a degree.

A student may seek permission to modify graduation requirements by petition to the BA Program.
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<td>Chemical Engineering (06-xxx)</td>
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<td>Chemistry (09-xxx)</td>
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<td>Civil and Environmental Engineering (12-xxx)</td>
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<td>Computer Science (15-xxx)</td>
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<td>Electrical and Computer Engineering (18-xxx)</td>
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<td>Engineering and Public Policy (19-xxx)</td>
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<td>Mathematical Sciences (21-xxx)</td>
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<td>Mechanical Engineering (24-xxx)</td>
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<td>Materials Science and Engineering (27-xxx)</td>
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<td>Military Science - Army ROTC (30-xxx)</td>
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<td>Aerospace Studies - Air Force ROTC (31-xxx)</td>
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<td>Naval Science - Navy ROTC (32-xxx)</td>
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<td>Physics (33-xxx)</td>
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<td>Statistics (36-xxx)</td>
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<td>Carnegie Institute of Technology Interdisciplinary (39-xxx)</td>
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<td>Biomedical Engineering (42-xxx)</td>
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<td>Architecture (48-xxx)</td>
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<td>Design (51-xxx)</td>
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<td>Drama (54-xxx)</td>
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<td>Art (60-xxx)</td>
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<td>College of Fine Arts Interdisciplinary (62-xxx)</td>
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<td>H&amp;SS Interdisciplinary (62-xxx)</td>
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<td>Physical Education (69-xxx)</td>
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<td>Business Administration (70-xxx)</td>
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<td>Economics (73-xxx)</td>
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<td>English (76-xxx)</td>
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<td>History (79-xxx)</td>
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<td>Modern Languages (82-xxx)</td>
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<td>Psychology (85-xxx)</td>
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<tr>
<td>Social and Decision Sciences (88-xxx)</td>
<td>495</td>
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</tbody>
</table>
Course Descriptions

Biological Sciences
Undergraduate Courses

03-050 Study Abroad
Fall: 0 units

03-051 Study Abroad
Spring: 0 units

03-101 Biological Sciences First Year Seminars
Fall and Spring: Mini Session - 3 units
Various seminars are offered that introduce first-year students to current topics of modern biology. These are mini courses that meet for half a semester. Topics have included: Proteins in Disease, Genes and Diseases, Pills and Poisons, Curing Cancer, Organ Transplantation & Blood Substitutes, and Prions — Mad Cows and Englishman. Courses restricted to first year students in the Mellon College of Science.

03-121 Modern Biology
Fall and Spring: 9 units
This is an introductory course that provides the basis for further studies in biochemistry, cell biology, genetics and molecular biology. This course emphasizes the chemical principles underlying biological processes and cell structures as well as the analysis of genetics and heredity from a molecular perspective. This is the introductory biology course for all science and non-science majors.

03-122 Organismic Botany
Spring: 9 units
This course provides an integrated overview of botany at the level of organism and above, including historical perspectives. It provides an introduction to the subdivisions of systematics, evolution, plant geography, and ecology, and surveys the anatomical, morphological, developmental, and environmental diversification of major groups within the plant kingdom.
Prerequisites: 03121

03-124 Modern Biology Laboratory
Fall and Spring: 9 units
This laboratory is designed to introduce students to modern concepts in the biological sciences. The experiments illustrate many of the principles covered in 03-121 and 03-130. Experimentation using living organisms and/or their tissues, cells or molecules is an essential component of this course. Special permission required.
Prerequisites: Corequisites: 03-121

03-125 Evolution and History of Life
Intermittent: 9 units
This course surveys the pattern and process of biological evolution. Major topics include: historical recognition of evolutionary pattern (biological diversity in geological time); foundation theory of evolutionary process; relationships of the major domains/kingdoms of life; early Earth and prebiotic evolution; origin of nucleic acids and self-replication; origin of prokaryotes; endosymbiosis and origin of the eukaryotic cell; origin and evolution of protoclasts, fungi, plants, and animals; modern theory of evolutionary process, including microevolution, speciation, and macroevolution; relationship of evolution and systematics; molecular approaches to the study of evolution and the construction of phylogenies.
Prerequisites: 03121

03-130 Biology of Organisms
Spring: 9 units
This course will survey the major organ systems, with an emphasis on cellular physiology and biochemistry. Current ideas of research and scientific controversy will also be presented. This course is intended to broaden students' exposure to biological systems.
Prerequisites: 03121

03-201 Undergraduate Colloquium for Sophomores
Fall: 1-3 units
The purpose of this seminar series is to update biology undergraduates about university and departmental functions, seminars, etc., that are pertinent or useful. In addition, research talks by faculty and undergraduates will be used to introduce students to the research being conducted in faculty laboratories. Additional topics may include graduate and medical school applications, career options, topics in the press, and important scientific discoveries.

03-202 Undergraduate Colloquium for Sophomores
Spring: 1-3 units

03-210 Independent Study
Fall and Spring: 3-9 units
Students will read papers from the original literature under the direction of a faculty member. Students will be required to demonstrate mastery of the readings by discussions with the sponsoring faculty member, oral presentations, or writing of one or more papers summarizing and extending the information in the readings. If appropriate, students may write a paper(s) to satisfy this last requirement. A student may take this course only once. Special permission required.

03-231 Biochemistry I
Fall: 9 units
This course provides an introduction to molecules and processes found in living systems. Amino acids, sugars, lipids and nucleotides and their corresponding higher structures, the proteins, polysaccharides, membranes and nucleic acids are studied. Kinetics and mechanisms of enzymes as well as elementary metabolic cycles and the energetics of biological systems are discussed.
Prerequisites: 03121 Corequisites: 09-217

03-232 Biochemistry I
Spring: 9 units
This course provides an introduction to the application of biochemistry to biotechnology. The functional properties of amino acids, nucleotides, lipids, and sugars are presented. This is followed by a discussion of the structural and thermodynamic aspects of the organization of these molecules into higher-order structures, such as proteins, nucleic acids, and membranes. The kinetics and thermodynamics of protein-ligand interactions are discussed for non-cooperative, cooperative, and allosteric binding events. The use of mechanistic and kinetic information in enzyme characterization and drug discovery are discussed. Topics pertinent to biotechnology include: antibody production and use, energy production in biochemical systems, expression of recombinant proteins, and methods of protein purification and characterization. The course is an alternate to 03-231.
Prerequisites: 09217 Corequisites: 09-106 or 06-221

03-240 Cell Biology
Spring: 9 units
This course provides descriptive information and mechanistic detail concerning key cellular processes in six areas: membrane function, protein targeting, signaling, cytoskeleton, cell division, and cell interaction. An attempt is made to introduce the methodology that was used to obtain this information and to discuss how our understanding of these processes relates to the treatment of human disease.
Prerequisites: 03121 and (03231 or 03232)

03-301 Undergraduate Colloquium for Juniors
Fall: 1-3 units

03-302 Undergraduate Colloquium for Juniors
Spring: 1-3 units

03-310 Introduction to Computational Biology
Spring: 9 units
This course covers the application of computers to solve problems in biology and medicine. Since computers are increasingly used in biological research, the course is valuable for all biological sciences majors and interested students from other departments. It is intended for students without computer programming experience (students with a desire to apply programming methods to these problems should take the more advanced course 03-510, Computational Biology). Topics covered are computational molecular biology (analysis of protein and nucleic acid sequences), biological modeling and simulation (including computer models of neuron behavior, biochemical kinetics, and simulation of mutation), and biological imaging. Course work consists primarily of homework assignments making use of software packages for these applications. Students may only use one of the following for credit, 03-310, 03-
311, 03-510 or 03-710. Prerequisites: (21118 or 21112) AND 03121 AND (99101 or 99102 or 99103).

03-311 Introduction to Computational Molecular Biology
Spring: Mini Session - 6 units
This course presents both the theoretical underpinnings of computational methods used in modern molecular biology and practical training in the use of these methods. It is intended for students without computer programming experience. Topics include: accessing Internet molecular biology resources, restriction enzyme analysis, finding protein coding regions (open reading frames), sequence alignment, homology searching, finding sequence features (e.g., promoters), and elementary protein structure prediction. Course work consists primarily of homework assignments making use of software packages for these applications. Students may only use one of the following for credit, 03-310, 03-311, 03-510 or 03-710. Prerequisites: 03121 and (99101 or 99102 or 99103)

03-315 Magnetic Resonance Imaging in Neuroscience
Spring: 9 units
The course is designed to introduce students to the fundamental principles of magnetic resonance imaging (MRI) and its application in neuroscience. MRI is emerging as the preeminent method to obtain structural and functional information about the living human brain. This methodology has helped to revolutionize neuroscience and the study of human cognition. The specific topics covered in this course will include: introduction to spin gymnastics, survey of imaging methods, structural brain mapping, functional MRI (fMRI), and MR spectroscopy (MRS). Approximately, one third of the course will be devoted to introductory concepts of magnetic resonance, another third to the discussion of MRI methods, and the remaining third will cover a broad range of neuroscience applications. Guest lectures will be incorporated into the course from neuroscientists and psychologists who use MRI in their own research. Prerequisites: 03121 AND (21117 or 21121 or 21122)

03-330 Genetics
Fall: 9 units
The mechanisms of transmission of inherited traits in viruses, bacteria, fungi, plants and animals are discussed. Molecular mechanisms of gene expression and gene regulation are analyzed. Recombinant DNA and cloning of genes and their uses and applications in genetic analysis, biotechnology, forensics, agriculture, medicine, and the pharmaceutical industry are presented. The coding capacity, genes and genomes of diverse organisms for which total DNA sequence information is available are considered. A special topic in human genetics is considered yearly; recent examples are the genetics of cancer, hypercholesterolemia, and human behavioral genetics. Prerequisites: 03231 or 03232

03-343 Experimental Techniques in Molecular Biology
Fall: 12 units
This laboratory course is designed to teach experimental methods of modern biology. Experiments in microbial genetics and physiology, molecular biology and eukaryotic genetics are performed. This course is designed to be taken during the junior year and is intended to prepare students for undergraduate research. Experimentation using living organisms and/or their tissues, cells or molecules is an essential component of this course. Prerequisites: (03231 or 03232) and 09222 Corequisites: 03-330

03-344 Experimental Biochemistry
Spring: 12 units
This course is designed to be taken as a sequel to 03-343. Experiments cover a variety of methods for investigating the structure and function of biological molecules. Experimental methods with proteins, enzyme kinetics, carbohydrates, lipids, and isolation and quantitation of biological molecules are covered. During the experiments, students design their own projects in kinetics and GFP isolation. Experimentation using living organisms and/or their tissues, cells or molecules is an essential component of this course. Prerequisites: (03231 or 03232) and 03343

03-345 Experimental Cell and Developmental Biology
Spring: 12 units
This laboratory is designed to teach concepts and experimental methods in cell and developmental biology. Students work with a variety of organisms to examine how cells traverse development from rapidly dividing, undifferentiated cells, through cell commitment and the establishment of spatial and temporal patterns of gene expression, to the specific characteristics and responses of terminally differentiated cells. The course makes extensive use of video microscopy with phase contrast, DIC and fluorescence microscopes. Biochemical, immunological and molecular biological techniques are used to probe the molecules and processes of cells undergoing development. Experimentation using living organisms and/or their tissues, cells or molecules is an essential component of this course. Prerequisites: (03231 or 03232) and 03240 and 03330 and 03343

03-350 Developmental Biology
Fall: 9 units
Developmental biology is the study of how organisms arise from a single cell -- the fertilized egg. The molecular pathways that control development also underlie many human diseases. Developmental biology encompasses stem cell biology, cell-cell signaling, regulation of gene expression, gene networks, morphogenesis and cell/tissue differentiation. This course serves as an introduction to the major concepts, experimental methodologies, research questions, and model organisms in developmental biology. Prerequisites: 03240

03-360 The Biology of the Brain
Fall: 9 units
The goal of modern neuroscience is to understand the function of the central nervous system using a wide variety of techniques and levels of analysis. This integrative field is actively engaged in addressing questions ranging from the genetics and cell biology of neurons to the perception and behavior of organisms. Topics covered in this course will include the evolution, development and anatomy of the nervous system, the electrophysiology and cell biology of neurons, the function and plasticity of sensory and motor systems and the neurobiology of brain disorders. This course will emphasize unanswered questions in neuroscience and focus on current experimental attempts to answer them. Prerequisites: 03121 or permission of instructor

03-380 Virology
Fall: 9 units
The concepts and methods of virology are studied with emphasis on animal viruses. A wide variety of DNA and RNA viruses, including some new and emergent viruses, are discussed within the framework of genetics, molecular biology, cell biology, immunology and epidemiology. Viral and cellular oncogenes and the processes of oncogenic transformation will be examined. A discussion of prions will also be included. These are novel, proteinaceous, infectious agents which, unlike viruses, lack nucleic acids. Prerequisites: 03240 Corequisites: 03-330

03-390 Molecular and Cellular Immunology
Spring: 9 units
This course offers the student a comprehensive view of modern immunology at the molecular and cellular level. The first half of the course presents the fundamentals of immunology, beginning with innate immunity, followed by a discussion of the structure and function of important molecules in the immune system, such as antibodies, major histocompatibility antigens, and the T-cell receptor. This portion of the course is concluded with a discussion of the development and function of the cellular immune response. The second half of the course is focused on applied immunology and discusses hyper-sensitivity, autoimmune, immunodeficiency, tumor immunology, infectious disease, and transplantation immunology. Presentations at the end of the course provide an opportunity for the student to explore additional topics in contemporary immunology. Prerequisites: (03231 or 03232) and 03240
### Course Descriptions

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
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<tbody>
<tr>
<td>03-401</td>
<td>Undergraduate Colloquium for Seniors</td>
<td>Fall: 1-3 units; Spring: 1-3 units</td>
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<tr>
<td>03-402</td>
<td>Undergraduate Colloquium for Seniors</td>
<td>Fall: 1-3 units; Spring: 1-3 units</td>
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<tr>
<td>03-410</td>
<td>Independent Study Biological Study</td>
<td>Fall and Spring: 3-9 units</td>
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<tr>
<td>03-411</td>
<td>Topics in Research</td>
<td>Fall and Spring: 1-2 units</td>
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<tr>
<td></td>
<td>During the year students attend and submit brief summaries of weekly seminars given by outside speakers or members of the Biology Department on current research topics in modern biology; some seminars outside of the department may be substituted.</td>
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<tr>
<td>03-412</td>
<td>Topics in Research</td>
<td>Spring: 1-2 units</td>
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<tr>
<td></td>
<td>During the year students attend and submit brief summaries of weekly seminars given by outside speakers or members of the Biology Department on current research topics in modern biology. Some seminars outside of the department may be substituted.</td>
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<tr>
<td>03-438</td>
<td>Physical Biochemistry</td>
<td>Fall: 9 units</td>
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<td>The physical properties of biological macromolecules and the methods used to analyze their structure and function are discussed. Topics covered include: protein architecture, folding and molecular evolution; nucleic acid structure; introduction to structure determination by X-ray crystallography and NMR; biological spectroscopy with emphasis on the biological applications of absorption, fluorescence, NMR, and CD spectroscopies; the kinetics and thermodynamics of protein-ligand interactions; enzyme catalysis; the use of hydrodynamics, chromatography and electrophoresis in the characterization of biological macromolecules; and analysis of biological molecules at the single molecule level. Topics will be illustrated by examples from the research literature. Prerequisites: 03231 or 03232 and 09214</td>
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<tr>
<td>03-439</td>
<td>Introduction to Biophysics</td>
<td>Fall: 9 units</td>
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<td>This course develops the physical concepts that apply to the understanding of biological systems. The forces that play roles in biological systems are discussed and the role of thermal energy is especially emphasized. Topics discussed include protein structure, helix-coil transitions, double layer potentials, membrane structure and transport, Nernst-Planck equations and electrochemical potential, molecular motors, and action potentials and voltage sensitive channels. The capstone of the course is the study of the potassium channel in axons. The treatment of biological phenomena and methods is based on physical principles, which will be treated with appropriate mathematics when necessary. Prerequisites: 03121 and 090105 and 33111 and 33112</td>
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<tr>
<td>03-441</td>
<td>The Molecular Biology of Prokaryotes</td>
<td>Spring: 9 units</td>
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<td>The course covers an introduction to the basic molecular techniques used in modern biology research. These are discussed against a background of prokaryotic molecular and genetic analysis of prokaryotic microorganisms with particular attention to certain selected topics. Among the topics covered are: the transcriptional and translational regulation of gene expression at the molecular level in Escherichia coli, the use of prokaryotic replicons in molecular cloning, and the principles of self-assembly and catalyzed assembly of virus particles. Prerequisites: 03231 or 03232 and 03330</td>
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<tr>
<td>03-442</td>
<td>Molecular Biology Of Eukaryotes</td>
<td>Fall: 9 units</td>
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<td>The structure and expression of eukaryotic genes are discussed, focusing on model systems from a variety of organisms including yeast, flies, worms, mice, humans, and plants. Topics discussed include (1) genomics, proteomics, and functional proteomics, (2) control of gene expression at the level of transcription, (3) splicing of pre-mRNA, export of spliced mRNA from the nucleus to the cytoplasm, and translation of mRNA, and (3) chromosome structure, including origins of replication, centromeres, telomeres, transposons, and regulated chromosomal rearrangements. Prerequisites: 03441</td>
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<tr>
<td>03-445</td>
<td>Undergraduate Research</td>
<td>Fall and Spring: 1-18 units</td>
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<td>Students may investigate research problems under the supervision of members of the faculty. Permission of a faculty advisor required.</td>
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<tr>
<td>03-450</td>
<td>Cellular and Genetic Mechanisms of Development</td>
<td>Spring: 9 units</td>
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<td>The development of a single fertilized egg into a complex multicellular organism is an amazing biological phenomenon that we are only beginning to understand. This course will explore our current understanding of the cellular and genetic mechanism that underlie this fundamental process. Focus will be on experimental approaches taken in model systems (C. elegans, Drosophila, mouse, etc.) to unravel the mysteries of development. Topics to be included but not limited to, include, but not limited to, aspects of signal transduction pathway and their consequences, cell cycle regulation, and molecular control of differential gene expression as they relate to developmental processes using examples from the primary literature. The course will be lecture based and include student presentations of current topics from the literature. Prerequisites: 03330 and 03350</td>
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<tr>
<td>03-510</td>
<td>Computational Biology</td>
<td>Spring: 12 units</td>
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<td>This course covers a range of applications of computers to solve problems in biology and medicine. Specific topics covered are computational molecular biology (analysis of protein and nucleic acid sequences), biological modeling and simulation (including computer models of neuron behavior, biochemical kinetics, and simulation of mutation), and biological imaging. Course work will include use of software packages for these applications, reading of scientific papers, and programming assignments. Students may only use one of the following for credit, 03-510, 03-511, 03-510 or 03-710. Prerequisites: 03121 and (15200 or 15211)</td>
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<tr>
<td>03-511</td>
<td>Computational Molecular Biology and Genomics</td>
<td>Fall: 9 units</td>
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<td>An advanced introduction to computational molecular biology, using an applied algorithms approach. The first part of the course will cover established algorithmic methods, including pairwise sequence alignment and dynamic programming, multiple sequence alignment, fast database search heuristics, hidden Markov models for molecular motifs and phylogeny reconstruction. The second part of the course will explore emerging computational problems driven by the newest genomic research. Course work includes four to six problem sets, one midterm and final exam. Prerequisites: (15211 and 03510) or 15451 or Permission of Instructor</td>
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<tr>
<td>03-512</td>
<td>Computational Methods for Biological Modeling and Simulation</td>
<td>Spring: 9 units</td>
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<td>This course covers a variety of computational methods important for modeling and simulation of biological systems. Topics to be included are ones of interest to both graduate and advanced undergraduates with either biological or computational backgrounds who are interested in developing computer models and simulations of biological systems. The course will emphasize practical algorithms and algorithm design methods drawn from various disciplines of computer science and applied mathematics that are useful in biological applications. The general topics covered will be models for optimization problems, simulation and sampling, and parameter tuning. Course work will include problems sets with significant programming components and independent or group final projects. Prerequisites: 03510</td>
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<tr>
<td>03-513</td>
<td>Bioinformatics Data Integration Practicum</td>
<td>Spring: 6 units</td>
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|             | This course will provide a practical experience in integration of bioinformatics data of diverse types in collaboration with a pharmaceutical company or biotechnology company. At the beginning
of the semester, students will be presented with a description of the problem and data sets. During the semester students will work as part of independent teams to design, implement and evaluate an appropriate data integration system (with the opportunity for interaction with the company developers for advice and feedback). The course grade will be based on an oral presentation of the developed software system and a written report describing its development and evaluation. Selected students will have the opportunity to present their work to the company.

Prerequisites: (03310 or 03311 or 03510) and 15211

03-534 Biological Imaging and Fluorescence Spectroscopy

Fall: 9 units

This course covers principles and applications of optical methods in the study of structure and function in biological systems. Topics to be covered include: absorption and fluorescent spectroscopy; interaction of light with biological molecules, cells, and systems; design of fluorescent probes and optical biosensor molecules; genetically expressible optical probes; photochemistry; optics and image formation; transmitted-light and fluorescence microscope systems; laser-based systems; scanning microscopes; electronic detectors and cameras: image processing; multi-mode imaging systems; microscopy of living cells; and the optical detection of membrane potential, molecular assembly, transcription, enzyme activity, and the action of molecular motors. This course is particularly aimed at students in science and engineering interested in gaining in-depth knowledge of modern light microscopy.

Prerequisites: (03231 or 03232) and 03240 and 09218 and (09144 or 09214)

03-545 Honors Research
Fall and Spring: 9 units

This semester of research consists primarily of research and preparation of an acceptable written thesis. Oral presentation and defense of the thesis research will be required. This course ordinarily will be taken in the second semester of the senior year. Permission of the research advisor required.

Prerequisites: 03330

03-620 Techniques in Electron Microscopy
Spring: 9 units

This course is designed to teach basic methods in transmission electron microscopy to graduate and undergraduate students. Sophomores with an interest in electron microscopy are encouraged to enroll, and will have the option and opportunity to utilize their skills in various laboratories during their junior or senior year. The course will be offered once each year, during the spring semester. Course enrollment will be limited to 4-6 students. Preferential enrollment will be given to graduate students and undergraduate students who have demonstrated a need for this technique in their research. The class will include one hour of lecture and 4 hours of laboratory each week (some additional laboratory time outside of the scheduled laboratory time is required). Students will learn basic methods in specimen preparation for both transmission and scanning electron microscopy (fixation, embedding and ultramicrotomy, drying and metal coating) and will be trained in the operation of both the Hitachi 7100 and 2460N electron microscopes. Lectures and laboratories during the last few weeks of the semester will introduce the students to special techniques (e.g. immuno-electron microscopy , cryoultramicrotomy, freeze substitution, variable pressure SEM, etc.) and will allow them to work with samples from their own research. Experimentation using living organisms and/or their tissues, cells or molecules is an essential component of this course. Special Permission

03-711 Computational Molecular Biology and Genomics

Fall: 12 units

An advanced introduction to computational molecular biology, using an applied algorithms approach. The first part of the course will cover established algorithmic methods, including sequence alignment and dynamic programming, multiple sequence alignment, fast database search heuristics, hidden Markov models for molecular motifs and phylogeny reconstruction. The second part of the course will explore emerging computational problems driven by the newest genomic research. Course work includes four to six problem sets, one midterm and final exam. A project based on recent results from the genomics literature will be required of students taking 03-711.

Prerequisites: (15211 and 03510) or 15451 or Permission of instructor

03-712 Computational Methods for Biological Modeling and Simulation
Spring: 12 units

This course covers a variety of computational methods important for modeling and simulation of biological systems. It is intended for graduates and advanced undergraduates with either biological or computational backgrounds who are interested in developing computer models and simulations of biological systems. The course will emphasize practical algorithms and algorithm design methods drawn from various disciplines of computer science and applied mathematics that are useful in biological applications. The general topics covered will be models for optimization problems, simulation and sampling, and parameter tuning. Course work will include problems sets with significant programming components and independent or group final projects.

Prerequisites: 03510

03-713 Bioinformatics Data Integration Practicum
Spring: Mini Session - 6 units

This course will provide a practical experience in integration of bioinformatics data of diverse types in collaboration with a pharmaceutical company or biotechnology company. At the beginning of the semester, students will be presented with a description of the problem and data sets. During the semester students will work as part of independent teams to design, implement and evaluate an appropriate data integration system (with the opportunity for interaction with the company developers for advice and feedback). The course grade will be based on an oral presentation of the developed software system and a written report describing its development and evaluation. Selected students will have the opportunity to present their work to the company.

Prerequisites: (03310 or 03311 or 03510) and 15211

03-730 Advanced Genetics
Spring: 12 units

This course considers selected current topics in genetics at an advanced level. Emphasis is on classroom discussion of research papers. Topics change yearly. Recent topics have included nucleocytoplasmic trafficking of RNA in yeast, genome imprinting in mammals, chromatin boundaries and long distance gene regulation. Must obtain a minimum grade of B in 03-330 to take this course.

Prerequisites: 03330 and 03441 and (03442 or 03742)
03-738 Physical Biochemistry
Fall: 12 units
The physical properties of biological macromolecules and the methods used to analyze their structure and function are discussed. Topics covered include: protein architecture, folding and molecular evolution; nucleic acid structure; introduction to structure determination by X-ray crystallography and NMR; biological spectroscopy with emphasis on the applications of absorption, fluorescence, NMR, and CD spectroscopies; the kinetics and thermodynamics of protein-ligand interactions; enzyme catalysis; the use of hydrodynamics, chromatography and electrophoresis in the characterization of biological macromolecules; and analysis of biological molecules at the single molecule level. One weekly session will be devoted to the detailed analysis of related research publications.
Prerequisites: 03231 or 03232 and (09214 or 09345)

03-740 Advanced Biochemistry
Spring: 12 units
This is a special topics course in which selected topics in biochemistry will be analyzed in depth with emphasis on class discussion of papers from the recent research literature. Topics change yearly. Recent topics have included single molecule analysis of catalysis and conformational changes; intrinsically disordered proteins; cooperative interactions of aspartate transcarbamoylase; and the mechanism of ribosomal protein synthesis.
Prerequisites: 03438 or 03738

03-741 Advanced Cell Biology
Spring: 12 units
This course covers fourteen topics in which significant recent advances or controversies have been reported. For each topic there is a background lecture by the instructor, student presentations of the relevant primary research articles and a general class discussion. Example topics are: extracellular matrix control of normal and cancer cell cycles, force generating mechanisms in trans-membrane protein translocation, signal transduction control of cell motility, and a molecular mechanism for membrane fusion.
Prerequisites: (03231 or 03232) and 03240 and Permission of Instructor

03-742 Molecular Biology Of Eukaryotes
Fall: 12 units
The structure and expression of eukaryotic genes are discussed, focusing on model systems from a variety of organisms including yeast, flies, worms, mice, humans, and plants. Topics discussed include (1) genomics, proteomics, and functional genomics; (2) control of gene expression at the level of transcription of mRNAs from DNA, splicing of pre-mRNA, and translation of mRNA from the nucleus to the cytoplasm, and translation of mRNA; and (3) chromosome structure, including origins of replication, centromeres, telomeres, transposons, and regulated chromosomal rearrangements.
Prerequisites: 03441

03-744 Membrane Trafficking
Spring: 9 units
While the focus of this course is to analyze membrane/protein traffic along both the biosynthetic and endocytic pathways, our general goal is to teach students how to read and interpret the literature. In particular, we emphasize the conclusions and discuss their validity. The course is updated each year to include topics in which new and interesting developments have occurred. Emphasis is placed on how membrane traffic is regulated and where applicable how it is disrupted or subverted during disease processes. The course is of general interest to students, fellows, and faculty interested in cell biology, immunology, neurobiology, pharmacology and virology.
Prerequisites: 03-240 and permission of instructor

03-751 Advanced Developmental Biology
Fall: 12 units
This course examines current topics in developmental biology at an advanced level. The course is team-taught by faculty from Carnegie Mellon University, the University of Pittsburgh Department of Biological Sciences, and the University of Pittsburgh Medical School. Each year several areas of current research are examined. Previous topics have included pattern formation, molecular signaling pathways, morphogen gradients, cell movements, and stem cells. Emphasis is on critical reading of original research papers and classroom discussion, with supporting lectures by faculty. Prerequisites: 03350

03-761 Neural Plasticity in Sensory and Motor Systems
Spring: 9 units
Neural plasticity underlies the capacity of the central nervous system to encode new information, develop new abilities and adapt to the environment. Plasticity is required for learning and is modulated during development and by disorders of the brain. Recent advances in experimental methodology have led to new insights on the biological mechanisms underlying neural plasticity. The topics of the papers chosen for review will center on recent experimental and theoretical studies of topics such as synaptic plasticity, developmental and activity-dependent changes in sensory and motor maps.
Prerequisites: 03360

03-871 Structural Biophysics
Fall: 12 units
This is an intermediate level course directed at providing a comprehensive survey of the major biophysical techniques used for characterizing the structure and dynamics of biological macromolecules. Topics include optical spectroscopy, fluorescence spectroscopy, Electron spin resonance, Nuclear magnetic resonance, and X-ray diffraction. Sufficient theoretical information is provided such that the student will be able to critically read the current literature. Applications of these techniques in the current literature are discussed in class. In addition, an in-depth understanding of the application of the various techniques to a single biological system is attained by analysis of a case study at the end of the semester.
Prerequisites: permission of instructor

Course Descriptions

Chemical Engineering

Undergraduate Courses

06-100 Introduction to Chemical Engineering
Fall and Spring: 12 units
We equip students with creative engineering problem-solving techniques and fundamental chemical engineering material balance skills. Lectures, laboratory experiments, and recitation sessions are designed to provide coordinated training and experience in data analysis, material property estimation for single- and multi-phase systems, basic process flowsheet, reactive and non-reactive mass balances, problem solving strategies and tools, and team dynamics. The course is targeted for CIT First Year students.
Prerequisites: Corequisites: 21-120, 09-105

06-200 Sophomore Research Project
Fall and Spring: 3-12 units
Research projects under the direction of the Chemical Engineering faculty. The nature of the project, the number of units, and the criteria for grading are to be determined between the student and the faculty supervisor. The agreement should then be summarized in a one-page project description for review by the faculty advisor of the student. A final written report or an oral presentation of the results is required.

06-221 Thermodynamics
Fall: 9 units
This course introduces students to the process thermodynamics of single component systems. Topics include equilibrium and thermodynamic state variables; heat and work; conservation of energy and the first law of thermodynamics; entropy balances and the second law of thermodynamics; reversibility; free energies; interconversion of heat and work via engines, refrigeration and power cycles; absolute temperature and the third law of thermodynamics; equations of state; principle of corresponding states; thermodynamic property relationships; changes of state; phase equilibrium and stability in single component systems; vapor pressure and phase transition.
Prerequisites: 06100 and 33106
06-222 Sophomore Chemical Engineering Seminar  
**Fall:** 1 unit  
This course provides an overview of the chemical engineering profession. It discusses the rationale for the curriculum, career paths, resume writing, written communication skills, and ethics, and also involves a project on the use and manufacture of chemicals.

06-261 Fluid Mechanics  
**Spring:** 9 units  
The principles of fluid mechanics as applied to engineering, including unit operations, are discussed; examples include flow in conduits, process equipment, and commercial pipes, flow around submerged objects, and flow measurement. Microscopic mass and momentum balances are described, including the continuity and Navier-Stokes equations, and modern solution techniques will be explored. Microscopic flow structures will be determined for flow visualization. Boundary layer theory, turbulence, and non-Newtonian fluids are also discussed. A case-study project based on new technological advancements is also required.  
Prerequisites: 06100 and 21259  
Corequisites: 06-262

06-262 Mathematical Methods of Chemical Engineering  
**Spring:** 12 units  
Mathematical techniques are presented as tools for modeling and solving engineering problems. Modeling of steady-state mass and energy balance problems using linear and matrix algebra, including Gaussian elimination, decomposition, and iterative techniques. Modeling of unsteady-state engineering problems using linear and nonlinear differential equations. Analytical techniques, including Laplace transforms, and numerical techniques for the solution of first- and higher-order differential equations and systems of differential equations arising in engineering models. Finally, the modeling of processes affected by chance and subject to experimental error; statistical and regression techniques within the context of experimental design and analysis of experimental data.  
Prerequisites: 06221 and 21122

06-300 Junior Research Project  
**Fall and Spring:** 3-12 units  
Research projects under the direction of the Chemical Engineering faculty. The nature of the project, the number of units, and the criteria for grading are to be determined between the student and the faculty supervisor. The agreement should then be summarized in a one-page project description for review by the faculty advisor of the student. A final written report or an oral presentation of the results is required.

06-321 Chemical Engineering Thermodynamics  
**Fall:** 9 units  
The objective of this course is to cover principles and solution techniques for phase and chemical equilibria in multicomponent systems. Topics include thermodynamic properties of ideal and non-ideal mixtures; criteria for equilibrium; chemical potential, fugacity and activity coefficients; flash calculations; Gibbs energy minimization; thermodynamics of chemical reactions including equilibrium conversions.  
Prerequisites: 06221

06-322 Junior Chemical Engineering Seminar  
**Fall:** 2 units  
This course discusses career choices for chemical engineers, professional practice, including alternate career paths, global industry, and graduate studies. It also emphasizes writing, interview skills, and oral presentations. Safety, environmental and ethical issues are illustrated in projects and via invited lectures.

06-323 Heat and Mass Transfer  
**Fall:** 9 units  
This course presents the fundamentals of heat and mass transfer, including steady-state and transient heat conduction and molecular diffusion, convection of heat and mass, and thermal radiation, with application to heat and mass transfer processes. Development of dimensionless quantities for engineering analysis is emphasized.  
Prerequisites: 06262 or 21260

06-361 Unit Operations of Chemical Engineering  
**Spring:** 9 units  
This course comprises many of the standard operations in chemical plants such as gas absorption, heat exchange, distillation and extraction. The design and operation of these devices is emphasized. A project dealing with a novel unit operation is also investigated.  
Prerequisites: 06321 and 06323

06-362 Chemical Engineering Process Control  
**Spring:** 9 units  
This course presents basic concepts of process dynamics and feedback control. Included are selection of measurements and manipulated variables, definition of transfer functions, creation of block diagrams and closed loop configurations. The course also covers concepts of open loop and closed loop stability, and tuning of PID controllers.  
Prerequisites: 06262

06-363 Transport Process Laboratory  
**Spring:** 6 units  
Develop skills for proposing, designing, planning, implementing, interpreting, and communicating the results of experiments in fluid flow and heat and mass transfer. Oral and written reports are required.  
Prerequisites: 06261 and 06323

06-400 Senior Research Project  
**Fall and Spring:** 3-36 units  
Research projects under the direction of the Chemical Engineering faculty. The nature of the project, the number of units, and the criteria for grading are to be determined between the student and the faculty supervisor. The agreement should then be summarized in a one-page project description for review by the faculty advisor of the student. A final written report or an oral presentation of the results is required.

06-421 Chemical Process Systems Design  
**Fall:** 12 units  
Prerequisites: 06321  
Corequisites: 06-422

06-422 Chemical Reaction Engineering  
**Fall:** 9 units  
Fundamental concepts in the kinetic modeling of chemical reactions, the treatment and analysis of rate data. Multiple reactions and reaction mechanisms. Analysis and design of ideal and non-ideal reactor systems. Energy effects and mass transfer in reactor systems. Introduction principles in heterogeneous catalysis.  
Prerequisites: 09347

06-423 Unit Operations Laboratory  
**Fall:** 9 units  
A series of open-ended laboratory projects illustrate the principles of unit operations and process control. Experiments are designed to be relevant to current industrial, environmental, and safety practices. Examples include distilling mixtures, such as ethanol and water; removing pollutants from stack gasses; controlling pH in tank systems with flow; testing mixture explosion properties; operating liquid-liquid extraction systems, such as ethanol and water; designing reactors based on the reaction kinetics of ethane hydrogelenolysis; and separating oxygen and nitrogen in air using a hollow-fiber membrane. Oral and written reports are required.  
Prerequisites: 06361 and 06362

06-426 Experimental Colloid Surface Science  
**Fall:** 9 units  
Laboratory exercises will deal with preparation and stabilization of colloids, flocculation, micellar aggregates, surface tension, contact angle, spreading and adsorption. Basic concepts will be related to practical problems of wetting, lubrication, foaming, adhesion, coatings and corrosion.
06-610 Rheology and Structure of Complex Fluids
Fall: 9 units
This course will cover the basic concepts of rheology and mechanical behavior of fluid systems. Both the experimental and theoretical aspects of rheology will be discussed. The basic forces influencing complex fluid rheology and rheology will be outlined and discussed; including excluded volume, van der Waals, electrostatic and other interactions. Methods of characterizing structure will be covered including scattering techniques, optical polarimetry and microscopy. Examples will focus on several types of complex fluids including polymer solutions and melts, gelling systems, suspensions and self-assembling fluids.
Prerequisites: 06609 or 09509

06-619 Semiconductor Processing Technology
Spring: 9 units
This is an introductory course to the physical and chemical concepts involved in integrated circuit processing. The material focuses on basic principles in chemical reaction engineering and how they can be applied to integrated circuit process engineering. Students not having the prerequisites listed may seek permission of the instructor.
Prerequisites: 06422 and 09347

06-620 Global Atmospheric Chemistry: Fundamentals and Data Analysis Methods
Spring: 9 units
This course will explore global atmospheric chemistry through a series of case studies: Stratospheric Ozone, Global Methane and OH, and Urban and Regional Ozone. Each case will begin with a description of the chemistry and atmospheric physics fundamental to the particular problem. Students will formulate testable mathematical models incorporating that chemistry and physics, turning then to existing atmospheric data sets to test current understanding. The emphasis of this course is to develop an understanding of how to pose a testable hypotheses in a complex chemical environment such as the atmosphere, validate or refute those hypotheses, and then by extension predict how the system will respond to perturbations. A particular objective is to explore how to extend this methodology from the stratosphere and background troposphere (the first two cases), where it has been applied with success, to the much more complicated problem of urban and regional air quality. Students not having the prerequisites listed may seek permission of the instructor.
Prerequisites: 06262 and 09105

06-621 Biotechnology and Environmental Processes
Fall: 9 units
First half of the course: microbial physiology and metabolism, fermentations and respiration, metabolic regulation, bioconversions, recombinant DNA methodology and gene cloning. Second half: separation and purification, kinetics and design of biological reactors, mass transfer limitations within cell suspensions, and control of fermentation processes. Lectures will cover aspects of accuracy and resolution, relative merits and limitations, selection criteria, and typical practical applications for these devices. Several laboratory demonstrations will be provided. Each student will be expected to submit a project report on a topic assigned in the beginning of the course.
Prerequisites: 03231 and 06262

06-622 Bioprocess Design
Fall and Spring: 9 units
This course is designed to link concepts of cell culture, bioprocesses, formulation and delivery together for the commercial production and use of biologically-based pharmaceuticals; products considered include proteins, nucleic acids, and fermentation-derived fine chemicals. Associated regulatory issues and biotech industry case studies are also included. A fair knowledge of cell culture and fermentation operations is assumed.
Prerequisites: 06621 or 42621

06-630 Atmospheric Chemistry, Air Pollution and Global Change
Fall and Spring: 12 units
Principles necessary to understand the atmospheric behavior of air pollutants in urban, regional, and global scales are the subjects of this course. Key topics include atmospheric gas-, aqueous-, and aerosol-phase chemistry; removal processes and residence times; aerosol...
Course Descriptions

Chemistry
Undergraduate Courses

09-101 Introduction to Experimental Chemistry
Fall and Spring: Mini Session - 3 units
This is a seven session chemistry laboratory course that is designed to introduce students to some basic laboratory techniques, equipment commonly used in experimental scientific investigations. Experiments include: (1) An organic synthesis (the preparation and purification of aspirin), (2) Qualitative determination of aspirin by a Beer’s Law analysis and a chromatographic (TLC) analysis of the ingredients in nonprescription medications, (3) Kinetics (determining the order and reaction rate constant for a reaction), (4) An acid-base titration analysis (including the identification of an unknown organic acid), (5) Transition Metal Complexes (synthesis and color study of a coordination compound and a thermochemical study of a ligand replacement reaction of transition metal complexes using a temperature data acquisition/analysis device (Labworks II or CBL), (6) Polymers (determining the molecular weight of a polymer by an end-group analysis), and (7) Biochemistry (total iron content, iron release properties, and structure of ferritin, the iron storage protein). 1 hr. lec., 3 hrs. lab.

09-102 Special Topics
Spring: Mini Session - 3 units
A selection of mini-courses offered to introduce first-year students to special topics in modern chemistry. The courses meet for half a semester and may include some hands-on laboratory and computer experiences. Topics vary, but have included: Forensic Chemistry in the Criminal Justice System, Macromolecules for Nanotechnology, Popularization of Science Through Books, Plays and Film, Kaboom and Other Approaches to Teaching Science, Dating Using Radioactivity and Computer Molecular Modeling. Enrollment limited to first-year MCS and SHS students.

09-103 Atoms, Molecules and Chemical Change
Fall: 9 units
This is a one-semester introductory college level course designed for non-science majors who have had a high school course in chemistry. Objectives are to provide students with an understanding of basic chemical principles and to show how these are applied in so many different and practical applications, from atmospheres to the cancer treatment material cis-platinum. Major topics include: measurements, matter, atomic theory and the Periodic Table, chemical bonding, stoichiometry and chemical reactions, properties of aqueous solutions, states of matter (solids, liquids and gases), and acid-base chemistry. Additional topics include: chemical equilibrium, thermochemistry, reaction rates, and nuclear chemistry. Students should gain confidence in applying scientific reasoning concepts to situations beyond the course. 3 hrs. lec., 1 hr. rec.

09-104 Fundamental Aspects of Organic Chemistry and Biochemistry
Spring: 9 units
This course, which includes demonstrations and “hands-on” activities, is designed to engage non-majors in the fascination of chemistry. It is not essential that a student has completed 09-103 in order to take this course. The lecture part of this course will include wide ranging science topics designed to put the world of chemistry in perspective. After achieving a competency in fundamentals we proceed to systematically survey the important topics of synthesis, structure and mechanism in organic chemistry. With these insights we finally confront the important industrial molecules including some transition metal complexes. Relevant examples will be drawn from such areas as environmental, materials, and biological chemistry. 3 hrs. lec., 1 hr. rec.

09-105 Introduction to Modern Chemistry I
Fall and Spring: 10 units
This course begins with a very brief survey of some fundamental principles of chemistry and a presentation of chemically interesting applications and sophisticated problems. These will form the basis for introducing the relationships between the structure of molecules and their chemical properties and behavior. The subject matter will include principles of atomic structure, chemical bonding, and molecular structures of organic and inorganic compounds including some transition metal complexes. Relevant examples will be drawn from such areas as environmental, materials, and biological chemistry. 3 hrs. lec., 2 hrs. rec.

09-106 Modern Chemistry II
Fall and Spring: 10 units
The course provides an introduction to some basic concepts of chemical equilibria and thermodynamics. Topics may include gas phase equilibria, acid-base chemistry, solubilities, oxidation-reduction reactions, enthalpy, entropy, free energy, colligative properties and electrochemistry. Chemical kinetics is introduced to complement the study of thermodynamics. 3 hrs. lec., 2 hrs. rec.

Prerequisites: 09105 or 09107

09-107 Honors Chemistry: Fundamental Concepts and Applications
Fall: 10 units
Honors Chemistry is an introductory course that teaches the foundations of Modern Chemistry and applies them to current scientific issues, such as Green Chemistry, Biotechnology and Materials Science. Topics include modern theories of bonding, organization of atoms, molecular interactions, biochemistry and transition metal chemistry. Enrollment is limited to first-year students, with priority given to those in MCS. 3 hrs. lec., 2 hrs. rec.

09-201 Undergraduate Seminar I
Fall: 1 units
Issues and topics of importance to beginning chemistry majors are discussed in this course. It provides a general introduction to the facilities, faculty and programs of the Department of Chemistry and introduces students to career and research opportunities in the field of chemistry. Enrollment limited to students majoring in chemistry. 1 hr.

09-202 Undergraduate Seminar II
Spring: 1 units
Issues and topics focused on laboratory safety are discussed in this class. The topics are selected to supplement information covered in 09-221, Labortory I. This course is intended to provide the necessary safety training for students wishing to undertake undergraduate research projects in the laboratory and is taught in collaboration with the Office of Environmental Health and Safety. Enrollment is limited to chemistry majors. 1 hr.
09-204  Issues in Chemistry  
Spring:  3 units  
This course uses current issues in chemistry such as environmental and ethical topics as a vehicle for developing verbal and communication skills. Enrollment is restricted to students majoring in chemistry. 1 hr. lec.

09-214  Physical Chemistry  
Spring:  9 units  
This is a one-semester course intended primarily for students majoring in Biological Sciences, students pursuing a B.A. degree program in Chemistry, and students in the B.S.A. program with a concentration in clinical sciences. The course focuses on thermodynamics and its application to chemical and biological systems. Emphasis is given towards attaining a good fundamental understanding of entropy and free energy. Topics include applications of thermodynamics to chemical and biochemical equilibria, electrochemistry, and chemical kinetics. 3 hrs. lec.  Prerequisites: 09106 and 21118 and 33111 and (09105 or 09107)  

09-217  Organic Chemistry I  
Fall:  9 units  
This course presents an overview of structure and bonding as it pertains to organic molecules. Selected topics include: introduction to functional group chemistry, stereochemistry, conformational analysis, reaction mechanisms and use of retrosynthetic analysis in the development of multistep syntheses. Methods for structure determination of organic compounds by modern spectroscopic techniques are introduced. 3 hrs. lec., 1 hr. rec.  Prerequisites: 09105 or 09107  

09-218  Organic Chemistry II  
Spring:  9 units  
This course further develops many of the concepts introduced in Organic Chemistry I, 09-217. Emphasis is placed on the utilization of reaction mechanisms for understanding the outcome of chemical transformations, and the employment of a wide variety of functional groups and reaction types in the synthesis of organic molecules. Also included in the course will be special topics selected from the following: polymers and advanced materials, biomolecules such as carbohydrates, proteins and nucleic acids, and drug design. 3 hrs. lec., 1 hr. rec.  Prerequisites: 09105 or 09107  

09-220  Supramolecular Chemistry  
Spring:  3 units  
Supramolecular chemistry involves the use of noncovalent bonding interactions to assemble molecules into stable, well-defined structures. This course will provide students with an introduction to this exciting field of research. Students will be introduced to essential background concepts such as types of noncovalent bonding and strategies for the design of supramolecular assemblies. Readings from monographs and classroom lectures by the instructor will cover this material. Students will then begin to read about applications of supramolecular chemistry from the scientific literature, learning to compare the quality of the data and interpretations reached by the authors, to use the knowledge gained from these readings and discussions to predict the outcomes of related experiments, and to ultimately be able to design their own experiments to answer a relevant question. Meeting hours set by instructor, enrollment limited with priority given to sophomore chemistry majors.  Prerequisites: 09217  Corequisites: 09-218  

09-221  Laboratory I: Introduction to Chemical Analysis  
Fall and Spring:  12 units  
This course is the first in a sequence of four laboratory courses on experimental aspects of chemistry. The experimental work emphasizes the techniques of quantitative chemical analysis. Included are projects dealing with a variety of instrumental and wet chemical techniques. The course is project-oriented with the experiments becoming more complex, requiring greater student input into the experimental design as the semester progresses. A mixture of individual and team experiments are conducted during the semester. In addition to techniques, safety, written and oral communication skills, and effective teamwork are emphasized. 2 hrs. lec., 6 hrs. lab.  Prerequisites: (09106 and (09105 or 09107)  

09-222  Laboratory II: Organic Synthesis and Analysis  
Spring:  12 units  
This course covers mathematical techniques that are important in the chemical sciences. The techniques will be covered in the context of chemical phenomena, and concrete topics from 3-dimensionsal calculus, differential equations, linear algebra and statistics. This course does not count towards the minor in chemistry. 3 hrs. lec.  Prerequisites: 09106 and (21122 or 21123)  

09-231  Mathematical Methods for Chemists  
Fall:  9 units  
This is a one-semester course intended primarily for students majoring in chemistry. 1 hr. lec.  

09-301  Undergraduate Seminar III  
Fall:  1 units  
Students attend seminars on current topics in chemistry. Students are sent a menu of choices for each week of the semester and may select topics of interest. Enrollment is restricted to students majoring in chemistry. 1 hr.  

09-302  Undergraduate Seminar IV  
Spring:  1 units  
Students attend seminars presented by senior chemistry majors. Presentations are evaluated and students become familiar with special topics in chemistry. Some pointers on how to organize and present an effective seminar on a topic in chemistry are given. The courses establish what should be included in a good seminar. These seminar courses are required for chemistry majors. If a schedule conflict exists, students may, with permission of the instructor, attend other chemistry seminars or make other arrangements to fulfill the requirement. 1 hr.  

09-321  Molecular Design and Synthesis  
Fall:  12 units  
This course further develops many of the concepts introduced in Organic Chemistry I, 09-217. Emphasis is placed on the utilization of reaction mechanisms for understanding the outcome of chemical transformations, and the employment of a wide variety of functional groups and reaction types in the synthesis of organic molecules. Also included in the course will be special topics selected from the following: polymers and advanced materials, biomolecules such as carbohydrates, proteins and nucleic acids, and drug design. 3 hrs. lec., 1 hr. rec.  Prerequisites: 09105 or 09107  

09-322  Laboratory IV: Molecular Spectroscopy and Dynamics  
Spring:  12 units  
This laboratory course is devoted to physical chemistry experiments, which involve the use of modern spectroscopic instrumentation to probe the optical and magnetic properties of molecules. The experiments include the use of high-resolution infrared, laser Raman, NMR, EPR, fluorescence, and UV-visible spectroscopies. Additional experiments demonstrate methods for measuring phase equilibria and enzyme-catalyzed reaction rate constants, and develop skills in error analysis, basic electronics, and vacuum techniques. 2 hrs. lec., 6 hrs. lab.  Prerequisites: 09218 and 09222  

09-331  Modern Analytical Instrumentation  
Fall:  9 units  
This course will cover all aspects of analytical instrumentation and its application to problems in materials, environmental, and biological chemistry. Topics covered will include chromatographic separations, mass spectrometry, optical spectroscopies, electrochemistry, optical and force microscopies and potentially NMR. In addition, the course will emphasize how to select an analytical method
Course Descriptions

**09-344 Physical Chemistry (Quantum): Microscopic Principles of Physical Chemistry**  
Fall: 9 units  
The measurement and theoretical description of the properties of atoms and molecules are presented. The elementary principles of quantum chemistry are developed. The many types of spectroscopy used to study atoms and molecules are described. Methods of atomic structure determination are discussed. The structure and properties of solids are also presented. The basic results of statistical chemistry are outlined and a brief connection to thermodynamics is made. 3 hrs. lec., 1 hr. rec.  
Prerequisites: (09105 or 09107) and (21259 or 09231)

**09-345 Physical Chemistry (Thermo): Macroscopic Principles of Physical Chemistry**  
Spring: 9 units  
The measurement and theoretical descriptions of the equilibrium properties of chemical systems are presented. Chemical thermodynamics is introduced at the upper division level. The phases of matter are discussed. The quantitative treatment of mixtures is developed. The detailed description of chemical equilibrium is elaborated. The measurement and theoretical description of the nonequilibrium properties of chemical systems are presented. Elementary transport properties are introduced. The principles of classical chemical kinetics are developed in great detail. 3 hrs. lec., 1 hr. rec.  
Prerequisites: 09106 and (21259 or 09231)

**09-347 Advanced Physical Chemistry**  
Fall: 12 units  
A course of study designed to provide the microscopic basis of concepts encountered in the field of chemical engineering. The properties of macroscopic materials are calculated in terms of the microscopic properties of atoms and molecules. Both classical and quantum approaches are employed. The thermodynamic properties are developed in terms of the chemical potentials of the constituent particles. The transport properties are calculated using molecular dynamics and Brownian dynamics. Classical chemical kinetics is fully developed and applied to complex reactions. Rate constants are calculated for simple reactions in gases and solutions. The course is limited to chemical engineering majors. 5 hrs. lec.  
Prerequisites: (06151 or 06221) AND (06155 or 06262) AND (09105 or 09107)

**09-348 Inorganic Chemistry**  
Spring: 10 units  
The focus of this class is understanding the properties of the elements and of the inorganic compounds. The electronic structure of elements is discussed as the basis for the element's organization in the Periodic Table. The properties of compounds are discussed in relation to these trends and the place of the elements in the Periodic Table. The biological role of inorganic compounds in living matter is illustrated in the part of the class dedicated to the study of bioinorganic chemistry. 3 hrs. lec., 1 hr. rec.  
Prerequisites: 09106

**09-401 Undergraduate Seminar V**  
Fall: 1 units  
Students attend seminars on current topics in chemistry. Students are sent a menu of choices for each week of the semester and may select topics of interest. Enrollment is restricted to students majoring in chemistry. 1 hr.

**09-402 Undergraduate Seminar VI**  
Fall and Spring: 3 units

Students enrolled in this course present a 20 - 30 minute oral report on a current topic in chemistry. This may be from the student's research work or a special chemistry topic of general interest. Presentations or papers prepared for other courses are not acceptable. Thoroughness in the use of the chemical literature is emphasized. The use of presentation aids such as PowerPoint is encouraged. Other students in the class submit written evaluations of the presentation. A seminar presentation is required of all chemistry majors. No exceptions possible. Enrollment is limited to students majoring in chemistry. 1 hr.

**09-441 Nuclear and Radiochemistry**  
Intermittent: 9 units  
This course is designed for upper level science and engineering students, and provides an introduction to the fundamentals and applications of nuclear phenomena. Among the topics discussed are the systematics of stable and unstable nuclei, nature and energetics of radioactive decay, detection and measurement of nuclear radiation, tracer techniques in chemical applications, nuclear processes as chemical probes, and nuclear energy. (Graduate Course: 12 units, 09-732)  
Prerequisites: 09345

**09-445 Undergraduate Research**  
Fall and Spring: 3-18 units  
Properly qualified students may undertake research projects under the direction of members of the faculty, normally 6 to 12 hrs/week. A written, detailed report describing the project and results is required. Course may be taken only with the consent of a faculty research advisor in chemistry or on occasion in another department provided that the project is chemical in nature and with permission of the Director of Undergraduate Studies. The number of units taken generally corresponds to the actual number of hours the student actually spends in the lab doing research during the week. Maximum number of units taken per semester is 18.

**09-455 Honors Thesis**  
Fall and Spring: 6,15 units  
Students enrolled in the departmental honors program are required to enroll in this course to complete the honors degree requirements. A thesis written in an acceptable style describing an original research project, and a successful oral defense of the thesis topic before an Honors Committee are required. Limited to students accepted into the honors program. (B.S. Honors candidates normally enroll for 6 units; B.S./M.S. candidates enroll for 15 units.)

**09-502 Organic Polymer Chemistry**  
Spring: 9 units  
A study of the synthesis and reactions of high polymers. Emphasis is on practical polymer preparation and on the fundamental kinetics and mechanisms of polymerization reactions. Topics include: relationship of synthesis and structure, step-growth polymerization, chain-growth polymerization via radical, ionic and coordination intermediates, copolymerization, discussions of specialty polymers and reactions of polymers. (Graduate Course: 12 units, 09-741)  
Prerequisites: 09218

**09-509 Physical Chemistry of Macromolecules**  
Fall: 9 units  
This course develops fundamental principles of polymer science. Emphasis is placed on physio-chemical concepts associated with the macromolecular nature of polymeric materials. Engineering aspects of the physical, mechanical and chemical properties of these materials are discussed in relation to chain microstructure. Topics include an introduction to polymer science and a general discussion of commercially important polymers; molecular weight; condensation and addition synthesis mechanisms with emphasis on molecular weight distribution; solution thermodynamics and molecular conformation; rubber elasticity; and the rheological and mechanical properties of polymer systems. (This course is also listed as 06-609. Graduate Course: 12 units, 09-715) 3 hrs. lec.  
Prerequisites: 09345 or 09347
Course Descriptions

09-510  Introduction to Green Chemistry
Intermittent: 9 units
This course covers the most significant emerging field in modern chemistry, namely, Green chemistry, the field, which focuses upon the reinvention of chemistry such that pollution can be avoided. Sustainability ethics will be introduced and discussed. The "principles of green chemistry" will be presented and analyzed. The chemical nature and action of certain pollutants of the atmosphere, land, and water, will be highlighted along with prospects for their minimization, and approaches for their eradication. Particular attention will be paid to sources and potential replacements of persistent bioaccumulative pollutants. A historical and technical analysis of the chlorine industry and pollution emanating from this industrial sector will be covered in some detail. The recently discovered mechanism of toxicity called "endocrine disruption" will be presented in the context of this industry. The chemical process by which white paper is made will be treated in detail emphasizing the environmental effluent problems and the steps that industry has taken to reduce these problems. A new technology with potential to further significantly reduce toxic effluents in this and other industrial sectors will be described and students will examine the use of the technology in a laboratory setting: this technology has been invented at Carnegie Mellon. Themes woven throughout the course include emerging concepts for guiding green chemistry, environmental toxicology, conventional versus biorational pesticides, the development of green oxidants, and an identification of toxins, especially persistent toxins, where elimination will require new green chemistry. A significant effort has been made by the instructor to produce a course suitable for an interdisciplinary audience and recent classes have come from diverse backgrounds throughout the university. (Graduate Course: 12 units, 09-710) 3 hrs. lec. Prerequisites: 09218 and 09348

09-517  Organotransition Metal Chemistry
Fall: 9 units
The first half of this course focuses on the fundamentals of structure and bonding in organotransition metal complexes and how the results can be used to explain, and predict, chemical reactivity. The latter half of the course covers applications, and more specifically, homogeneous catalysts for industrial processes and organic synthesis. (Graduate Course: 12 units, 09-717) Prerequisites: 09348

09-518  Bioorganic Chemistry: Nucleic Acids and Carbohydrates
Fall: 9 units
This course will introduce students to new developments in chemistry and biology, with emphasis on synthetic and functional aspects of nucleic acids and carbohydrates, and their applications. Later in the course, students will get to explore some of the ongoing research in functional genomics. Students will be required to keep abreast of the current literature, and homework will be assigned on a regular basis. The homework assignments will require data interpretation and experimental design. (Graduate Course: 12 units, 09-718) 3 hrs. lec. Prerequisites: 09217 and 09218

09-519  Bioorganic Chemistry: Peptides, Proteins and Combinatorial Chemistry
Spring: 9 units
This course will introduce students to new developments in chemistry and biology, with emphasis on synthetic and functional aspects of proteins, peptides, and small molecules. Basic concepts of bioorganic chemistry will be presented in the context of the current literature and students will have the opportunity to learn about the experimental methods that are used. An introduction to combinatorial chemistry in the context of drug design will also be presented. Students will be required to keep abreast of the current literature, and homework will be assigned on a regular basis. The homework assignments will require data interpretation and experimental design. Students enrolled in the graduate level course (09-719) will be required to write and present an original research proposal, in addition to the homework assignments, midterm, and final exam that are required for the undergraduate course. (Graduate Course: 12 units 09-719) 3 hrs. lec. Prerequisites: 09218

09-520  Special Topics in Atmospheric Chemistry
Fall: 9 units
This course will explore global atmospheric chemistry through a series of case studies: Stratospheric Ozone, Global Methane and Oh, and Urban and Regional Ozone. Each case will begin with a description of the chemistry and atmospheric physics fundamental to the particular problem. Students will formulate testable mathematical models incorporating that chemistry and physics, turning then to existing atmospheric data sets to test current understanding. The emphasis of this course is to develop an understanding of how to pose a testable hypotheses in a complex chemical environment such as the atmosphere, validate or disprove these hypotheses, and then predict how the system will respond to perturbations. A particular objective is to explore how to extend this methodology from the stratosphere and background troposphere (the first two cases), where it has been applied with success, to the much more complicated problem of urban and regional air quality. (This course is also listed as 06-620.) Prerequisites: 21260 Corequisites: 09-347, 09-344

09-521  Bioorganic Chemistry
Intermittent: 9 units
The course addresses the basis for the selection and regulation of metal atoms and ligand systems and their interactions with their corresponding protein environments. The chemistry of catalytic processes in metalloenzymes, and atom transfer and electron transport in metalloproteins will be reviewed. The array of physical methods required for study will be introduced, with application toward the determination of electronic and molecular structure and enzymatic mechanisms. (Graduate Course: 12 units, 09-721) Prerequisites: 09344 and 09348

09-522  Oxidation and Inorganic Chemistry
Intermittent: 9 units
The roles of metal complexes in chemical and biochemical oxidations will be presented. Special attention is given to processes involving the activation of molecular oxygen and hydrogen peroxide from a mechanistic viewpoint. Kinetics of homogeneous reactions, mechanisms of catalysis, redox properties, and electronic structures of metal complexes will be reviewed. The relationships between electronic structures, catalytic properties, and oxidation reactivity of biologically relevant metal complexes will be provided. (Graduate Course: 12 units, 09-722) Prerequisites: 09348

09-525  Transition Metal Chemistry
Intermittent: 9 units
This class covers fundamental concepts in Transition Metal Chemistry, including coordination numbers and stereochemistry, electronic structure, physical properties, and aspects of chemical reactivity of transition elements and their complexes. Point group theory is used to link the geometric and electronic structures of high symmetry coordination compounds. Analysis of the electronic structure of low symmetry coordination complexes is based on the Angular Overlap Model. In choosing coordination complexes that are discussed in class, special emphasis is given to those that are relevant for the fields of research of students enrolled in the class, such as supramolecular chemistry, molecular materials, and metal-based catalysis. The choice and relevance of modern questions posed by researchers in these fields is discussed, as are modern methods and techniques used to answer the questions. Students learn in this course how to use the Cambridge Crystallographic Database, a repository of structural data for more than 200,000 compounds that contain at least one carbon atom, and how to use Mathematica to answer chemical problems. No prior knowledge of this software is required. (Graduate Course: 12 units, 09-725) 3 hrs. lec.
### Course Descriptions

**Prerequisites:** 09348

09-541 Spectroscopy  
Spring: 9 units  
This course emphasizes the use of modern optical methods in the study of molecular properties and reactivity. Basic topics such as the use of group theory in the analysis of vibrational, rotational and electronic spectra are covered in detail. In addition, recently developed techniques such as time-resolved and nonlinear spectroscopies are discussed as are applications of optical methods to problems in chemistry, biology and materials science. (Graduate Course: 12 units, 09-841)  
Prerequisites: 09344 and 09345

09-543 Mass Spectrometry: Fundamentals, Instrumentation and Techniques  
Intermittent: Mini Session - 6 units  
This course is intended for students of chemistry, physics, material science and the biological sciences who are interested in understanding fundamentals, instrumentation and techniques used in mass spectrometry. The operating principles of various ion sources (EI, CI, ESI and MALDI), mass analyzers (magnetic, quadrupole, time-of-flight, ion traps) and detectors are covered. Applications are focused in the areas of proteomics and polymer characterization such as protein identification, peptide sequencing, polymer polydispersity and end group determination. Hypenphated techniques such as GC/MS, LC/MS, and CE/MS are covered. Various MS scan modes (i.e. SIM, SRM, MS/MS) and basic spectrum interpretation are covered. Students are exposed to QET and RRKM theory and select gas phase reactions. The lecture is supplemented with an Internet tool called the "Virtual Mass Spectrometry Laboratory", remote control of mass spectrometers and real MS experiments. 3 hrs. lec., 3 hrs. lab.  
Prerequisites: 09214 or 09345 or 33341

09-545 Polymer Rheology  
Intermittent: 9 units  
This course is designed for students of chemistry, physics, material science and the biological sciences who are interested in understanding fundamentals, instrumentation and techniques used in mass spectrometry. The operating principles of various ion sources (EI, CI, ESI and MALDI), mass analyzers (magnetic, quadrupole, time-of-flight, ion traps) and detectors are covered. Applications are focused in the areas of proteomics and polymer characterization such as protein identification, peptide sequencing, polymer polydispersity and end group determination. Hypenphated techniques such as GC/MS, LC/MS, and CE/MS are covered. Various MS scan modes (i.e. SIM, SRM, MS/MS) and basic spectrum interpretation are covered. Students are exposed to QET and RRKM theory and select gas phase reactions. The lecture is supplemented with an Internet tool called the "Virtual Mass Spectrometry Laboratory", remote control of mass spectrometers and real MS experiments. 3 hrs. lec., 3 hrs. lab.  
Prerequisites: 09344 or 09347 AND (09509 or 06609)

09-560 Molecular Modeling and Computational Chemistry  
Fall: 12 units  
Computer modeling is playing an increasingly important role in chemical, biological and materials research. This course provides an overview of computational chemistry techniques including molecular mechanics, molecular dynamics, electronic structure theory and continuum medium approaches. Sufficient theoretical background is provided for students to understand the uses and limitations of each technique. An integral part of the course is hands on experience with state-of-the-art computational chemistry tools running on graphics workstations. 3 hrs. lec.  
Prerequisites: (15113 or 15200) and 09344 and 09345

09-611 Chemical Thermodynamics  
Fall: Mini Session - 6 units  
A focused course on applied chemical thermodynamics. The basic thermodynamic functions will be introduced and discussed. The formal basis for thermochemistry will be presented. Single component phase equilibrium will be considered. The thermodynamic basis of solutions will be developed and applied to separation methods. The fundamental basis of chemical equilibrium will be developed and applied to a wide variety of reactions. Finally, a few special topics such as self-assembled systems will be presented.

09-702 Statistical Mechanics and Dynamics  
Intermittent: 12 units  

09-711 Physical Organic Chemistry  
Intermittent: 12 units  
The study of the structure and reactivity of organic molecules from a physical and theoretical standpoint. Introduction to molecular orbital theory and the study of mechanisms in pericyclic, electron-transfer, photochemical and heterolytic reactions by the use of physical methods such as kinetics, isotope effects, substituent effects and spectroscopic methods.

09-712 Synthetic Organic Chemistry  
Intermittent: 12 units  
General synthetic strategies are discussed with a focus on C-C bond formation, functional group transformations, unnatural products and mechanisms.

09-714 Advanced Organic Chemistry Spring: 12 units  
This course will examine the following advanced topics in organic chemistry: orbital interactions as applied to structure and reactivity, conformational analysis, computational methods, structure elucidation by NMR and IR spectroscopy, reaction mechanisms and special topics of current interest such as electron transfer and recently developed synthetic methods. Problem solving will be emphasized, especially with respect to orbital interactions, NMR spectroscopy and reaction mechanisms. Individual projects in computational chemistry will also be undertaken.

09-720 Physical Inorganic Chemistry  
Intermittent: 12 units  
This course develops principles of magnetoochemistry and inorganic spectroscopy. Electronic absorption, magnetic circular dichroism, resonance raman, NMR, EPR, Mossbauer, as a first step towards nanotechnology, since they demonstrate the feasibility of building purposeful structures one atom or one (macro)molecule at a time. This course is designed for the students of chemistry, physics and engineering, who are interested in the fundamentals of proximal probe techniques and in their applications in various areas, converging into a rapidly developing, interdisciplinary field of nanoscience. It will provide physical background of such basic techniques as Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), and Near-Field Scanning Optical Microscopy (NSOM) and of their variants. Throughout the course, the working "virtual AFM" computer model will be assembled in classroom by each student and then used extensively to gain thorough understanding of AFM operation principles. Particular emphasis will be placed on modes of operation facilitating chemical contrast and contrast based on other material properties. (No prior experience with computer programming required). magnetization and x-ray methods will be introduced with application toward the determination of electronic structures of transition metal complexes.

Intermittent: 12 units  
Proximal probe techniques are revolutionizing physical and biological sciences, owing to their ability to explore and manipulate matter at the nanoscale, and to operate in various environments (including liquids). Proximal probe techniques rely on the use of nanoscale probes, positioned and scanned in the immediate vicinity of the material surface. Their development is often viewed
Civil & Environmental Engineering

Undergraduate Courses

12-090 Technology and the Environment
Spring and Summer: 9 units
Technical elective for undergraduate, non-engineering majors. Overview of major environmental issues and concerns associated with modern technology. Topics in the course include automobiles and associated air emissions and fuel consumption, information technology and electricity usage, electricity generation and alternative sources to reduce air emissions and wastes, CFCs and their influence on the ozone layer, and various issues related to land use patterns such as agriculture and infrastructure. Methods for using technology to improve environmental conditions also discussed. Within this framework the course aims to build fundamental problem solving skills, basic familiarity with engineering calculations, and understanding of everyday environmental issues. The overall purpose is to instill an appreciation of the complexity of issues and viewpoints surrounding technology development and associated environmental impacts.

12-100 Introduction to Civil and Environmental Engineering
Fall and Spring: 12 units
Presentation of selected topics in the discipline with an emphasis on fundamentals. The course includes treatment of topics in mechanics and provides an exposure to environmental engineering. Problem-solving exercises within the course apply these concepts to integrate the steps of analysis, synthesis, and evaluation through individual and group projects that require attention to a broad range of issues. The course also exposes the students to issues related to engineering practice such as scheduling, evaluating risk, and making ethical decisions. In addition to regular lectures and project exercises, the course includes guest speakers, field trips, and class demonstrations. 3 hrs., rec., 1 hr. lab.
Prerequisites: Corequisites: 21-120, 33-106

12-235 Statics
Spring: 9 units
Introduction to vector mechanics; equivalent systems of forces; equilibrium of rigid bodies; free body diagram; distributed forces, hydrostatic forces, effective forces, centroids; applications to simple statically determinate trusses, beams, frames, cables and other physical systems; friction. 3 hrs. rec.
Prerequisites: Corequisites: 12-100, 21-122, 33-106

12-251 Introduction to Environmental Engineering
Fall: 9 units
Provides a scientific and engineering basis for understanding environmental issues and problems. Introduces material and energy balances for tracking substances in the atmosphere, surface and ground waters, and soil systems. Pertinent environmental laws are described, simple quantitative engineering models are developed, and qualitative descriptions of environmental engineering control technologies are presented. 3 hrs. rec.
Prerequisites: Corequisites: 12-100, 21-122, 33-106

12-252 Introduction Environment Engineering Lab
Fall: 3 units
(Required for CEE students, not for others) Laboratory and field experiments that illustrate the basic principles of environmental engineering. 1 hr. lab.
Corequisites: 12-251

12-271 Introduction to Computer Applications in Civil & Environmental Engineering
Fall: 9 units
Introduction to the use of computer-based applications in civil engineering, using generic tools such as spread-sheets, equation solvers and computer graphics. Discussion of the role of computer-based methods in civil engineering practice. 3 hrs. rec.
Prerequisites: 21-120 and 33106

12-301 CEE Projects
Fall: 12 units
Basic elements of civil and environmental engineering projects, from project conception through design, to implementation and operation. Project components are explored through formal instruction combined with analysis of actual engineering projects and student team activities. The course is intended to develop skills and understanding related to the application of engineering and science principles, approximations, empiricism, and experience to engineering projects; basic theory and practice of design; the importance and challenge of team efforts and effective communication; and the utility of measurements, modeling, visualization, quality control, and engineering graphics. 4 hrs. rec.
Prerequisites: 12235 and 12251 and 12271

12-331 Solid Mechanics
Fall: 9 units
Analysis of deformable bodies incorporating concepts of stress, strain, mechanical properties of materials, and geometric compatibility. Response under axial loads, torsion, bending, transverse shear, and combined loadings. Stress and strain transformations and Mohr's circles, deflections of beams and shafts, buckling of columns. Laboratory experiments and reports associated with theoretical concepts. 1 hr. lab.
Prerequisites: 12235 Corequisites: 21-259

12-332 Solid Mechanics Lab
Fall: 3 units
Analysis of stress-strain relationships, torsion of solid shafts, deformation due bending, deformations in three dimensions, Mohr's circle representation of stress and strain, buckling of slender columns. Laboratory experiments and reports associated with theoretical concepts. 3 hrs. rec.
Prerequisites: 12235 Corequisites: 12-331

12-335 Soil Mechanics
Spring: 9 units
Sampling, testing and identification of soils. Physical, chemical and hydraulic characteristics. Stress-strain relationships for soils. Permeability, seepage, consolidation, and shear strength, with applications to deformation and stability problems, including earth dams, foundations, retaining walls, slopes and landfills. 3 hrs. rec.
Prerequisites: 12231 Corequisites: 12-355

12-336 Soil Mechanics and Materials Laboratory
Spring: 3 units
Examination of material properties and behavior of soils. Experiments include soil classification, permeability, compaction, consolidation and strength tests. 1 hr. lab.
Prerequisites: 09105 and 27357 and 33107

12-355 Fluid Mechanics
Spring: 9 units
Fluid characteristics; continuity, momentum and energy equations; dynamic similitude; laminar and turbulent boundary layers; flow in pipes; lift and drag on immersed bodies; open channel flow.
Prerequisites: Corequisites: 21-260, 21-259

12-356 Fluid Mechanics Lab
Spring: 3 units
Fluid properties: density, specific gravity, viscosity; fluid characteristics; continuity, conservation of energy; fluid behavior: center of pressure, pipe flow, open-channel flow. Laboratory experiments illustrating basic principles. 1 hr. lab.
Prerequisites: Corequisites: 12-355

12-358 Materials Lab
Spring: 3 units
Examination of materials properties and behavior of concrete, masonry, and timber. 2 hr. lab

12-401 Civil & Environmental Engineering Design
Fall: 15 units
Methodology for formulating and solving design problems, characterized by incomplete specifications, open-ended solution
space, and partial evaluations. The methodology is illustrated and applied in the context of realistic design problems drawn from civil and environmental engineering. Design projects are performed by teams, emphasizing collaborative problem-solving and preparation of written and oral reports. 2 hrs. rec., 2 hrs. lab. Prerequisite: Senior Standing in Civil and Environmental Engineering or instructor approval for Design Minors.

12-411 Engineering Economics
Fall: Mini Session - 6 units
Basic concepts of economic analysis and evaluation of alternative engineering projects for capital investment. Consideration of time value of money and common merit measures such as net present value and internal rate of return. Selection of independent projects and mutually exclusive proposals, using various methods of analysis. Capital budgeting and project financing. Influence of price level changes, depreciation and taxation on choice of alternatives. Uncertainty and risk in operation and financing. Important factors affecting investment decisions for private and public projects. 3 hrs. rec. Prerequisite: 21-120 and Senior Standing in Civil and Environmental Engineering

12-605 Design and Construction
Spring: 9 units
Introduction to steel, concrete, wood, and masonry construction methods and material selection; integration of design and constructability criteria; conformance of designs to applicable building and fire codes; preparation of plans and specifications; laboratory demonstration and experiments. 2 hrs. rec., 2 hrs. lab. Prerequisites: 12-331 or permission of the instructor. Prerequisites: Corequisites: 12-331

12-611 Project Management Construction
Fall: 9 units
Introduction to construction project management from owner's perspective in organizing planning, design, construction and operation as an integrated process. Examination of labor productivity, material management and equipment utilization. Cost estimation and financing of constructed facilities. Contracting, construction planning and fundamental scheduling procedures. Cost control, monitoring and accounting for construction. 3 hrs. rec. Prerequisites: 36-220

12-631 Structural Design
Spring: 12 units
Design of structural members for bending moment, shear force, axial force, and combined axial force and bending. Reinforced concrete, structural steel, and composite beam construction are considered. Buckling effects in columns, beams and local plate segments are treated. Serviceability limits such as deflection and cracking are addressed. Design projects include the determination of loads and the selection of system geometry. Prerequisites: 12-331 and 27-357 and 12-358

12-635 Structural Analysis
Fall: 9 units
Matrix Algebra. Introduction to the Stiffness Method - spring element, direct stiffness method, stiffness assembly, boundary conditions, potential energy approach; one-dimensional governing equations for heat flow, axial bar, transversely loaded spring, diffusion, electric current, laminar pipe flow; truss analysis; beam analysis; frame and grid analysis, arbitrarily oriented beam in space, substructure analysis; plane stress and plane strain analysis, equations of elasticity, constant strain triangle, body and surface forces, linear strain triangle; axisymmetric elements; isoparametric formulation, bar element, rectangular elements, Gaussian quadrature, high order shape functions. Prerequisites: 12331

12-636 Geotechnical Engineering
Spring: 9 units
Emphasis is on three major components of geotechnical engineering: (1) planning and design of exploration programs, interpretation of field and laboratory test data for use in geotechnical site characterization; (2) problem definition (e.g., slope stability, settlement analysis, etc.) and development of idealized analytical models; and (3) applications of analytical and numerical methods, particularly computer methods, applied to analysis and design. 3 hrs. rec. Prerequisites: 12335

12-651 Air Quality Engineering
Fall: 9 units
Problems and methodologies for studies of environmental management, with an emphasis on air pollution. Key topics include sources of pollutants, focusing on combustion chemistry for a hydrocarbon fuel; behavior of gaseous and particulate pollutants in the atmosphere including the role of meteorology and the use of dispersion equations; effects of pollutants on human health and global climate; and procedures by which air pollution standards are developed and enforced by regulatory agencies. Statistical treatment of data is included at several places in the course. 3 hrs. rec. Prerequisites: 12-251, 12-355 Co-requisite: 36-220

12-655 Water Quality Engineering Lab
Spring: 3 units
Examination of water quality using titrimetric, spectrometric, potentiometric and reductive/oxidative techniques. Illustration of principles of dilute aqueous chemistry and processes for affecting water quality. 2 hrs. lab. Corequisites: 12-655

12-657 Water Resources Engineering
Spring: 9 units
Principles and applications of open channel flow. Hydrology of surface and ground water sources and the estimation of water requirements. Planning and design of water distribution and wastewater and storm water collection systems. 3 hrs. rec. Prerequisites: 12251 Corequisites: 12-355

12-658 Hydraulic Structures
Spring: 9 units
Theory and practice of design of riverine and coastal structures, including dams, levees, bridge piers, culverts and groins, seawalls, bulkheads, breakwaters, marinas, and harbors. Key related concepts from surface and ground water hydrology, and wave mechanics. 3 hrs. rec. Prerequisites: Corequisites: 12-355

Computer Science

15-050 Study Abroad
All Semesters: 0 units
Students who are interested in studying abroad should first contact the Office of International Education. More information on Study Abroad is available on OIE's Study Abroad page and at the CS Undergraduate Office.

15-075 Computer Science Co-Op
All Semesters: 0-3 units
Students who are interested in a Co-Op experience with an external employer typically do so in their Junior year. A Co-Op is distinguished from a summer internship in that it encompasses a summer and a contiguous semester, either Spring-Summer or Summer-Fall. A list of companies who are interested in hiring Co-Op students is available from the SCS Career Consultant at the
15-090  Computer Science Practicum  
All Semesters: 3 units  
This course is for international students who are interested in Curricular Practical Training (CPT). Such students interested in CPT must first be authorized by the Office of International Education before being able to enroll in the Practicum course. More information on CPT is available on OIE’s Foreign Student Employment page and at the CS Undergraduate Office.

15-100  Introductory/Intermediate Programming  
All Semesters: 10 units  
An introduction to the process of program design and analysis using the Java programming language for students who have NO prior programming experience. Topics to be covered include basic data types and their operators, I/O, control structures (selection, loops), classes (including methods and fields), arrays, and simple sorting and searching algorithms. If you’ve taken a programming course in a language other than Java and have used functions, loops, and arrays you should NOT enroll in 15-100 and instead enroll in 15-111. NOTE: students who receive a grade of C or less in 15-100 should discuss whether they are adequately prepared for 15-200 with their academic advisor.

15-110  Intermediate/Advanced Programming  
All Semesters: 10 units  
An introduction to the process of program design and analysis using the Java programming language for students with some prior programming experience (functions, loops, and arrays). Topic to be covered include an overview of fundamental programming concepts using Java as well as object-oriented programming techniques, data structures, data structures (e.g., linked lists, stacks, queues, trees, and graphs), and an introduction to the analysis of algorithms that operate on those data structures. This course, along with 21-127, serves as a prerequisite for 15-211. NOTE: students who receive a grade of C or less in 15-110 should discuss whether they are adequately prepared for 15-211 with their academic advisor.

15-111  Intermediate/Advanced Programming  
All Semesters: 10 units  
An introduction to the process of program design and analysis using the Java programming language for students with some prior programming experience (functions, loops, and arrays) in a language other than Java. Topics to be covered include an overview of fundamental programming concepts using Java as well as object-oriented programming techniques, data structures, data structures (e.g., linked lists, stacks, queues, trees, and graphs), and an introduction to the analysis of algorithms that operate on those data structures. This course, along with 21-127, serves as a prerequisite for 15-211. NOTE: students who receive a grade of C or less in 15-111 should discuss whether they are adequately prepared for 15-211 with their academic advisor.

15-113  Systems Skills in C  
All Semesters: Mini Session  - 5 units  
This course is designed to provide a substantial exposure to the C programming language and the Unix programming environment (gcc) for students with prior programming experience but minimal exposure to C. Topics to be covered include arrays, structs and unions, dynamic memory allocation (malloc and free), pointers and pointer arithmetic. This course, along with 15-211, serves as the prerequisite for 15-213.
Prerequisites: 15111 or 15200

15-200  Advanced Programming/Practicum  
All Semesters: 9 units  
This course assumes prior programming experience in Java (at the level of 15-100) and is designed to expand students’ knowledge of computer science and sharpen their programming skills through the implementation of a large project. The course extends object-oriented programming techniques begun in 15-100 and covers data aggregates, data structures (e.g., linked lists, stacks, queues, trees, and graphs), and an introduction to the analysis of algorithms that operate on those data structures. The course is currently taught in Java and, along with 21-127, serves as a prerequisite for 15-211. NOTE: students who receive a grade of C or less in 15-200 should discuss whether they are adequately prepared for 15-211 with their academic advisor.
Prerequisites: 15100

15-211  Fundamental Data Structures and Algorithms  
Fall and Spring: 12 units  
Fundamental programming concepts are presented together with supporting theoretical foundations and practical applications. This course emphasizes the practical application of techniques for writing and analyzing programs: data abstraction, program verification, and performance analysis. These techniques are applied in the design and analysis of fundamental algorithms and data structures. The course is currently taught in Java.
Prerequisites: (15111 or 15200) and 21127

15-212  Principles of Programming  
Fall and Spring: 12 units  
This course presents principles and techniques of programming, focusing on sophisticated methods for specifying, constructing, and reasoning about computer programs. Via features of a high-level functional programming language (currently ML), this course concretely illustrates mechanisms for building user-defined data types, including recursive and polymorphic types, and infinite data structures such as streams; for building higher-order control constructs such as first-class functions and continuations; and for building large programs using modules and abstract data types. It also introduces the use of formal methods for specifying and verifying programs.
Prerequisites: 15211

15-213  Introduction to Computer Systems  
Fall and Spring: 12 units  
This course provides a programmer’s view of how computer systems execute programs, store information, and communicate. It enables students to become more effective programmers, especially in dealing with issues of performance, portability and robustness. It also serves as a foundation for courses on compilers, networks, operating systems, and computer architecture, where a deeper understanding of systems-level issues is required. Topics covered include: machine-level code and its generation by optimizing compilers, performance evaluation and optimization, computer arithmetic, memory organization and management, networking technology and protocols, and supporting concurrent computation.
Prerequisites: 15113 and 15211

15-251  Great Theoretical Ideas in Computer Science I  
Spring: 12 units  
This course is about how to use theoretical ideas to formulate and solve problems in computer science. It integrates mathematical material with general problem solving techniques and computer science applications. Examples are drawn from Algorithms, Complexity Theory, Game Theory, Probability Theory, Graph Theory, Automata Theory, Algebra, Cryptography, and Combinatorics. Assignments involve both mathematical proofs and programming.
Prerequisites: (15100 or 15111) and 21127

15-312  Foundations of Programming Languages  
Fall and Spring: 12 units  
This course discusses in depth many of the concepts underlying the design, definition, implementation, and use of modern programming languages. Formal approaches to defining the syntax and semantics are used to describe the fundamental concepts underlying programming languages. A variety of programming paradigms are covered such as imperative, functional, logic, and concurrent programming. In addition to the formal studies, experience with programming in the languages is used to illustrate how different design goals can lead to radically different languages and models of computation.
Prerequisites: 15212

15-351  Great Theoretical Ideas in Computer Science II  
Fall: 12 units  
This is the second semester of a year long pair of courses: 251 and 351. These courses are about how to use theoretical ideas to formulate and solve problems in computer science. It integrates mathematical material with general problem solving techniques and computer science applications. Examples are drawn from Algorithms, Complexity Theory, Game Theory, Probability Theory, Graph Theory, Automata Theory, Algebra, Cryptography, and Combinatorics. Assignments involve both mathematical proofs and programming.
Prerequisites: 15251
### Course Descriptions

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### Course Descriptions Details

**15-354 Computational Discrete Mathematics**
- **Fall**: 12 units
- This course is about the computational aspects of some of the standard concepts of discrete mathematics (relations, functions, logic, graphs, algebra, automata), with emphasis on efficient algorithms. We begin with a brief introduction to computability and computational complexity. Other topics include: iteration, orbits and fixed points, order and equivalence relations, propositional logic and satisfiability testing, finite fields and shift register sequences, finite state machines, and cellular automata. Computational support for some of the material is available in the form of a Mathematica package.
- Prerequisites: 15251

**15-381 Artificial Intelligence: Representation and Problem Solving**
- **Fall and Spring**: 9 units
- This course is about the theory and practice of Artificial Intelligence. We will study modern techniques for computers to represent task-relevant information and make intelligent (i.e. satisficing or optimal) decisions towards the achievement of goals. The search and problem solving methods are applicable throughout a large range of industrial, civil, medical, financial, robotic, and information systems. We will investigate questions about AI systems such as: how to represent knowledge, how to effectively generate appropriate sequences of actions and how to search among alternatives to find optimal or near-optimal solutions. We will also explore how to deal with uncertainty in the world, how to learn from experience, and how to learn decision rules from data. We expect that by the end of the course students will have a thorough understanding of the algorithmic foundations of AI, how probability and AI are closely interrelated, and how automated agents learn. We also expect students to acquire a strong appreciation of the big-picture aspects of developing fully autonomous intelligent agents. Other lectures will introduce additional aspects of AI, including natural language processing, web-based search engines, industrial applications, autonomous robotics, and economic/game-theoretic decision making.
- Prerequisites: 15212

**15-384 Robotic Manipulation**
- **Fall**: 12 units
- Foundations and principles of robotic manipulation. Topics include computational models of objects and motion, the mechanics of robotic manipulators, the structure of manipulator control systems, planning and programming of robot actions.
- Prerequisites: (15111 or 15200) and (18202 or 21241 or 24311)

**15-385 Computer Vision**
- **Spring**: 9 units
- An introduction to the science and engineering of computer visions, i.e. the analysis of the patterns in visual images with the view to understanding the objects and processes in the world that generate them. Major topics include feature extraction, image representation, edge detection, grouping, discrimination, inference of depth and shape, learning, classification, recognition, tracking and active vision. The emphasis is on the learning of fundamental mathematical concepts and techniques, and applying them to solve real vision problems. The discussion will be guided by comparison with human and animal vision. This parallel biological and computational perspectives. Students will learn to think mathematically, and develop skills in translating ideas and mathematical thoughts into Matlab programs to solve real problems.
- Prerequisites: 15113 and (18202 or 21241)

**15-391 Technology Consulting in the Community**
- **Fall and Spring**: 9 units
- In this course, the student learns process consulting while collaborating on site with a community leader of a non-profit organization. This service-learning course de-emphasizes coding, asking the student instead to analyze a complex organization, then design and implement a work plan that will expand the organization’s capacity to use information technology. Throughout the semester, students develop a consulting report. They learn how to work as a working document to collaborate with others and to think through and communicate a strategic technology plan. Students also experience how urban community organizations function, seeing the valuable benefits these organizations provide to society.
- Prerequisites: 15211

**15-410 Operating System Design and Implementation**
- **Fall and Spring**: 12 units
- Operating systems monitor the execution of user programs and the allocation of various resources such as memory space and peripheral devices. The course introduces the basic concepts of multiprogramming, timesharing and asynchronous processes. These concepts lead to interesting problems of synchronization, scheduling, memory management, information sharing and protection. Emphasis of the course is on the design aspects of operating systems.
- Prerequisites: 15213

**15-411 Compiler Design**
- **Fall**: 12 units
- This course covers the design and implementation of compiler and run-time systems for high-level languages, and examines the interaction between language design, compiler design, and run-time organization. Topics covered include syntactic and lexical analysis, handling of user-defined types and type-checking, context analysis, code generation and optimization, and memory management and run-time organization.
- Prerequisites: 15213 or 15312

**15-415 Database Applications**
- **Fall and Spring**: 12 units
- This course covers the fundamental topics for Database Management Systems: Database System Architectural Principles (ACID properties; data abstraction; external, conceptual, and internal schemata; data independence; data definition and data manipulation languages), Data models (entity-relationship and relational data models; data structures, integrity constraints, and operations for each data model; relational query languages: SQL, algebra, calculus), Theory of database design (functional dependencies; normal forms; dependency preservation; information loss), Query Optimization (equivalence of expressions, algebraic manipulation; optimization of selections and joins), Storage Strategies (indices, B-trees, hashing), Query Processing (execution of sort, join, and aggregation operators), and Transaction Processing (recovery and concurrency control).
- Prerequisites: 15212

**15-441 Computer Networks**
- **Fall and Spring**: 12 units
- This is an introductory course about computer networks. The emphasis will be on the basic performance and engineering tradeoffs in the design and implementation of computer networks. Students will learn not only what computer networks are and how they work today, but also why they are designed the way they are and how they are likely to evolve in the future. We will draw examples primarily from the Internet. Topics to be covered include: LAN, congestion/flow/error control, routing, addressing, naming, multicasting, switching, internetworking, quality of service, and network security. There will be both written and programming assignments, and a substantial project involving the design and implementation of a complete protocol stack.
- Prerequisites: 15213

**15-451 Algorithm Design and Analysis**
- **Fall and Spring**: 12 units
- This course is about the design and analysis of algorithms. We study specific algorithms for a variety of problems, as well as general design and analysis techniques. Specific topics include searching, sorting, algorithms for graph problems, efficient data structures, lower bounds and NP-completeness. A variety of other topics may be covered at the discretion of the instructor. These include parallel algorithms, randomized algorithms, geometric algorithms, low level techniques for efficient programming, cryptography, and cryptographic protocols.
- Prerequisites: 15212 and (15351 or 15354 or 15355 or 21301 or 21373 or 21484)

**15-453 Formal Languages and Automata**
- **Spring**: 9 units
- An introduction to the fundamental ideas and models underlying computing: finite automata, regular sets, pushdown automata, context-free grammars, Turing machines, undecidability, and complexity theory.
- Prerequisites: 15212 and (15351 or 15354 or 15355 or 21301 or 21354 or 21355)
Course Descriptions

**Computer Graphics**

Fall and Spring: 12 units
This course provides a comprehensive introduction to computer graphics modeling, animation, and rendering. Topics include basic image processing, geometric transformations, geometric modeling of curves and surfaces, animation, 3-D viewing, visibility algorithms, shading, and ray tracing. Prerequisites: (15213 and 21241 and 21259) or (15213 and 18202)

**Computational Perception and Scene Analysis**

Spring: 9 units
The goal of this course is to teach how to reason scientifically about problems and issues in perceptual cognition, how to extract the essential computational properties of those abstract ideas, and finally how to convert these into explicit mathematical models and computational algorithms. The course teaches advanced aspects of perception, scene analysis, and recognition, in both the visual and auditory modalities, concentrating on those aspects that allow us and animals to behave in natural, complex environments. Both the experimental approaches of scientific disciplines and the computational approaches of engineering disciplines are emphasized. Each topic in the course begins by studying the ethology of natural behaviors, analyzing and decomposing these to identify the essential components that are required for the total behavior in a natural environment. This aspect of the course follows the lines of scientific reasoning and key experimental results that lead to our current understanding of the important computational problems in perception and scene analysis. The course then surveys the most important solutions to these problems, focusing on the idealizations and simplifications that are sensory coding, perceptual invariance, spatial vision and sound localization, visual and auditory scene segmentation, many aspects of attention, and the basics of objects and speech recognition. Prerequisites: 15385 or 85370

**Independent Study in Programming Systems**

Fall and Spring: 3-18 units

**Independent Study in Human-Computer Interaction**

Fall and Spring: 3-18 units

**Independent Study in Computer Science Pedagogy**

Fall and Spring: 3-18 units

**Rapid Prototyping of Computer Systems**

Spring: 12 units
This is a project-oriented course, which will deal with all four aspects of project development: the application, the artifact, the computer-aided design environment, and the physical prototyping facilities. The class consists of students from different disciplines who must synthesize and implement a system in a short period of time. Upon completion of this course the student will be able to: generate system specifications from a perceived need; partition functionality between hardware and software; produce interface specifications for a system composed of numerous subsystems; use computer-aided development tools; fabricate, integrate, and debug a hardware/software system; and evaluate the system in the context of an end user application. The class consists of students from different disciplines who must synthesize and implement a system in a short period of time. Prerequisites: 15211

**Independent Study in Computer Systems**

Fall and Spring: 3-18 units

**Independent Study in Theoretical Computer Science**

Fall and Spring: 3-18 units

**Independent Study in Graphics**

Fall and Spring: 3-18 units

**Independent Study in Robotics**

Fall and Spring: 3-18 units

**Independent Study in Artificial Intelligence**

Fall and Spring: 3-18 units

**Undergraduate Thesis Research**

Fall and Spring: 0-18 units
Available only to students registered in the CS Senior Research Thesis Program. More information is available at the CS Undergraduate Office.

**Artificial Intelligence: Machine Learning**

Fall: 12 units
Machine Learning is concerned with computer programs that automatically improve their performance through experience (e.g., programs that learn to spot high-risk medical patients, recognize human faces, detect credit card fraud, and drive autonomous robots). This course covers the theory and practical algorithms for machine learning from a variety of perspectives. We cover topics such as datamining, decision tree learning, neural network learning, statistical learning methods, genetic algorithms, Bayesian learning methods, expectation-based learning, and reinforcement learning. The course covers theoretical concepts such as inductive bias, the PAC learning framework, minimum description length principle, and Occam's Razor. Short programming assignments include hands-on experiments with various learning algorithms. Typical assignments include neural network learning for face recognition, and decision tree learning from databases of credit records. Prerequisites: 15212

**Electrical & Computer Engineering**

**Undergraduate Courses**

**Introduction to Electrical and Computer Engineering**

Fall and Spring: 12 units
The goals of this freshman engineering course are: to introduce basic concepts in electrical and computer engineering in an integrated manner; to motivate basic concepts in the context of real applications; to illustrate a logical way of thinking about problems and their solutions; and to convey the excitement of the profession. These goals are attained through analysis, construction and testing of an electromechanical system (e.g., a robot) that incorporates concepts from a broad range of areas within Electrical and Computer Engineering. Some of the specific topics that will be covered include system decomposition, ideal and real sources, Kirchhoff's Current and Voltage Laws, Ohm's Law, piecewise linear modeling of nonlinear circuit elements, Ideal Op-Amp characteristics, combinational logic circuits, Karnaugh Maps, Flip-Flops, sequential logic circuits, and finite state machines. 3 hrs. lec., 1 hr. rec., 3 hr. lab. Prerequisites: Corequisites: 21-121, 21-120

**Emerging Trends in Electrical and Computer Engineering**

Fall: 1 unit
This class consists of a series of individual lectures given by different faculty members and distinguished alumni. The lectures are designed to serve the following purposes: 1) provide students a good understanding of our curriculum structure and the courses in each of our five principle subject areas; 2) introduce to students the emerging trends in electrical and computer engineering and the relevance of our courses; 3) present to students our faculty's research fields; 4) discuss basic learning and working ethics; 5) prepare students career-making skills; 6) introduce new undergraduate courses and research opportunities. The class will contain 12 lectures from faculty members, 2 lectures on learning and working ethics, and 2 lectures from our alumni. Students are required to attend each lecture. An award for the best lecturer, selected by students, will be given at the end of the semester. 1 credit, 1 hr per week, pass/fail, required to graduate. Sophomore standing required. Prerequisites: 18100
Course Descriptions

18-202 Mathematical Foundations of Electrical Engineering
Fall and Spring: 12 units
This course covers topics from engineering mathematics that serve as foundations for descriptions of electrical engineering devices and systems. It is the corequisite mathematics course for 18-220, Fundamentals of Electrical Engineering. The topics include: (1) MATLAB as a robust computational tool, used to reinforce, enrich and integrate ideas throughout the course, including software exercises and projects in combination with homework assignments, (2) Complex Analysis, including rectangular and polar representations in the complex plane with applications, Cauchy-Riemann equations, complex Taylor series, complex linear, sinusoidal and hyperbolic functions, and Euler's formula, (3) Fourier Analysis, including orthogonality of sinusoids, trigonometric and exponential forms of Fourier series, Fourier integrals and Fourier transforms, (4) Linear, Constant-Coefficient Differential Equations, including complex exponential solutions to homogeneous equations and particular solutions with polynomial homogeneous coefficients and functions described by phasors, (5) Difference Equations, with emphasis upon their relationship to differential equations, and (6) Linear Algebra and Matrices, including matrix arithmetic, linear systems of equations and Gaussian elimination, vector spaces and rank of matrices, matrix inverses and determinants, eigenvalue problems and their relationship to systems of homogeneous differential equations. 4 hrs. lec., 1 hr. rec. Prerequisites: 21122 or 21118 or 21123

18-220 Fundamentals of Electrical Engineering
Fall and Spring: 12 units
This course covers fundamental topics that are common to a wide variety of electrical engineering devices and systems. The topics include circuit analysis techniques, passive and active components modeling, operational amplifiers, energy storage elements, power analysis, time-response of first- and second-order systems, sinusoidal steady-state response, frequency domain analysis, and filters. Other topics may include: diodes and transistors, basic noise analysis, transformers, pole-zero plotting and analysis in the complex plane. The laboratories are designed to give students the opportunity to build and operate circuits that address specific concepts covered in the lectures, including circuit and component modeling, amplifiers, filters, and signal detection & processing. 3 hrs. lec., 1 hr. rec., 3 hrs. lab. Prerequisites: 18100 Corequisites: 18-202

18-231 Sophomore Projects
Fall: 1-18 units
Experience in planning and conduct of independent engineering research, development or design projects, usually in concert with the research interests and programs of individual faculty members. Prerequisite: sophomore standing in Electrical and Computer Engineering.

18-232 Sophomore Projects
Spring: 1-18 units
Experience in planning and conduct of independent engineering research, development or design projects, usually in concert with the research interests and programs of individual faculty members. Prerequisite: sophomore standing in Electrical and Computer Engineering.

18-240 Fundamentals of Computer Engineering
Fall and Spring: 12 units
This course introduces basic issues in design and verification of modern digital systems. Topics include: Boolean algebra, digital number systems and computer arithmetic, combinational logic design and simplification, sequential logic design and optimization, register-transfer design of digital systems, basic processor organization and instruction set issues, assembly language programming and debugging, and a hardware description language. Emphasis is on the fundamentals: the levels of abstraction and hardware description language methods that allow designers to cope with hugely complex systems, and connections to practical hardware implementation problems. Students will use computer-aided digital design software and actual hardware implementation laboratories to learn about real digital systems. 3 hr. lec., 1 hr. rec., 3 hr. lab. Prerequisites: 18100 Corequisites: 21-127

18-303 Engineering Electromagnetics
Spring: 12 units
This course introduces electromagnetic principles and describes ways in which those principles are applied in engineering devices and systems. Topics include: Review of mathematical foundations, Static electric and magnetic fields in free space and in materials, Maxwell's equations in integral and differential forms, Electromagnetic waves and potential functions, Uniform plane waves in free space and in materials, Transients and sinusoidal steady state on 2-conductor transmission lines, Modes in conducting and dielectric waveguides, Radiation and antennas. 4 hrs. lec. and 1.5 hr. rec. Prerequisites: 18220

18-311 Semiconductor Devices I
Spring: 12 units
In this course you will receive an introduction to the operation and fabrication of the most important semiconductor devices in integrated circuit technology together with device design and layout. At the end of the course you will have a basic understanding of pn diodes, bipolar transistors, and MOSFETs as well as some light emitting and light detecting devices such as photodiodes, LEDs and solar cells. You will also receive an introduction to the fundamental concepts of semiconductor physics such as doping, electron and hole transport, and band diagrams. In the laboratory you will learn how to lay out both bipolar and MOS devices and you will design small (2-3 transistor) circuits. The laboratory portion of the course emphasizes the relation between device design and layout and circuit performance. You will also experimentally evaluate the operation of amplifier and gate circuits fabricated with discrete devices. This course will give you an excellent understanding of the operation and fabrication of the devices which is necessary for high-performance analog and digital circuit design. 3 hrs. lec., 3 hrs. lab. (Note: the prerequisite is typically waived for MSE students who intend to pursue the Electronic Materials Minor). Prerequisites: 18220

18-315 Optical Communication Systems
Fall: 12 units
In this course, students will receive an introduction to the fundamental principles and components of optical communications. The course objective is to provide a basic understanding of present optical communication systems as well as future engineering challenges. The course covers the basic concepts of data modulation in optical fiber channels, channel multiplexing, wavelength division multiplexing, and fiber optics. The course also includes the basic function principles of optical fiber, light emitting diodes, lasers, optical amplifiers, optical filters, and optical receivers. 3 hrs. lec., 1 hr rec. Prerequisites: 18220

18-316 Introduction to Data Storage Systems Technology
Fall: 12 units
This course teaches the fundamentals of magnetic and optical recording technology as used in data storage systems, audio and video recording. It begins with a treatment of systems considerations, including data rate, storage capacity, and formats of various tape and disk systems. It then moves on to treat the details of the writing and readback processes including descriptions of the heads and media. The concepts in magnetic materials and electromagnetics required to understand these devices are also covered. Lectures and problem sets are supplemented by six laboratories in which students record, readback, analyze actual signals, and operate magnetic and magnetoresistive devices. 3.0 hrs. lec., 3.0 hrs. lab (meets six times). Prerequisites: 18220 and 33107

18-321 Analysis and Design of Analog Circuits
Spring: 12 units
The purpose of this course is to introduce the student to the fundamentals of the analysis and design of basic analog circuits. Topics to be covered include: operational amplifier design, basic
amplifier feedback theory, frequency stability and compensation, dc bias calculations and circuits, MOSFET and BJT large- and small-signal device models, small-signal gain and frequency response characteristics of amplifiers, large-signal characteristics and nonidealities. In the hardware laboratory the student will gain experience designing, building, and characterizing analog circuits. The students will also learn how to use the SPICE circuit simulation program to compare actual and simulated performance. The analysis and design of analog circuits incorporating both Bipolar and CMOS technologies will be considered. 3 hrs. lec., 1 hr. rec., 3 hrs. lab.

Prerequisites: 18220

18-322 Analysis and Design of Digital Circuits
Fall: 12 units
This course is intended to provide the electrical and computer engineering student with a familiarity to and an understanding of the analytical and computer skills required for the design, computer, and simulation, design, and computer-aided physical layout of digital integrated circuits. This course is preparatory for study in the fields of Very Large Scale Integrated (VLSI) circuits and Computer-Aided Design techniques. The course presents systematic analysis and design of digital integrated circuits in CMOS technology using CADENCE Design Systems software tools.

Prerequisites: 18220 and 18240

18-331 Junior Projects
Fall: 1-18 units
Experience in planning and conduct of independent engineering research, development or design projects, usually in concert with the research interests and programs of individual faculty members.
Prerequisite: junior standing in Electrical and Computer Engineering

18-332 Junior Projects
Spring: 1-18 units
Experience in planning and conduct of independent engineering research, development or design projects, usually in concert with the research interests and programs of individual faculty members.
Prerequisite: junior standing in Electrical and Computer Engineering

18-340 Digital Computation
Spring: 12 units
In this course we will explore the techniques for designing high-performance digital circuits for computation along with methods for evaluating their properties. We begin by quickly reviewing number systems and digital arithmetic along with basic arithmetic circuits such as ripple-carry adders. We then focus on formal techniques and theory for analyzing the functionality, timing, power consumption, and chip area properties of these basic circuits and ones yet to be presented. From there, we move to more complex adders (carry-lookahead, carry-skip, carry-bypass, Wallace trees, and hybrid techniques) and multipliers (sequential, array, Booth, and others) along with various divider circuits. Floating point units are then built upon the concepts introduced for adder, multipliers, and dividers. Finally, we will investigate the design and implementation of digital filter circuits. For each circuit introduced, we will develop techniques for evaluating the circuit's functionality, their speed, power consumption, and silicon area requirements. In addition, we will utilize various CAD tools to design and evaluate most of the computation circuits discussed. After successful completion of the course, students will not only have an understanding of complex computation circuits, but subtle concepts that include hazards, metastability, false paths, inertial delay, sticky bits, clock skew/jitter, dynamic and static sensitization, and many others. 3 hrs. lec., 1 hr. rec.

Prerequisites: 18240

18-342 Fundamentals of Embedded Systems
Fall: 12 units
This practical, hands-on course introduces students to the basic building-blocks and the underlying scientific principles of embedded systems. The course covers both the hardware and software aspects of embedded processor architectures, along with operating system fundamentals, such as virtual memory, concurrency, task scheduling and synchronization. Through a series of laboratory projects involving state-of-the-art processors, students will learn to understand implementation details and to write assembly-language and C programs that implement core embedded OS functionality, and that control/debug features such as timers, interrupts, serial communications, flash memory, device drivers and other components used in typical embedded applications. Relevant topics, such as optimization, profiling, digital signal processing, feedback control, real-time operating systems and embedded middleware, will also be discussed. This course is intended for INI students.
Prerequisites: 18240

18-345 Introduction to Telecommunication Networks
Fall: 12 units
This course introduces the fundamental concepts of telecommunication networks. Underlying engineering principles of telephone networks, computer networks and integrated digital networks are discussed. Topics in the course include: telephone and data networks overview; OSI layers; data link protocol; flow control, congestion control, routing; local area networks (Ethernet, Token Ring and FDDI); transport layer; introduction to high-speed networks; performance evaluation techniques. 4 hrs. lec.
Prerequisites: 15113 and 18240 and 36217

18-349 Embedded Real-Time Systems
Fall: 12 units
The term “computer” usually conjures up in the minds of many people the image of a mainframe, a minicomputer, a PC, a workstation or a laptop computer. However, computers have always been embedded into all sorts of everyday items from automobiles and planes to TVs, in-house entertainment centers and toasters. These are usually called embedded computers or embedded systems, and actually account for more than 90% of all the world’s manufactured processors. In general, users of embedded systems see a specialized function (such as a High-Definition TV) and do not directly think of the computer embedded within the system. Such embedded computers are gaining importance as an increasing number of systems use embedded processors, RAM, disk drives, and networks. Embedded systems range in size from simple toasters and mini-robots to large-scale systems deployed in process control, manufacturing, power generation, defense systems, telecommunication systems, automotive systems, air traffic control, avionics, video-on-demand and video-conferencing systems. Embedded systems also differ from their conventional PC or workstation cousins in several ways. Embedded systems are typically used over long periods of time, will not (or cannot) be programmed or maintained by its end-users, and often face significantly different design constraints such as limited memory, low cost, strict performance guarantees, fail-safe operation, low power, reliability and guaranteed real-time behavior. These embedded systems often use simple executives (OS kernels) or real-time operating systems with typically small footprints, support for real-time scheduling and no hard drives. This introductory course on embedded computing focuses on these issues germane to embedded systems.
Prerequisites: 18240 and 15213

18-360 Introduction to Computer-Aided Digital Design
Spring: 12 units
This course introduces the techniques of modeling digital systems at various levels of abstraction, and computer-aided design algorithms that are applied to these models to support design and analysis tasks. The course covers modeling through the use of a modern hardware description language (Verilog). The language is used to model an IC in the early stages of design using behavioral modeling techniques and in later stages using structural modeling techniques. This course is not a how-to course on using CAD tools. Rather it is a study of the algorithms used by CAD tools. The course will cover: modeling of digital systems for simulation and synthesis using Verilog; test generation which is used to determine if a manufactured design is correct; event-driven simulation algorithms, and physical design which is used to map the synthesized logic design onto physical IC area. 4 hrs. lec.
Prerequisites: 15211 and 18240
Course Descriptions

18-370  Fundamentals of Control
Fall: 12 units
An introduction to the fundamental principles and methodologies of classical feedback control and its applications. Emphasis is on problem formulation and the analysis and synthesis of servomechanisms using frequency and time domain techniques. Topics include analytical, graphical, and computer-aided (MATLAB) techniques for analyzing and designing automatic control systems; analysis of performance; stability; transient response; transfer function and state space modeling of linear dynamic physical systems; nonlinearities in control systems; and control engineering software (MATLAB). 4 hrs. lec., 1 hr. rec.
Prerequisites: 18396

18-390  ECE CO-OP
All Semesters: 0-3 units

18-396  Signals and Systems
Fall and Spring: 12 units
This course is a breadth course that also is a prerequisite for most courses in communications, signal processing and control systems. The objective of this course is to provide students with an integrated understanding of the relationships between mathematical tools and properties of real signals and systems. This is accomplished by motivating lectures and recitation problems using demonstrations and laboratory assignments which cover such topics as radio transmission and reception, audio synthesizers, CDs, image processing, and prosthetic devices. In the course of the semester students are introduced to industry-standard computing and simulation tools that will be used in subsequent courses. Continuous and discrete-time signals and systems are treated in a unified manner through the concept of sampling. The course covers the basic concepts and tools needed to perform time and transform domain analyses of signals and linear time-invariant systems, including: unit impulse response and convolution; Fourier transforms and filtering; Laplace transforms, feedback and stability; and a brief introduction to transfer function based systems in the context of digital filtering.
Prerequisites: 18202 and 18220

18-410  Physical Sensors, Transducers and Instrumentation
Spring: 12 units
While modern electronic circuits have become largely digital, the physical world, and consequently, the electronic interface to the physical world remains fundamentally analog. Therefore, sensors, transducers, and the initial signal processing remain in the analog domain. Simultaneously, the commercial market place optimizes sensor technology based upon multiple attributes including cost, detectivity, size, speed, etc. In this course we explore both the many types of possible responses to various physical stimuli, as well as the instrumentation, electronic detection, signal conversion and signal processing techniques used to bring the physical event into the electronic world in a practical manner. This requires that we learn about the diversity of physical phenomena, materials and devices that can be used to convert the various forms of physical energy into electronic signals. Due to the significant diversity of physical phenomena the course requires reading from textbooks, the technical literature and patent literature. The course is taught via the case method with student participation via oral and written reports. The student should arrive with a strong interest in, and basic understanding of, physics, material science, chemistry and analog electronic circuits as taught at the sophomore and junior course level. Prerequisites: One of the courses listed below or permission of the instructor.
Prerequisites: 18303 or 18311 or 18321 or 27432

18-412  Semiconductor Devices II
Fall: 12 units
This course is designed to follow 18-311, which provides an introduction to the physics of semiconductor devices. 18-412 addresses in detail the physics and technology of semiconductor devices which work on the field effect principle. These devices include the MOSFET, junction field effect devices (JFET and MESFETS), thin film field effect transistors (TFTs), and related devices. The course material is specifically motivated by current applications in which portable and low power operation is required. Particular applications, which are discussed in detail, include scaled MOSFETs for logic and memory; CCD imagers; active matrix flat panel displays; and MESFETs for digital and RF applications. This course will be particularly valuable for students interested in semiconductor device technology (including device physics and integrated circuit process technology) and analog/RF or aggressive digital circuit design. 3 hrs. lecture.
Prerequisites: 18311 and 33107

18-431  Undergraduate Projects - Senior
Fall: 1-18 units
Experience in planning and conduct of independent engineering research, development, or design projects, usually in concert with the research interests and programs of individual faculty members.
Prerequisite: senior standing in Electrical and Computer Engineering.

18-441  Verification of Computer Hardware Systems
Fall: 12 units
This course will present state-of-the-art methodologies and tools for simulation-based and formal verification of complex digital systems. The problem of verification will be introduced and its importance motivated by the current crisis in industry. Various simulation-based techniques will be presented including white, gray, and black-box testing, random test case generation, and code-coverage metrics. Formal verification techniques will be emphasized, as well. Lectures covering equivalence checking, model checking, and symbolic trajectory evaluation will be presented. Pros and cons of each technique will be evaluated and techniques for selecting a verification methodology appropriate for a given application will also be described. Student projects will involve the use of commercial tools to test, debug, and verify real designs from industry. Students enrolled in the course must have advanced design experience and therefore prerequisites include one of the following courses: 18-340, 18-347 (or 18-447), 18-349 or 18-360. 3 hrs. lec.
Prerequisites: 18340 or 18347 or 18349 or 18360 or 18447

18-447  Introduction to Computer Architecture
Fall and Spring: 12 units
Computer architecture is the science and art of selecting and interconnecting hardware components to create a computer that meets functional, performance and cost goals. This course introduces the basic hardware structure of a modern programmable computer including, the basic laws underlying performance evaluation. We will learn, for example, how to design the control and data path hardware for a MIPS-like processor, how to make machine instructions execute simultaneously through pipelining and simple superscalar execution, and how to design fast memory and storage systems. The principles presented in lecture are reinforced in the laboratory through design and simulation of a register transfer (RT) implementation of a MIPS-like pipelined superscalar in Verilog. Learning to design programmable systems requires that you already have the knowledge of building RT systems as is taught in the prerequisite 18-240, the knowledge of the behavior storage hierarchies (e.g., cache memories) and virtual memory as is taught in the prerequisite 15-213, and the knowledge of assembly language programming as is taught in both prerequisites. 3 hrs. lec., 3 hrs. lab.
Prerequisites: 15213 and 18240

18-450  Wireless Communications
Fall: 12 units
In this course, wireless communication channels will be introduced,
and their peculiarities such as fading and co-channel interference will be emphasized. Solutions to combat the problems will be described, covering equalization and detection, coding, diversity ideas, and elementary interference cancellation. Throughout the course, the emphasis will be on discovering unifying ideas in transmission, rather than specifying the details of each application. Illustrative examples will be chosen from existing wireless standards (e.g., W-CDMA). A course project on designing a wireless transceiver simulation model will enhance understanding of the underlying theories. Possible research directions will be pointed out, for students interested in a more detailed understanding. The course will also cover basic communication theory in sufficient detail. The specific topics covered are baseband and passband analysis, modulation, equalization, coding, diversity, multiple-access systems, interference cancellation, and spread spectrum communications. 18-450 is a prerequisite for graduate-level wireless communication courses. 4 hrs. lec.

Prerequisites: 18-396 or equivalent, and 36-217 or equivalent, and some exposure to MATLAB.

Prerequisites: 18396 and 36217

18-474 Embedded Control Systems

Fall: 12 units

This course introduces principles for design of embedded controllers. In applications ranging from airplanes, to automobiles, to manufacturing systems, embedded computers now close feedback loops that were previously closed by mechanical devices or by humans in the loop. This course emphasizes practical insight into the tools for modeling and simulating these dynamic physical systems, and methods for designing the real-time software for embedded computers to control them. Lectures cover relevant theory and background from real-time systems and control engineering, including event-based and clock-based sampling, switching control, PWM (pulse-width modulation), PID (proportional-integral-derivative) design, state-variable feedback, state estimation, and methods for setpoint control and trajectory tracking. Basic embedded computing, sensor, and actuator technologies are reviewed, including microcontrollers, DC motors and optical encoders. In the laboratory, students use commercial tools for simulation and automatic code generation to design and implement embedded control system experiments. 3 hrs. lecture, 3 hrs. lab.

Prerequisites: 18396

18-482 Telecommunications, Technology Policy & Management

Fall: 12 units

This course provides a comprehensive introduction to basic principles of telecommunications technology and the telephone network, and the legal, economic, and regulatory environment of the telecommunications industry. Role of new technologies such as fiber, integrated digital networks, computer communications, and information services. Common carrier law and the economics of natural monopoly as the basis for regulation of the telecommunications industry. Issues of competition, monopoly and technical standards. Spectrum allocation and management. International communications and transborder data flow. Special emphasis on how the new technologies have altered and are altered by regulation. Prerequisites: 73-100 and Junior or Senior standing.

Prerequisites: 73100

18-493 Electroacoustics

Fall: 12 units

This course provides an introduction to physical, engineering, and architectural acoustics. The course begins with a review of the wave equation and some of its solutions that are relevant to the propagation of sound from planar and spherical sources, and from arrays of simple sources. Jumped-parameter electrical circuit analogies are developed to describe mechanical and acoustical systems, leading to a unification of the constraints and tradeoffs involved in the design of loudspeakers, microphones, and other transducers. The characteristics of sound in regular and irregular enclosures will be developed and discussed in the context of the acoustical design for rooms and auditoriums. The interaction of sound and man is also discussed, with introductory lectures on audiological perception and the acoustics of speech production, with applications in the areas of efficient perceptually-based coding of music and speech, and virtual acoustical environments.

Prerequisites: 18220

18-517 Data Storage Systems Design Project

Spring: 12 units

This course gives students a comprehensive understanding of data storage systems through lecture and simulation exercises. Over the course of the semester, students will work in teams to build a computer simulation of an entire disk drive recording channel, and observe the different forms that the stored information takes on its passage through a non-volatile storage system. As many realistic aspects of the storage system will be incorporated in the simulation as possible, including magnetic media hysteresis, magnetic and electronic noise, magnetoresistive readback sensors, and various methods of data detection. The class will culminate with demonstrations by each group of their models, and the effect the changes in recording parameters have on data integrity. Currently the SIMULINK package is used with Matlab to construct the simulation, and students are provided with a 3 hr. recitation period each week during which they can work on their simulation under the supervision of the course instructors. 3 hrs. lecture, 3 hrs. rec.

Prerequisites: 18316 and 18396

18-523 Analog Integrated Circuit Design

Fall: 12 units

Some form of analog circuit design is a critical step in the creation of every modern IC. First and foremost, analog circuits act as the interface between digital systems and the real world. They act to amplify and filter analog signals, and to convert signals from analog to digital and back again. In addition, high performance digital cell design (either high speed or low power) also invokes significant analog circuit design issues. The goal of this course is to teach students some of the methods used in the design and analysis of analog integrated circuits, to illustrate how one approaches design problems in general, and to expose students to a broad cross-section of important analog circuit topologies. The course will focus on learning design through carrying out design projects. Design and implementation details of wide-band amplifiers, operational amplifiers, continuous-time filters, phase lock loops and data converters will be covered. The
course will focus primarily on analog CMOS, but some aspects of BJT design will be discussed. 4 hrs. lec. 
Prerequisites: 18321 and 18322

18-525 Integrated Circuit Design Project 
Spring: 12 units
Integrated Circuit Design Project (18-525) is intended to provide the electrical and computer engineering student with IC design experience. It supplies theoretical background and practical skills gained in 18-322. The primary stress of the 18-525 class will be on the IC design process as a whole. Such a process, seen as a sequence of design decisions, must lead to a design which optimizes a given objective function under a number of constraints. The optimum design must be achieved using a number of variables involving all levels of design abstraction and ranging between architecture choice and detail of the IC layout. Typical design objectives adopted in 18-525 designs will be IC performance (throughput, clock frequency, etc.) and typical constraints will be die size and minimum feature size. The second most important objective of 18-525 is to mimic a large design team environment in which individual designers must: (a) communicate precisely and efficiently his/her ideas and (b) utilize any feedback provided by the "design environment". This objective will be achieved through class presentations given by each student and by stressing the importance of design documentation. 4 hrs. class. Prerequisites: 18322

18-544 Network Design and Evaluation 
Fall: 12 units
The purpose of the "Network Design and Evaluation" is to give students hands-on experience building networking software. A typical project will be the design, implementation, and evaluation of a network protocol. The design will specify the requirements, protocol specification, and success criteria. The implementation will work over an actual network, and the evaluation will evaluate whether the success criteria have been met. Students will work in teams and will have a choice of a small number of projects. Prerequisites: (18345 and 15213) or 15441

18-549 Advanced Digital Design Project 
Spring: 12 units
This is a term-project course oriented towards the development of skills to design large digital systems at a professional level. Proficiency gained in other software and hardware design courses will be utilized in the design and development of a System-on-a-Chip (SoC) prototype. Project development will utilize a mix of system architecture design, custom hardware design and software programming skills. The project will result in a prototype which will be built in a lab setting. Prototype development will include some wire-wrap and also the use of some state-of-the-art design tools. Industry standard practices of design reviews, final project presentations, and weekly reports will be followed. The design process will be studied. Through the project, class discussions, and interactions with classmates the course will allow you to enhance your effectiveness in future projects in industry or academia. 2 hours lecture, 24 hour access lab. Prerequisites: 18349 or 18447 or any two of (15213, 18322, 18347, 18360)

18-549 Distributed Embedded Systems 
Fall: 12 units
This advanced course considers embedded systems with multiple, distributed processing elements connected by a real-time network. These distributed embedded systems are becoming very common in application areas as diverse as transportation, medical equipment, industrial control, and household appliances. The course is divided into three phases: (1) the fundamentals of distributed system architecture and design approaches, (2) real-time embedded networks and systemwide scheduling, and (3) dependable system design. A semester-long course project, such as a detailed distributed implementation of an elevator simulation, is used to tie together the various aspects of the lecture material. While a significant understanding of hardware organization and operation is assumed, the focus of the course is mainly on software, simulation, and embedded network issues. Relevant aspects of the Unified Modeling Language (UML) are included, although this is not an in-depth course on that topic. 1 hour of the lecture times per week is primarily used for discussion of non-testable advanced topics and talks by visitors from industry. 4 hrs. lec., 1 hr. rec./lab. Prerequisites: 15412 or 18349

18-551 Digital Communication and Signal Processing Systems Design 
Spring: 12 units
This course provides the student with a rich, in-depth design and application hardware project experience in the areas of digital communications and/or signal processing systems using DSP hardware. Teams of students work on a semester-long project of their choice. Topics include: speech and music processing, digital communications, multimedia processing, data compression, data storage, wireless communications, CD, image and/or signal processing, etc. One month of introductory laboratories familiarize the student with DSP hardware, computer fundamentals, and support software. Lectures address z-transforms, IIR and FIR filter design using MATLAB and DSP hardware, LPC and adaptive filters, channel coding, time and frequency multiplexing, short time Fourier and wavelet transforms, and spread spectrum techniques. 4 hrs. lec., 3 hrs. lab. Prerequisites: 18396 and (15211 or 18550 or 18552 or 18791 or 18793 or 18796 or 18798)

18-575 Control Systems Design 
Intermittent: 12 units
A capstone design elective in Electrical and Computer Engineering integrating the computer-aided analysis and design of feedback control systems from both the classical (transfer function) and modern (state-space) points of view. The perspective spans the dynamic modeling of physical systems and the analysis and computer-aided design (utilizing MATLAB) of linear and nonlinear, continuous-time and discrete-time, robust multivariable feedback systems. In illustrating the centrality of numerical linear algebra in control engineering, case studies are selected from servomechanism and linear-quadratic design and Kalman filtering. A significant emphasis is placed upon student selected design projects. 4 hrs. lec., 3 hrs. MATLAB lab. Prerequisites: 18370

18-578 Mechatronic Design 
Spring: 12 units
Mechatronics is the synergistic integration of mechanism, electronics, and computer control to achieve a functional system. Because of the emphasis upon integration, this course will center around system integration in which small teams of students will configure, design, and implement a succession of mechatronic subsystems, leading to a main project. Lectures will complement the laboratory experience with comparative surveys, operational principles, and integrated design issues associated with the spectrum of mechanism, electronics, and control components. Class lectures will cover topics intended to complement the laboratory work, including mechanisms, actuators, motor drives, sensors and electronic interfaces, microcontroller hardware and programming and basic controls. During the first week of class, each student will be asked to complete a questionnaire about their technical background. The class will then be divided into multi-disciplinary teams of three students. During the first half of the class, lab assignments will be made every 1-2 weeks to construct useful subsystems based on material learned in lecture. The lab assignments are geared to build to the main project. This course is cross-listed as 16-778 and 24-778. Students in other departments may take the course upon availability of slots with permission of instructor. Prerequisites: 18370 or 18349 or (18321 and 18396)
Engineering & Public Policy
Undergraduate Courses

19-101 Introduction to Engineering and Public Policy
Spring: 12 units
This course examines the processes of public and private decision making and of policy formation, which shape the evolution of a technology and its impact on our society. Technology plays an important role in shaping our worlds. At the same time, social forces often play a central role in the evolution of a technology. A particular technology such as an automobile or computer is chosen to study technology and policy in context. Specific topics covered in the case of the automobile includes automotive design and manufacture, safety, pollution, fuel economy and their interactions. In each area, we discuss the technological and institutional issues, their interaction, the possible need for public policy and the factors that govern the policy. The course will involve several group problem-solving sessions.
Prerequisites: Corequisites: 21-115, 21-116, 33-106

19-102 EPP Sophomore Seminar
Fall: 3 units
The Sophomore Seminar has the objective of introducing the student to the interdisciplinary nature of Engineering and Public Policy problems. This is achieved through the use of three or four case studies dealing with aspects of decision-making in policy issues which have a technological basis. Cases used include: Salmon Management in the Northwest, Earth Observing Station, B-2 or not B-2?, and Fiber-to-the-Home: Management of an integrated services network. Students are introduced to the technical and policy dimensions of these problems as well as to skills such as data collection and analysis, group work, and oral and written presentations. A few seminars by EPP graduates and faculty are also included to give the student an idea of careers and EPP problems.

19-426 Environmental Decision Making
Intermittent: 9 units
This course focuses on the role of human behavior in creating and addressing environmental problems. Topics include commons dilemmas; risk analysis, perception, and communication; the value of non-market goods; efficacy of policy interventions; components of sustainability; environmental justice; and intergenerational equity. Findings from the literature on judgment and decision-making are highlighted in readings and class discussions.

19-430 Civilian and Military Applications of Space
Intermittent: 12 units
An analysis of some specific defense and space policy issues is conducted. This analysis is abstracted from a study of the specific technologies involved. An assessment of the impact of technological advancement on the military capability, space policy and arms control issues is proposed. As the exploitation of high technology has a lot of ramifications, the course focuses on some areas carefully chosen, based on the recent events, to illustrate the extent of the impact and to permit as wide-ranging a discussion as possible. Those issues cover areas of advanced imaging and target recognition capabilities; the military exploitation of new physical principles; the development of new capabilities in space for military or civilian exploitation, and the convolution of these new capabilities with the increasing technological demands of arms control. In all examples, the interaction between technological progress and needs for policy changes (or emergence of policy dilemmas) are emphasized.

19-440 Combustion and Air Pollution Control
Intermittent: 9 units
Formation and control of gaseous and particulate air pollutants in combustion systems. Basic principles of combustion, including thermochromic equilibrium, flame temperature, chemical kinetics, hydrocarbon chemistry, and flame structure. Formation of gaseous and particulate pollutants in combustion systems. Combustion modifications and postcombustion technologies for pollutant control. Relationship between technology and regional, national, and global air pollution control strategies. The internal combustion engine and coal-fired utility boiler are used as examples.

19-448 Science, Technology & Ethics
Intermittent: 9 units
Technology has always been a pervasive force in society. But the last century, and especially the last 50 years have seen an unprecedented acceleration of the growth and permeation of technology. The central role of technology and engineering in the modern world calls for a reflective examination of the responsibility of those who develop, deploy and spread technologies as well as those who avail of them for various purposes. This course will explore one technology of recent origin in detail –biotechnology. After examining the way people think about and deal with technological risk, the basic science behind the technology and the ethos of science and technology, the students will learn about the philosophical foundations of possible ethics for science and technology. Projects and discussions will explore how these foundations can be used to provide ways to frame important questions and develop an understanding of an ethic for the development and use of biotechnology.

19-451 EPP Projects
Spring: 12 units
Interdisciplinary problem-solving projects in which students work as leaders or members of project teams. Problem areas are abstracted from local, state and national situations and involve the interaction of technology and public policy, with different projects being chosen each semester. Oral and written presentations concerning the results of project studies are required.

19-452 EPP Projects
Fall: 12 units
Interdisciplinary problem-solving projects in which students work as leaders or members of project teams. Problem areas are abstracted from local, state and national situations and involve the interaction of technology and public policy, with different projects being chosen each semester. Oral and written presentations concerning the results of project studies are required.
Course Descriptions

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19-500 Directed Study in EPP: Undergraduate
All Semesters: 0-12 units
Students may do undergraduate research as one course for EPP
technical elective credit, with an EPP faculty member, or on an
approved project with a faculty member from another department.
The research credits must be pre-approved by your advisor, and
should result in a written product, one copy of which should be sent to
EPP.

19-601 Information Warfare
Intermittent: 12 units
Information security is one major concern raised by the increasing
use of computers in networks. In this course we first review, in some
technical detail, the nature of the "threats". These include viruses and
worms (their history and how they "evolved"), backdoor exploits,
Trojan horses, buffer overflows, and the extent to which they imperil
the information in computers. Then we discuss the use and limitations
of firewalls in solving computer security problems. We also discuss intrusion
detection and the problems associated with it. We review past and
present cyberattacks, like Denial of Service attacks, viruses such as
Melissa and I love you, and assess their implications. We analyze the
origin of computer vulnerabilities which make those attacks possible
and discuss the extent to which they could be reduced. Finally, we
analyze the response to this situation at the national, security and
international level.

19-606 Special Topics: Civil Systems Investment Planning and
Pricing
Intermittent: 12 units
Economic framework for identifying and analyzing investment and
operation options facing agencies and firms, (both in theory and in
practice); economic efficiency, utilization, pricing, and investment;
and multi-objective evaluation.

19-609 Public Policy and Regulation
Intermittent: 9 units
Regulations are a significant policy tool of government. How society
and the economy will react to new regulations can be hard to predict.
Unintended side effects sometimes occur resulting in costs exceeding
estimates and/or benefits never being realized. This course will review
the basics of regulatory policy and using historical examples, will
explore the reasons why past regulations have succeeded and failed.
The second half of the course will involve 2-3 detailed case studies.
Quantitative methods will be used to evaluate several pending
regulations for real-world clients from both government and industry
perspectives. Prerequisites: Basic statistics, economics, and
quantitative methods

19-644 Medical Devices
Intermittent: 9 units
This course is an introduction to the engineering, clinical, legal and
regulatory aspects of medical device performance and failure. Topics
covered include phenomenological and mechanistic descriptions of
processes such as wear, corrosion fatigue and fretting, in addition to
the characterization of bone and other biological materials as it relates
to device performance requirements, including biocompatibility. The
course also involves case studies of orthopedic fixation devices and
prostheses, pacemakers, heart valves and artificial organs. A major
portion of the course is a final design project which involves the
design of a new medical device or the redesign of an existing device.

21-101 Freshman Mathematics Seminar
Fall: Mini Session - 3 units
This course is offered in the second half of the Fall semester for
first semester Freshmen interested in majoring in mathematics.
Topics vary from year to year. Recent topics have been finite
difference equations, convexity, and fractals. 3 hrs. lec.

21-105 Pre-Calculus
Fall: 9 units
Review of basic concepts, logarithms, functions and graphs,
inequalities, polynomial functions, complex numbers, and
trigonometric functions and identities. 3 hrs lec., 1 hr rec.

21-106 Co-Calculus
Fall: Mini Session - 2 units
A review of the basic skills needed for success in calculus and other
science and engineering courses with a focus on problem solving
skills, basic algebra, and inequalities. To be taken concurrently with
21-120. 2 hours lecture, 2 hours lab.

21-110 Problem Solving in Recreational Mathematics
Spring: 9 units
The emphasis is on learning to solve problems in elementary
mathematics. Topics may vary among offerings of the course, but
typically include puzzles, algebraic problems, number theory, and
graph theory. 3 hrs. lec.

21-111 Calculus I
All Semesters: 10 units
Review of basic algebra, functions, limits, derivatives of algebraic,
exponential and logarithmic functions, curve sketching, applications
with emphasis on economic models. 3 hrs lec., 2 hrs rec.

21-112 Calculus II
All Semesters: 10 units
Indefinite integral, definite integral and applications, techniques of
integration, trigonometric functions, functions of several variables,
partial derivatives, maximum-minimum problems, Lagrange
multipliers, geometric series, Newton's method, applications. 3 hrs.
lec., 2 hrs rec. Prerequisites: 21111

21-115 Differential Calculus
All Semesters: Mini Session - 5 units
Functions, limits, derivatives, curve sketching, Mean Value Theorem,
trigonometric functions, related rates, linear and quadratic
approximations, maximum-minimum problems. 3 hrs lec., 2 hrs rec.

21-120 Differential and Integral Calculus
All Semesters: 10 units
Functions, limits, derivatives, logarithmic, exponential, and
trigonometric functions, inverse functions; L'Hospital's Rule, curve
sketching, Mean Value Theorem, related rates, linear and quadratic
approximations, maximum-minimum problems, inverse functions,
definite and indefinite integrals, and hyperbolic functions; applications
of integration, integration by substitution and by parts. 3 hrs lec., 2 hrs rec.

21-121 Integration and Differential Equations
Fall and Spring: 10 units
Differential review, L'Hospital's Rule, Mean Value Theorem,
maximum-minimum problems. Definite and indefinite integrals;
hyperbolic functions; applications of integration, integration by
substitution and by parts. Integration by trigonometric substitution
and partial fractions; arclength; improper integrals; Simpson's and
Trapezoidal Rules for numerical integration; separable differential
equations, first order linear differential equations, homogeneous
second order linear differential equations with constant coefficients. 3
hrs lec., 2 hrs rec.

21-122 Integration, Differential Equations, and Approximation
All Semesters: 10 units
Integration by trigonometric substitution and partial fractions;
arclength; improper integrals; Simpson's and Trapezoidal Rules for
numerical integration; separable differential equations, first order
linear differential equations, homogeneous second order linear
differential equations with constant coefficients, series solution,
Newton's method, Taylor's Theorem including a discussion of the
remainder, sequences, series, power series. 3 hrs lec., 2 hrs rec.
Prerequisites: 21112 or 21120 or 21121
Course Descriptions

21-123  Calculus of Approximation
Fall and Spring:  Mini Session - 5 units
Newton's method, Taylor's Theorem including a discussion of the remainder, sequences, series, power series. 3 hrs. lec., 2 hrs. rec.
Prerequisites: 21117 or 21121

21-125  Maple Lab
Fall and Spring:  3 units
An introduction to the symbolic programming package Maple using mathematical topics chosen from calculus and matrix algebra. Recommended to accompany any calculus course beyond 21-120 Differential and Integral Calculus. 1 hr. lec.

21-126  Introduction to Mathematical Software
Spring:  Mini Session - 3 units
This course provides an introduction to the use of several software packages, which are useful to mathematics students. Among the packages are Maple and Mathematica for symbolic computing, TeX and LaTeX for mathematical documents, and Matlab for numerical computing. The course will also introduce the mathematical facilities built into spreadsheets such as Excel. The aim of the course is to provide the student with some basic skills in the use of this software without attempting complete coverage. A deeper knowledge of the software will be easy to obtain after completing this course. There are no prerequisites for the course, other than basic computer literacy and a knowledge of elementary mathematics. It is suggested that the course should be taken during the first two years of undergraduate studies.

21-127  Concepts of Mathematics
All Semesters:  9 units
This course introduces the basic concepts, ideas and tools involved in doing mathematics. As such, its main focus is on presenting informal logic, and the methods of mathematical proof. These subjects are closely related to the application of mathematics in many areas, particularly computer science. Topics discussed include a basic introduction to elementary number theory, induction, the algebra of sets, relations, equivalence relations, congruences, partitions, and functions, including injections, surjections, and bijections. A prerequisite for 15-211. 3 hrs. lec., 2 hrs. rec.

21-131  Analysis I
Fall:  10 units
An enriched first course in calculus, which includes a greater concentration on the foundations of the subject. Recommended for students with some prior background in calculus and who seek a deeper calculus course. Functions, limits, continuity; the Intermediate Value Theorem; the Riemann integral; the Fundamental Theorem of Calculus; integrability of continuous functions; the derivative and its significance; product rule, quotient rule, chain rule; Mean Value Theorem; inverse functions. 3 hrs. lec., 2 hrs. rec.

21-132  Analysis II
Spring:  10 units
A continuation of Analysis I. L'Hospital's rule; trigonometric, logarithmic, and exponential functions; techniques of integration; approximation by polynomials, Taylor's theorem; sequences, series, power series; introduction to linear differential equations. 3 hrs. lec., 2 hrs. rec.
Prerequisites: 21131

21-201  Undergrad Colloquium
Fall and Spring:  1 units
All mathematics majors meet for one hour each week to hear discussions on current research by faculty or students, presentations on mathematics from mathematicians outside academia, and expository talks on selected mathematical topics not part of the usual curricula. Also will include topics of special interest to undergraduates such as preparation for graduate school.

21-228  Discrete Mathematics
All Semesters:  9 units
The techniques of discrete mathematics arise in every application of mathematics, which is not purely continuous, for example in computer science, economics, and general problems of optimization. This course introduces two of the fundamental areas of discrete mathematics: enumeration and graph theory. The introduction to enumeration includes permutations, combinations, and topics such as discrete probability, combinatorial distributions, recurrence relations, generating functions, Ramsey's Theorem, and the principle of inclusion and exclusion. The introduction to graph theory includes topics such as paths, walks, connectivity, Eulerian and Hamilton cycles, planar graphs, Euler's Theorem, graph coloring, matchings, networks, and trees. 3 hrs. lec, 1 hr. rec.
Prerequisites: 15129 or 21127

21-229  Set Theory
Spring:  9 units
Set theory was invented about 110 years ago by George Cantor as an instrument to understand infinite objects and to compare different sizes of infinite sets. Since then set theory has come to play an important role in several branches of modern mathematics, and serves as a foundation of mathematics. Contents: Basic properties of natural numbers, countable and uncountable sets, construction of the real numbers, some basic facts about the topology of the real line, cardinal numbers and cardinal arithmetic, the continuum hypothesis, well ordered sets, ordinal numbers and transfinite induction, the axiom of choice, Zorn's lemma. Optional topics if time permits: Infinitary combinatorics, filters and large cardinals, Borel and analytic sets of reals. 3 hrs. lec.
Prerequisites: 21127

21-235  Mathematical Studies I
Fall:  20 units
A unified and intensive presentation of algebra, analysis, and geometry by a team of instructors. For capable and dedicated students who can allot a substantial amount of time to the study of mathematics. Aims at providing a modern background in mathematics for a career in pure or applied mathematics, science, or engineering. Topics covered include analysis in IR, analysis in Euclidean spaces, linear algebra, geometry, algebraic theories, multi-linear algebra, ordinary differential equations. Covers and extends the material in the courses Calculus in Three Dimensions, Advanced Calculus I and II, Algebraic Structures, and Linear Algebra I. Normally taken by students in the third semester. Participation by invitation. Interested freshmen should contact the Department in March.
Prerequisites: 21132

21-236  Mathematical Studies II
Spring:  20 units
A unified and intensive presentation of algebra, analysis, and geometry by a team of instructors. For capable and dedicated students who can allot a substantial amount of time to the study of mathematics. Aims at providing a modern background in mathematics for a career in pure or applied mathematics, science, or engineering. Topics covered include analysis in IR, analysis in Euclidean spaces, linear algebra, geometry, algebraic theories, multi-linear algebra, ordinary differential equations. Covers and extends the material in the courses Calculus in Three Dimensions, Advanced Calculus I and II, Algebraic Structures, and Linear Algebra I. Normally taken by students in the fourth semester. On completion a number of options are open, among them the Honors Degree Program. Participation by invitation.
Prerequisites: 21235

21-241  Matrix Algebra
Fall and Spring:  9 units
Vectors and matrices, the solution of linear systems of equations, vector spaces and subspaces, orthogonality, determinants, real and complex eigenvalues and eigenvectors, linear transformations. 3 hrs. lec.

21-256  Multivariate Analysis and Approximation
Fall or Spring:  9 units
Taylor's Theorem; geometric sequences and series and their applications in compound interest; vectors and matrices, lines, and planes; partial derivatives, directional derivatives, gradient, chain rule, maximum-minimum problems, Lagrange multipliers and the Kuhn-Tucker Theorem. 3 hrs. lec., 2 hrs. rec.
Prerequisites: 21116 or 21120 or 21121

21-257 Models and Methods for Optimization
All Semesters: 9 units
Introduces basic methods of operations research and is intended primarily for Business Administration and Economics majors. Review of linear systems; linear programming, including the simplex algorithm, duality, and sensitivity analysis; the transportation problem; the critical path method; the knapsack problem, traveling salesman problem, and an introduction to set covering models. 3 hrs. lec., 1 hr. rec.
Prerequisites: 06262 or 18200 or 18202 or 21241 or 21256 or 21341

21-259 Calculus in Three Dimensions
All Semesters: 9 units
Vectors, lines, planes, quadratic surfaces, polar, cylindrical and spherical coordinates, partial derivatives, directional derivatives, gradient, divergence, curl, chain rule, maximum-minimum problems, multiple integrals, parametric surfaces and curves, line integrals, surface integrals, Green-Gauss theorems. 3 hrs. lec., 2 hrs. rec.
Prerequisites: 21116 or 21120 or 21121

21-260 Differential Equations
All Semesters: 9 units
Ordinary differential equations: first and second order equations, applications, Laplace transforms; partial differential equations: partial derivatives, separation of variables, Fourier series; systems of ordinary differential equations; applications. 3 hrs. lec., 1 hr. rec.
Prerequisites: 21118 or 21122 or 21123 or 21132

21-270 Introduction to Mathematical Finance
Fall: 9 units
This course introduces the mathematical ideas, which underlie the recent rapid expansion of financial markets. Topics include: an introduction to financial instruments and markets, simple models for the random variation of prices in financial markets, the fundamental concept of arbitrage, and the use of arbitrage-free models for valuation of securities and for risk management. 3 hrs. lec.

21-295 Models and Methods for Optimization
Intermittent: 9 units
The objective of this course is to learn to program in Maple, a powerful symbolic mathematics package available on many platforms at Carnegie Mellon. After learning what Maple can do with the commands provided with the package, students will learn to develop their own Maple functions to accomplish extended mathematical computations. Grades in the course will be based mostly on project work. Projects may come from any relevant field and may be graphical, numerical, or symbolic or all three. The course will involve online demonstrations in most classes. 3 hrs. lec.

21-341 Linear Algebra
Fall and Spring: 9 units
Fields, vector spaces, subspaces, linear independence, basis and dimension, matrices and linear equations, linear transformations, groups, rank and nullity theorem, change of basis, inner product spaces, eigenvalues and eigenvectors. 3 hours lecture.
Prerequisites: 21127

21-342 Linear Algebra II
Intermittent: 9 units
Prerequisites: 21341

21-350 History of Mathematics
Intermittent: 9 units
Mathematics has a long and interesting history, and there is much insight into both mathematics and history to be gained from its study. The emphasis here will be on learning the mathematics with the added value of appreciating it in historical context. Selected topics may range from early number systems, the development of geometry, the emergence of the ideas of analysis, through to the origins of modern set theory. 3 hrs. lec.

21-355 Principles of Real Analysis I
Fall and Spring: 9 units
Prerequisites: 21118 or 21122

21-356 Principles of Real Analysis II
Spring: 9 units
Topology in metric spaces, specialization to finite dimensional normed linear spaces. Vector differential calculus: continuity and the total derivative, partial derivatives, directional derivatives, gradients, Jacobians, the chain rule, implicit function theorem. Vector integral calculus: double and triple integrals, arclength and surface area, line integrals, Green's Theorem, surface integrals, Divergence and Stokes Theorems. If time permits: trigonometric series, Fourier series for orthonormal bases, minimization of square error. 3 hours lecture. Prerequisites: 21241 and 21259 and 21355
21-357  Sequences and Series of Functions  
Fall:  9 units  
This course serves as a sequel to Advanced Calculus I. The course begins with a thorough coverage of uniform and pointwise convergence of sequences and series of functions. This is followed by application to power series and Fourier series. Additional topics may include (at the discretion of the instructor and as time permits) the Weierstrass approximation theorem, metric spaces, contraction mapping, existence of solutions to ODEs, the Arzela-Ascoli theorem, and wavelets. 3 hrs. lec.  
Prerequisites: 21241 and 21259 and 21355

21-365  Projects in Applied Mathematics  
Fall:  9 units  
This course provides students with an opportunity to solve problems posed by area companies. It is also designed to provide experience working as part of a team to solve problems for a client. The background needed might include linear programming, simulation, data analysis, scheduling, numerical techniques, etc.

21-366  Topics in Applied Mathematics  
Intermittent:  9 units  
Typical of courses that might be offered from time to time are game theory, non-linear optimization, and dynamic programming. 3 hrs. lec.  
Prerequisites: 21373

21-369  Numerical Methods  
Fall and Spring:  9 units  
This course provides an introduction to the use of computers to solve scientific problems. Methods for the computational solution of linear algebra systems, nonlinear equations, the interpolation and approximation of functions, differentiation and integration, and ordinary differential equations. Analysis of roundoff and discretization errors and programming techniques. 3 hrs. lec.  
Prerequisites: 21259

21-370  Discrete Time Finance  
Fall:  9 units  
This course treats the multi-period binomial model for derivative security pricing. Options, futures, exotic options, bonds, and interest rate swaps are treated, and prices of some of these are computed by backward recursion and by Monte Carlo simulation. The Black-Scholes equation will be obtained as a limiting case of the binomial model. 3 hrs. lec.  
Prerequisites: (21257 or 21292) and (21170 or 21270) and (36225 or 70207)

21-371  Functions of a Complex Variable  
Intermittent:  9 units  
This course provides an introduction to one of the basic topics of both pure and applied mathematics and is suitable for those with both practical and theoretical interests. Algebra and geometry of complex numbers; complex differentiation and integration. Cauchy's theorem and applications; conformal mapping; applications. 3 hrs. lec.  
Prerequisites: 21259 and 21260

21-372  Partial Differential Equations  
Spring:  9 units  
This course provides an introduction to partial differential equations and is recommended for majors in mathematics, physical science, or engineering. Boundary value problems on an interval, Fourier series, uniform convergence, the heat, wave, and potential equations on bounded domains, general theory of eigenfunction expansion, the Fourier integral applied to problems on unbounded domains, introduction to numerical methods. 3 hrs. lec.  
Prerequisites: 21259 and 21260

21-373  Algebraic Structures  
Fall and Spring:  9 units  
This course introduces the basic concepts of algebra, preparing the student to understand abstract concepts, and thus to go on to other courses. Algebraic systems, groups, rings, fields, integral domains, fields, polynomials, unique factorization domains, rings and ideals, applications to computer science and coding theory. 3 hrs. lec.  
Prerequisites: 21241 or 21341

21-374  Field Theory  
Spring:  9 units  
The purpose of this course is to provide a successor to Algebraic Structures, with an emphasis on applications of groups and rings within algebra to some major classical problems. These include constructions with a ruler and compass, and the solvability or unsolvability of equations by radicals. It also offers an opportunity to see group theory and basic ring theory "in action", and introduces several powerful number theoretic techniques. The basic ideas and methods required to study finite fields will also be introduced. These ideas have recently been applied in a number of areas of theoretical computer science including primality testing and cryptography. 3 hrs. lec.  
Prerequisites: 21373

21-380  Introduction to Mathematical Modeling  
Intermittent:  9 units  
This course shall examine mathematical models, which may be used to describe natural phenomena. Examples, which have been studied include: continuum description of highway traffic, discrete velocity models of a monotonic gas, chemotactic behavior in biological systems, European options pricing, and cellular-automata. Systems such as the first four are described by partial differential equations; the last involves discrete-time and discrete-phase dynamical systems, which have been used to successfully represent both physical and biological systems. The course will develop these models and then examine the behavior of the underlying systems, both analytically and numerically. The mathematical tools required will be developed in the course.  
Prerequisites: 21241 and 21260

21-393  Operations Research II  
Fall:  9 units  
An important goal of this course is for the student to gain experience with the process of working in a group to solve a problem. Much of the course is devoted to a group project based upon case studies and methods presented. Topics may include combinatorial optimization, game theory, integer programming, heuristic methods. 3 hrs. lec.  
Prerequisites: 21257 or 21292

21-420  Continuous-Time Finance  
Spring:  9 units  
Prerequisites: 21260 and 21370

21-440  Selected Topics in Algebra  
Intermittent:  9 units  
Typical of courses which are offered from time to time are Boolean algebras, algebraic theory of semigroups, rings and ideals, number theory, inequalities.

21-441  Number Theory  
Fall:  9 units  
Number theory deals with the integers, the most basic structures of mathematics. It is one of the most ancient, beautiful, and well-studied branches of mathematics, and has recently found surprising new applications in communications and cryptography. Course contents: Structure of the integers, greatest common divisors, prime factorization. Modular arithmetic, Fermat's Theorem, Chinese Remainder Theorem. Number theoretic
functions, e.g. Euler's function, Mobius functions, and identities. Diophantine equations, Pell's Equation, continued fractions. Modular polynomial equations, quadratic reciprocity. 3 hrs. lec.
Prerequisites: 21127

21-450 Topics in Geometry
Intermittent: 9 units
Typical of courses, which are offered from time to time are convex sets, differential geometry, projective geometry, and classical geometry. 3 hrs. lec.
Prerequisites: 21356 or 21460

21-470 Selected Topics in Analysis
Intermittent: 9 units
Typical of courses, which are offered from time to time are finite difference equations, calculus of variations, and applied control theory. 3 hrs. lec.
Prerequisites: (21236) or (21241 and 21355)

21-476 Ordinary Differential Equations
Intermittent: 9 units
Review of solution techniques, modeling techniques, existence and uniqueness, numerical procedures, linear equations and systems, special functions, autonomous non-linear systems, qualitative techniques. 3 hrs. lec.
Prerequisites: 21241 and 21260

21-484 Graph Theory
Spring: 9 units
Graph theory uses basic concepts to approach a diversity of problems and nontrivial applications in operations research, computer science and other disciplines. It is one of the very few mathematical areas where one is always close to interesting unsolved problems. Topics include graphs and subgraphs, trees, connectivity, Euler tours and Hamilton cycles, matchings, graph colorings, planar graphs and Euler's Formula, directed graphs, network flows, counting arguments, and graph algorithms. 3 hrs. lec.
Prerequisites: 21127

21-599 Undergraduate Reading and Research
Fall and Spring: 0-99 units
Individual reading courses or projects in mathematics and its applications. Prerequisites and units to be negotiated with individual instructors.

21-600 Mathematical Logic I
Fall: 12 units
The study of formal logical systems, which model the reasoning of mathematics, scientific disciplines, and everyday discourse. Propositional Calculus and First-order Logic. Syntax, axiomatic treatment, derived rules of inference, proof techniques, computer-assisted formal proofs, normal forms, consistency, independence, semantics, soundness, completeness, Lowenheim-Skolem Theorem, compactness, equality. 3 hrs. lec.
Prerequisites: 21132 or 21228 or 21373 or 21484

21-602 Introduction to Set Theory I
Fall: 12 units
First order definability and the Zermelo-Fraenkel axioms; cardinal arithmetic, ordered sets, well-ordered sets (axiom of choice), transfinite induction, the filter of closed unbounded sets (Fodor, Ulem and Solovay's theorems), Delta systems, basic results in partition calculus (e.g., Ramsey's Theorem and the Erdos-Rado Theorem); small to medium large cardinals; applications to general topology (e.g., Alexandroff's conjecture), and the basic ideas of descriptive set theory. The independence of Suslin conjecture from the usual axioms. Godel's axiom of constructibility. Time permitting, the Galvin-Hajnal-Sheelah inequality will be proved. 3 hrs. lec.

21-603 Model Theory I
Intermittent: 12 units
Similarity types, structures; downward Lowenheim Skolem theorem; construction of models from constants, Henkin's omitting types theory, prime models; elementary chains of models, basic two cardinal theorems, saturated models, basic results on countable models including Ryll-Nardzewski's theorem; indiscernible sequences, Ehrenfeucht-Mostowski models; introduction to stability, rank functions, primary models, and a proof of Morley's categoricity theorem; basic facts about infinitary languages, computation of Hanf-Morley numbers.

21-610 Algebra I
Spring: 12 units
The structure of finitely generated abelian groups, the Sylow theorems, nilpotent and solvable groups, simplicity of alternating and projective special linear groups, free groups, the Nielsen-Schreier theorem. Vector spaces over division rings, field extensions, the fundamental Galois correspondence, algebraic closure. The Jacobson radical and the structure of semisimple rings. Time permitting, one of the following topics will be included: Wedderburn's theorem on finite division rings, Frobenius' Theorem. Prerequisite: Familiarity with the content of an undergraduate course on groups and rings. 3 hrs. lec.

21-620 Real Analysis
Fall: Mini Session - 6 units
A review of one-dimensional, undergraduate analysis, including a rigorous treatment of the following topics in the context of real numbers: sequences, compactness, continuity, differentiation, Riemann integration. (Mini-course. Normally combined with 21-621.) 3 hrs. lec.

21-621 Introduction to Lebesgue Integration
Fall: Mini Session - 6 units
Construction of Lebesgue measure and the Lebesgue integral on the real line. Fatou's Lemma, the monotone convergence theorem, the dominated convergence theorem. (Mini-course. Normally combined with 21-620.) 3 hrs. lec.

21-651 General Topology
Fall: 12 units

21-660 Introduction to Numerical Analysis I
Spring: 12 units
Finite precision arithmetic, interpolation, spline approximation, numerical integration, numerical solution of linear and nonlinear systems of equations, optimization in finite dimensional spaces. 3 hrs. lec.

21-700 Mathematical Logic II
Spring: 12 units
Higher-order logic (type theory). Syntax, Lambda-notation, Axioms of Description and Choice, computer-assisted formal proofs, semantics, soundness, standard and non-standard models, completeness, compactness, formalization of mathematics, definability of natural numbers, representability of recursive functions, Church's Thesis. Godel's Incompleteness Theorems, undecidability, undefinability. Prerequisites: 21300 or 21600
Mechanical Engineering

Undergraduate Courses

24-101 Fundamentals of Mechanical Engineering
Fall and Spring: 12 units
The purpose of this course is to introduce the student to the field of mechanical engineering through an exposition of its disciplines, including structural analysis, mechanism design, fluid flows, and thermal systems. By using principles and methods of analysis developed in lectures, students will complete two major projects. These projects will begin with conceptualization, proceed with the analysis of candidate designs, and culminate in the construction and testing of a prototype. The creative process will be encouraged throughout. The course is intended primarily for CIT freshmen. 3 hrs. lec., 2 hrs. rec./lab.
Prerequisites: Corequisites: 21-115, 21-116, 33-106

24-201 Engineering Graphics
Fall and Spring: 9 units
Introduction to the use and preparation of manually and computer generated engineering drawings, including the following topics: basic drawing techniques; dimensioning of orthogonal drawings; auxiliary and oblique views; sectional drawings; working drawings; blueprint reading; freehand sketching; production standards, methods, and symbols; simplified drawing techniques; intersection and development; basic applied descriptive geometry. 3 hrs. rec., 3 hrs. lab.

24-221 Thermodynamics I
Fall: 10 units
Temperature and thermometry; equations of state for fluids and solids; work, heat, and the first law; internal energy, enthalpy, and specific heats; energy equations for flow; change of phase; the second law, reversibility, absolute temperature, and entropy; combined first and second laws; availability; power and refrigeration cycles. Applications to a wide range of processes and devices. 3 hrs. rec., 1 hr. rec./lab.
Prerequisites: 21118 and 24101 and 33106

24-231 Fluid Mechanics
Spring: 10 units
Hydrostatics. Control volume concepts of mass, momentum, and energy conservation. Euler's and Bernoulli's equations. Viscous flow equations. Head loss in ducts and piping systems. Dimensional analysis and similarity as an engineering tool. Measurement techniques. 3 hrs. lec., 1 hr. rec./lab.
Prerequisites: 21118 and 33106

24-261 Statics
Fall: 10 units
This course is the first in a two-semester sequence on the solid mechanics of engineering structures and machines. The course begins with a review of the statics of rigid bodies, which includes the identification of statically indeterminate problems. Two- and three-dimensional statics problems are treated. Thereafter, the course studies stresses and deflections in deformable components. In turn, the topics covered are: simple tension, compression, and shear; thin-walled pressure vessels; torsion; and bending of beams. For each topic, statically indeterminate problems are analyzed and elementary considerations of strength are introduced. 3 hrs. lec., 1 hr. rec./lab.
Prerequisites: 21118 and 33106

24-262 Stress Analysis
Spring: 12 units
This course is the second in a two-semester sequence on the solid mechanics of engineering structures and machines. The basic topics of uniaxial tension/compression, torsion, and flexural deformation from 24-261 are reviewed. Combined loadings and stresses are then treated, which lead to a consideration of failure criteria. Two-dimensional elasticity and the finite element method are introduced. Stress concentrations are quantified analytically, numerically, and with the use of engineering handbooks. Cyclic failure criteria are introduced, and both static and cyclic failure criteria are applied to results from numerical analysis. 3 hrs. lec., 1 hr. rec./lab.
Prerequisites: 24261 and 21259 and 33106

24-302 Mechanical Engineering Seminar I
Fall: 1 units
Practice in making an oral presentation on a technical topic. Each student prepares and delivers a talk on an engineering subject. This course is designed to improve the ability of the student to present a formal talk and to establish confidence in speaking before a group. 1 hr. rec.

24-303 Mechanical Engineering Seminar II
Spring: 1 units
Continuation of 24-302. Further practice in speaking to a group on a subject of interest to engineers. Each student will give at least one talk during the term. 1 hr. rec.

24-311 Numerical Methods
Fall: 9 units
Use of numerical methods for solving engineering problems with the aid of a digital computer. Problems will be drawn from all fields of interest to mechanical engineers. 3 hrs. rec.
Prerequisites: 21259 and 21260

24-321 Thermal Fluids Engineering
Spring: 12 units
Momentum and thermal boundary layer. Flow separation and control. Introduction to turbulence. Introduction to gas dynamics. Turbomachinery. Measurement and computational techniques. 3 hrs. lec., 3 hrs. rec./lab.
Prerequisites: 24221 and 24231 and 24311 and 24322 and 33106

24-322 Heat Transfer
Fall: 10 units
Prerequisites: 21260 and 24221 and 24231

24-323 Thermodynamics II
Fall: 12 units
Power cycles, including vapor cycles (Rankine, reheat, regenerative, etc.) and gas cycles (Otto, Brayton, Diesel, etc.). Refrigeration cycles, including heat pumps and gas liquefiers. Thermodynamic relations and equations of state. Mixtures of gases; application to hygrometry and air conditioning. Thermodynamics of reactive systems, including equilibrium criteria, the phase rule, heats of reaction, combustion and dissociation. 3 hrs. rec., 3 hrs. lab.
Prerequisites: 24221 and 24231

24-331 Viscous Flow
Fall: 10 units
The concept of fluid shear and viscosity and viscous flow in tubes and channels. Hydrodynamic lubrication of bearings. The concept of turbulence and turbulent flow in tubes and channels. The boundary layer concept and applications to momentum transfer (drag), energy transfer (heat convection), and mass transfer (evaporation, etc.). 3 hrs. rec., 1 hr. lab.
Prerequisites: 21259 and 21260 and 24221 and 24231

24-332 Potential Flow Aerodynamics
Intermittent: 9 units
Development of the fundamental equations of incompressible frictionless flow. Concepts of circulation, vorticity, irrotationality, stream function, and velocity potential. Two-dimensional low speed airfoil theory; lift and moment calculations for the infinite span wing; empirical airfoil data for real airfoils; thin airfoil theory. Three-dimensional effects; flow distribution; Prandtl's wing theory; induced drag; the elliptic lift distribution; the general lift distribution. 3 hrs. rec.
Prerequisites: 21259 and 21260 and 24231

24-333 Gas Dynamics
Spring: 9 units

Course Descriptions

Development of the foundations of frictionless compressible flow. Internal flow with friction and heat transfer. Acoustics and wave motion. Oblique shocks and expansion waves. Two-dimensional subsonic and supersonic flow including hodograph transformations, linearized theory of thin airfoils, and the method of characteristics. Introduction to transonic and hypersonic flow and reentry problems. 3 hrs. rec. Prerequisites: 21259 and 21260

24-341 Manufacturing Sciences
Fall: 9 units
This course has two broad concerns: an introductory review of manufacturing systems organization and a review of common manufacturing processes from the point of view of design for manufacturability. The features of mass and batch production are quantitatively considered. The basic principles of group technology and production planning are outlined. The use of computers in manufacturing is described, together with a review of the current capabilities of industrial robots. Students will be involved in weekly seminars, which will describe the basic features of common manufacturing processes, including metal machining, metal forming, polymer processing, casting techniques, joining techniques, ceramic processing, and powder processing. Case studies from industry and films may be used. 3 hrs. rec. Prerequisites: 24262

24-351 Dynamics
Fall: 12 units
This first course on the modeling and analysis of dynamic systems concentrates on the motion of particles, systems of particles, and rigid bodies under the action of forces and moments. Topics include the kinematics of motion in rectangular, polar, and intrinsic coordinates; relative motion analysis with multiple reference frames; and planar kinetics through the second law, work-energy method, and impulse-momentum method. Time and frequency domain solutions to first and second order equations of motion are discussed. 4 hrs. lec. Prerequisites: 21259 and 24261

24-352 Dynamic Systems and Controls
Spring: 12 units
This second course on the modeling and analysis of dynamic systems emphasizes the common features, which are exhibited by physical systems that include mechanical, hydraulic, pneumatic, thermal, electrical, and electromechanical elements. State equations and the concepts of equilibrium, linearization, and stability are discussed. Time and frequency domain solutions are developed. 1 hr. lec., 3 hrs. rec., 2 hrs. lab. Prerequisites: 21260 and 24351 and 33107

24-353 Intermediate Dynamics
Spring: 9 units
This course presents classical (i.e., nonrelativistic) dynamics via the vector formulation of Newtonian mechanics and the analytical dynamics of Lagrange's equations. Classical dynamics is used for the purpose of obtaining mathematical models of dynamic systems which are then employed in the analysis of dynamic behavior and in design synthesis. Course contents include a review of particle kinematics and Newton's laws, kinematics of rigid bodies in general motion, Newtonian kinetics of rigid bodies including the Newton-Euler equations of motion, impulse-momentum and work-energy methods, fundamentals of analytical mechanics including the principle of virtual work and Hamilton's principle leading to Lagrange's equations of motion, and advanced issues of analytical mechanics. 3 hrs. lec.

24-354 General Robotics
Fall: 12 units
This course presents an overview of robotics in practice and research with topics including vision, motion planning, mobile mechanisms, kinematics, inverse kinematics, and sensors. In lab projects, students construct robots which are driven by a microcontroller, with each lab project reinforcing the basic principles developed in lectures. Students nominally work in teams of three: an electrical engineer, a mechanical engineer, and a computer scientist, outside of the lecture and recitation. The lab projects are the primary homework assignments. This course will also expose students to some of the contemporary happenings in robotics, which includes current robot lab research, applications, robot contests and robot web surfing. 3 hrs. lec., 1 hr. rec., and several labs throughout the semester. Prerequisites: 21118 or 21122

24-355 Kinematics and Dynamics of Mechanisms
Spring: 9 units
This design-oriented course addresses the kinematics and dynamics of mechanisms with applications to linkage systems, reciprocating engines, and industrial machinery. Conventional as well as innovative rigid-body dynamic systems are studied. Problems of kinematics and dynamics are framed in a form suited for computer analysis and design by emphasizing the synthesis of mechanisms. To stimulate a creative approach, homework and project work draw upon actual engineering design problems. 3 hrs. rec.

24-356 Engineering Vibrations
Intermittent: 11 units
Frequency response of linear mechanical systems, with and without damping. Use of computational methods for simulating system response and the use of modal analysis for understanding the vibratory response of complex systems. Lumped and distributed mass systems. Applications include isolation, stability, and balancing. 3 hrs. lec., 1 hr. rec., 2 hrs. lab. Corequisites: 24-352

24-357 Intermediate Stress Analysis
Spring: 10 units
This course first reviews important solutions from strength of materials, Mohr's circle, and multiaxial failure theories. Students are then introduced to the theory of elasticity with an emphasis on understanding the field equations and boundary conditions. A short introduction to the theory of finite element methods is given. Additional topics covered include buckling, stress concentrations, plasticity, and fracture mechanics. An important aspect of the course is teaching students how topics covered in class can be applied to predict or understand failures in engineering applications. Another important skill that is emphasized is the application of fundamentals from the lectures and physical intuition to interpret results generated by finite element models. 3 hrs. lec., 1 hr. lab. Prerequisites: 21259 and 24262

24-371 Electromechanical Systems
Spring: 10 units
Few engineered systems exist today that are purely mechanical in nature. Many incorporate electrical, electronic, or computer subsystems in the form of sensors, actuators, and controls, and mechanical engineers take advantage of such capabilities. The course begins with a review of circuit analysis techniques. Topics then proceed to passive, active, and digital devices; operational amplifiers; power analysis; sensors and signal conditioning; and motors and other actuators. Three laboratory assignments spaced throughout the semester include construction and diagnostics of circuits and electromechanical systems with a view towards sensing, actuation, and integration. 3 hrs. lec., 3 labs per semester.

24-380 Special Topics in Mechanical Engineering
Intermittent: 9 units
The Special Topics in Mechanical Engineering courses provide students with exposure to a variety of advanced concepts related to Mechanical Engineering and are offered on an "as available" basis. The final digit reflects the primary application area of the material, where 0 is professional; 1 is mathematics; 2 is thermal engineering; 3 is fluid mechanics; 4 is design and manufacturing; 5 is dynamics and controls; and 6 is solid mechanics.

24-391 Mechanical Engineering Project
Fall and Spring: 3-12,18 units
Practice in the organization, planning, and execution of appropriate engineering projects. These investigations may be assigned on an individual or a team basis and in most cases will involve experimental work. 9 hrs. lab.
Course Descriptions

24-392  Mechanical Engineering Project
Fall and Spring:  3-12 units
Practice in the organization, planning, and execution of appropriate engineering projects. These investigations may be assigned on an individual or a team basis and in most cases will involve experimental work. 9 hrs. lab.

24-401  Engineering Analysis
Fall and Spring:  12 units
The purpose of this course is to develop in the student the professional method of solving engineering problems in analysis and design, through application of the fundamental principles of physics, mathematics, thermodynamics, and electricity. Because the course is built around actual engineering problems, it leans heavily on problem definition and modeling, for which assumptions based on engineering judgment must be made. Checking analytical results is emphasized, by use of dimensions, limiting cases, and reasonableness, since solutions are generally open-ended or not unique, and therefore must be technically defensible. Particular attention is paid to the interpretation, evaluation, and generalization of results, with dimensionless variables being used where appropriate. 3 hrs. rec., 2 hrs. lab.
Prerequisites:  24262 and 24321 and 24352

24-421  Internal Combustion Engines
Fall:  10 units
Basic principles and fundamentals of internal combustion engines; gas turbine, spark ignition and diesel compression ignition engines. Combustion chamber design. Monitoring and control of fuel efficiency and emission of pollutants in exhaust gases. Developments in direct injection, rotary, prechamber and stratified charge engines. Ignition, fuel injection, mixing and combustion processes, heat release, and energy balances. Engine laboratory projects include: air and fuel controls, measurement of particulate and species concentrations in exhaust gases. 3 hrs. rec., 1 hr. lab.
Prerequisites:  24321

24-422  Thermal System Analysis
Spring:  9 units
Performance studies of various thermal processes and devices with emphasis on energy utilization and environmental impact. Examples may be drawn from nuclear power plant processes, jet propulsion, energy conversion, internal and external combustion engines, desalination, and other areas of current interest. 3 hrs. rec.
Prerequisites:  24221 and 24321

24-423  Direct Energy Conversion
Spring:  9 units

24-424  Energy and the Environment
Spring:  9 units
Fuel cycles for conventional and non-conventional energy resources; relationships between environmental impacts and the conversion or utilization of energy; measures of system and process efficiency; detailed study and analysis of coal-based energy systems including conventional and advanced power generation, synthetic fuels production, and industrial processes; technological options for multi-media (air, water, land) pollution control; mathematical modeling of energy-environmental interactions and tradeoffs and their dependency on technical and policy parameters; methodologies for energy and environmental forecasting; applications to issues of current interest.
Prerequisites:

24-425  Combustion and Air Pollution Control
Spring:  9 units
Formation and control of gaseous and particulate air pollutants in combustion systems. Basic principles of combustion, including thermochemical equilibrium, flame temperature, chemical kinetics, hydrocarbon chemistry, and flame structure. Formation of gaseous and particulate pollutants in combustion systems. Combustion modifications and post-combustion technologies for pollutant control. Relationship between technology and regional, national, and global air pollution control strategies. The internal combustion engine and coal-fired utility boiler are used as examples.

24-441  Engineering Design
Fall and Spring:  12 units
Introduction to engineering design. Lectures describe the typical design cycle and its associated activities. Professional responsibilities of designers are emphasized, including ethical relationships with other professionals and with clients. Regulatory aspects and public responsibility are discussed. A practical design project is done by each student, usually working as a member of a small team, and is based on a level of engineering knowledge expected of seniors. Proof of practicality is required in the form of descriptive documentation. Frequently, a working model will also be required. Oral progress reports and a final written and oral report are required. 3 hrs. rec., 3 hrs. lab.
Prerequisites:  24262 and 24321 and 24352

24-442  Engineering Design EPP
Fall and Spring:  12 units
A design course similar to 24-441. For Mechanical Engineering students who are taking a double major with Engineering and Public Policy.
Prerequisites:  24231 and 24262 and 24352

24-443  Design for Manufacture
Fall:  9 units
Introduces methods for concurrent design and manufacturing. Course topics will include methods of value engineering, function logic, design review process, Taguchi analysis, design of experiments, design for assembly, process selection, statistical process control, and discussion of such topics as net shape processes, zero quality control, just-in-time, FMS and robotics. Emphasis on analytical methods and their application to the design of products and manufacturing processes. Project oriented. 3 hrs. lec.
Prerequisites:  24341

24-451  Feedback Control Systems
Intermittent:  12 units
Fundamentals of feedback control with emphasis on classical techniques and an introduction to state space methods. Topics include the following: frequency domain modeling and state space modeling of dynamical systems; feedback control system concepts and components; control system performance specifications such as stability, transient response, and steady state error; analytical and graphical methods for analysis and design - root locus, Bode plot, Nyquist criterion; design and implementation of proportional, proportional-derivative, proportional-integral-derivative, lead, lag, and lead-lag controllers. Laboratory work will include implementation and evaluation of various controllers on real systems for comparison with analytical models. Extensive use of computer aided analysis and design software. 3 hrs. lec., 3 hrs. lab.
Prerequisites:  15127 and 24352

24-491  Department Research Honors
Fall and Spring:  3-24 units
This course is designed to give students increased exposure to “open-ended” problems and research type projects. It involves doing a project on a research or design topic and writing a thesis describing that project. The project would be conducted under the supervision of a mechanical engineering faculty member (the advisor), and must be approved by the advisor before inception. This course can be taken at any time after the Junior year and before graduation which includes the summer after the Junior year. Completion of 18 units of this course with a grade of B or better is a partial fulfillment of the requirements for Departmental Research Honors.

24-492  Department Research Honors
Fall and Spring:  3-24 units
This course is designed to give students increased exposure to “open-ended” problems and research type projects. It involves doing a
Course Descriptions

Materials Science & Engineering

Undergraduate Courses

27-100 Engineering the Materials of the Future
Fall and Spring: 12 units
Materials form the foundation for all engineering applications. Advances in materials and their processing are driving all technologies, including the broad areas of nano-, bio-, energy, and electronic (information) technology. Performance requirements for future applications require that engineers continue to design both new structures and new processing methods in order to engineer materials having improved properties. Applications such as optical communication, tissue and bone replacement, fuel cells, and information storage, to name a few, exemplify areas where new materials are required to realize many of the envisioned future technologies. This course provides an introduction to how science and engineering can be exploited to design materials for many applications. The principles behind the design and exploitation of metals, ceramics, polymers, and composites are presented using examples from everyday life, as well as from existing, new, and future technologies. A series of laboratory experiments are used as a hands-on approach to illustrating modern methodologies used in the processing and characterization of materials and for understanding and improving materials’ properties. Prerequisites: 21-120 Corequisites: 33-106

27-201 Perfect Crystals
Fall: Mini Session - 9 units
This course covers the fundamentals of crystallography and diffraction. Topics covered include: the periodic table of the elements, bonding in different classes of materials, Bravais lattices, unit cells, deformations and planes, crystal geometry computations, direct and reciprocal space, symmetry operations, point and space groups, nature of x-rays, scattering in periodic solids, Bragg’s law, the structure factor, and the interpretation of experimental diffraction patterns. 24 crystal structure types of importance to various branches of materials science and engineering will be introduced. Prerequisites: 21-122 Corequisites: 27-100

27-202 Defects in Materials
Fall: Mini Session - 9 units
Defects have a fundamental influence on the properties of materials. For example, the strength and deformation of materials, the electrical and optical properties of materials, and the rates of diffusion in solids are all determined by the population of intrinsic and extrinsic defects. The objective of this course is to define approaches to quantifying the populations and properties of defects in crystals. The course will be divided into three sections: point defects, dislocations, and planar defects. The formation of point defects and their influence on diffusion and electrical and optical properties will be considered. The properties and characteristics of dislocations and dislocation reactions will also be presented. Dislocations in different crystal systems and the role of dislocations in deformation will be discussed. The crystallography and energetics of planar defects and interfaces will also be described. Prerequisites: 21-122 Corequisites: 27-100

27-215 Thermodynamics of Materials
Fall: 12 units
The first half of the course will focus on the laws of thermodynamics and the inter-relationships between heat, work and energy. The concept of an equilibrium state of a system will be introduced and conditions which must be satisfied for a system to be at equilibrium will be established and discussed and the concepts of activity and chemical potential introduced. The second half of the course will focus on chemical reactions, liquid and solid solutions, and relationships between the thermodynamics of solutions and binary phase diagrams. Co-requisites: 27-100, 21-259

27-216 Transport in Materials
Spring: 12 units
This course is designed to allow the student to become familiar with the fundamental principles of heat flow, fluid flow, mass transport and reaction kinetics. In addition, the student will develop the skills and methodologies necessary to apply these principles to problems related to materials manufacture and processing. Topics will include thermal conductivity, convection, heat transfer equations, an introduction to fluid phenomena viscosity, etc. Newtons and Stokes Laws, mass momentum balances in fluids, boundary layer theory, diffusion and absolute reaction rate theory. Where appropriate, examples will be taken from problems related to the design of components and the processing of materials. Pre-requisites: 15-100, 27-215

27-217 Phase Relations and Diagrams
Spring: 12 units

27-299 MSE Undergraduate Seminar I
Fall: 1 units
This course will address a range of topics relating to professional development, creativity, innovation, and technical enrichment. Subjects covered will vary from year to year, but will cover contemporary issues in the engineering profession, including the development of skills for teamwork, leadership development, communication, and the business environment. The course is designed to help develop the understanding of professional and ethical responsibilities and the need for global and societal consideration in engineering decision making as well as need for implementing continual lifetime learning as part of the engineers career.

27-301 Microstructure and Properties I
Fall: Mini Session - 11 units
The objective of this courses and its companion 27-302 is to convey some of the essential concepts in materials science and engineering that relate material properties (strength, magnetism, thermal expansion) to microstructure (crystal structure, dislocations structure, grain structure, precipitate structure, composite structure) in single phase materials. The relationships will be illustrated with examples of both idealized and technological materials. The course will draw upon many aspects of materials science such as defects, phase transformations etc. Pre-requisites: 33-107, 27-216, 27-217 Prerequisites: 27-216 and 27-217 and 33-107

27-302 Microstructure and Properties II
Fall: Mini Session - 9 units
This course applies the principles and ideas developed in 27-301 to multiphase materials. The structure-property relationships will be illustrated with examples of both idealized and technological materials. The course will draw upon many aspects of materials science such as defects, phase transformations etc. Prerequisites: 27-301

27-322 Processing of Metals
Fall: 9 units
This course addresses the principles of processing of metals and the relationship between processing and performance. Topics include include chemical thermodynamics, reaction kinetics, surfaces, fundamentals of heat treatment, process engineering, powder handling, powder compaction, densification and sintering. These aspects of processing science will be applied to the processing of metals including electrometallurgy, hydrometallurgy, pyrometallurgy, extraction, refining, and specific examples of alloy systems such as the production of steel, aluminum or titanium. The principles and practice of materials processing will be applied to process optimization. The relationship between processing methods and the environment will be discussed. The impact of the processing history of
materials will be discussed in relation to material performance and lifetime. The concept of the lifecycle of materials will be discussed.

27-323 Powder Processing of Materials
Fall: 9 units
This course addresses the methods used in, and the principles that underlie, powder processing of metals and ceramics. Aspects of powder processing will be discussed in relation to the use of materials in engineering applications. The relationship between processing methods and materials performance in select applications will be discussed using specific materials examples including metals and ceramics. The course is broken down into three parts: (1) understanding, selecting, and controlling powder characteristics; (2) powder handling, compaction, and forming techniques; and (3) drying, burnout, densification, sintering, and grain growth in powder compacts. Topics include chemical thermodynamics, reaction kinetics, surfaces, colloids, dispersions, process engineering, powder handling, powder compaction, shape forming, densification, and sintering. Pre or Corequisites: 27-215, 27-216, 27-217

27-357 Introduction to Materials Selection
Fall: Mini Session - 6 units
This course introduces the student to the methodology by which a material can be successfully chosen for a given application from the various classes (metals, ceramics and glasses, electronic materials, polymers and composites). Criteria for selection include processing methods, fabrication of materials systems, costs, specifications and standards, environmental considerations, ethics, and substitutions for strategic materials. Common causes of failure and methods of prevention will be discussed. Each student will have the opportunity for an original paper with specialization in a material class of choice.

27-367 Selection and Performance of Materials
Fall: Mini Session 6 units
This course involves the application of materials and process selection methodologies used in product design. These methodologies are based upon the integration of function, shape, material, and process and are used to select materials and processes for a variety of product applications (electronic, magnetic, mechanical, optical, thermal, etc.) from amongst the entire spectrum of engineering materials (elastomers, ceramics, glasses, polymers, metals, and composites). Other factors in the selection process include engineering economics, codes and standards, environmental and safety regulations, professional ethics, and life cycle analysis. Common causes of failure and methods of prevention are evaluated as one stepping stone to a final project: the selection of a material or process for a new product or for an improved existing product. There is extensive use of the Ashby Materials Selection Software throughout the course. Prerequisites: 27-100 or 27-357

27-399 MSE Undergraduate Seminar II
Fall: 1 units
This course will address a range of topics relating to professional development, creativity, innovation, and technical enrichment. Subjects covered will vary from year to year, but will cover contemporary issues in the engineering profession, including the development of skills for teamwork, leadership development, communication, and the business environment. The course is designed to help develop the understanding of professional and ethical responsibilities and the need for global and societal consideration in engineering decision making as well as need for implementing continual lifetime learning as part of the engineers career.

27-401 MSE Capstone Course I
Fall: 12 units
This capstone course makes use of the relationship among processing, structure, and performance to address an important contemporary problem in materials science and engineering. The focus is on the application of a novel process technology to new product applications. A major component of the course is the actual definition of the problem to be addressed, in contrast to most capstone courses that rely upon industry to identify problems. Failure analysis is utilized to define the limitations in the state of the art and provide a basis for product improvement. Industry and national laboratories are enlisted in the solution of these problems, but the creativity and innovation in the definition and solution of the problem comes from the students themselves. Prerequisites: 27-302 and 27-367

27-402 MSE Capstone Course II
Fall: 12 units
This capstone course continues the discussion of materials selection and performance with an emphasis on design of components and systems. As in the companion course, the full range of tools for understanding materials structure, processing and properties are applied to optimizing materials performance in current engineering applications. The paper from the companion course will be expanded into a project. Prerequisites: 27401

27-421 Processing Design
Fall: Mini Session - 6 units
In this course, the concepts of materials and process design are developed, integrating the relevant fundamental phenomena in a case study of a process design. The course includes basic science and engineering as well as economic and environmental considerations. The case study is on environmentally acceptable sustainable steelmaking. Other case studies in materials processing could be used.

27-432 Electrical, Magnetic, Optical Properties of Materials
Fall: 9 units
Students will develop a basic understanding of the electrical, optical, and magnetic properties of materials using the principles of modern solid-state physics. The course will cover such topics as electrical conduction in metals and alloys, ionic conduction in ceramics, optical properties of pure and doped semiconductors, and magnetic recording media. Wherever possible, examples will emphasize applications involving materials, which were selected, designed, or processed to accentuate a particularly interesting electrical, optical, or magnetic property.

27-454 Supervised Reading
All Semesters: 3-12 units
This course provides the opportunity for a detailed study of the literature on some subject under the guidance of a faculty member, usually but not necessarily in preparation for the Capstone Course, 27-401/402.

27-499 MSE Undergraduate Seminar III
Fall: 1 units
This course will address a range of topics relating to professional development, creativity, innovation, and technical enrichment. Subjects covered will vary from year to year, but will cover contemporary issues in the engineering profession, including the development of skills for teamwork, leadership development, communication, and the business environment. The course is designed to help develop the understanding of professional and ethical responsibilities and the need for global and societal consideration in engineering decision making as well as need for implementing continual lifetime learning as part of the engineers career.

27-510 Biomaterials I
Spring: 9 units
This is Part I of a two-part course sequence in Biomaterials. This introductory course will address basic and applied concepts of polymers as biomaterials. The students will be exposed to both fundamental synthetic mechanisms of polymers and their physical and chemical properties. Specific emphasis will be placed on biodegradation mechanisms, mechanical properties, and surface chemistry of polymeric materials. Cellular interactions with various surfaces and immunological responses will be covered. Applications of biomaterials to be discussed include tissue engineering and artificial organs. Part II of this course will be offered in the fall and the focus will be on the principles, properties and applications of ceramics and metals as biomaterials.

27-511 Biomaterials II
Fall: 9 units
This is Part II of a two-part course sequence in Biomaterials. This introductory course will address basic and applied concepts of metals
and ceramics as biomaterials. The students will be exposed to the principles, properties and applications of amorphous and crystalline inorganic and metallic systems for biological applications. Specific emphasis will be placed on processing, biochemical activity, biodegradation mechanisms, and various properties relevant for biological response. Cellular interactions with various surfaces and immunological responses will also be covered. Applications of biomaterials will be discussed including tissue engineering, artificial implants and devices. Part I of this course is offered in the Spring and focuses on the principles, properties and applications of polymers as biomaterials. Prerequisites: None, but Introduction to Modern Chemistry (09105), Biomedical and Health Engineering (42101) will be useful, though not required.

27-530 Advanced Physical Metallurgy
Fall: 9 units
The purpose of this course is to develop a fundamental understanding of the evolution of microstructure in engineering alloys and how desired mechanical and physical properties can be obtained by control of microstructure. The first part of the course considers phase stability, phase diagrams and the thermodynamics, mechanics and kinetics of phase transformations. The second part of the course concerns property/microstructure relationships in engineering alloys and how the concepts covered in the first part of the course can be used to obtain the desired microstructures.

27-533 Principles of Growth and Processing of Semiconductors
Fall: Mini Session - 6 units
Development of a fundamental understanding of material principles governing the growth and processing of semiconductors. Techniques for growing and characterizing bulk crystals and epitaxial layers are considered. The processing of semiconductors into devices and the defects introduced thereby are discussed. The roles of growth- and processing-induced defects in determining long term reliability of devices are examined.

27-542 Processing and Properties of Thin Films
Fall: 9 units
This course is designed to provide an introduction to the science and technology of thin films, with special emphasis on methods to produce thin films and relationships between growth conditions and thin film properties. Topics include (1) various methods of thin film production, such as evaporation, sputtering and chemical vapor deposition, (2) nucleation and growth processes, (3) dimensional, chemical, and structural characterization of thin films and (4) properties and applications, such as optical properties and liquid crystal displays.

27-551 Properties of Ceramics and Glasses
Spring: 9 units
This course focuses on the diverse properties of ceramics and glasses. It includes discussions of thermal properties, such as heat capacity and thermal expansion; mechanical properties of ceramics and glasses, such as strength, toughness and environmental effects; electrical properties including electronic and ionic conductivity, dielectric properties, piezoelectricity, and ferroelectricity; and optical properties as they pertain to glasses. The course also includes a discussion of a selected current applications, such as recent trends in ceramic multi-layer packaging for electronics, advanced structural ceramics for automotive engines, and ceramic ferrites in phased-array radar systems. Numerical examples are used throughout the course to illustrate the engineering relevance of fundamental phenomena. This class will be co-taught with 27-751. Undergraduates taking the course will have separate homeworks and exams from the graduate students and will graded separately from the graduate students.

27-555 Materials Project I
Fall: 9 units
This course is designed to give experience in individualized research under the guidance of a faculty member. The topic is selected by mutual agreement, and will give the student a chance to study the literature, design experiments, interpret the results and present the conclusions orally and in writing.

27-556 Materials Project II
Spring: 9 units
Second semester of Materials Project. This course is designed to give experience in individualized research under the guidance of a faculty member. The topic is selected by mutual agreement, and will give the student a chance to study the literature, design experiments, interpret the results and present the conclusions orally and in writing.

27-557 Selection and Performance of Materials
Fall: 9 units
This course involves the application of materials and process selection methodologies used in product design. These methodologies are based upon the integration of function, shape, material, and process and are used to select materials and processes for a variety of product applications (electronic, magnetic, mechanical, optical, thermal, etc.) from amongst the entire spectrum of engineering materials (elastomers, ceramics, glasses, polymers, metals, and composites). Other factors in the selection process include engineering economics, codes and standards, environmental and safety regulations, professional ethics, and life cycle analysis. Common causes of failure and methods of prevention are evaluated as one stepping-stone to a final project: the selection of a material or process for a new product or for an improved existing product. There is extensive use of the Ashby Materials Selection Software throughout the course. Prerequisite: 27-100

27-560 Physical Chemistry of Metallurgical Reactions
Fall and Spring: 9 units
This course addresses the important rate controlling processes in high-temperature reactions, including gas phase mass transfer, free vaporizations, liquid phase mass transfer and heat transfer. It also discusses fundamental aspects of chemical kinetics, and analyzes the kinetics in selected technological processes. Each student in the course is assigned a published research paper, which he or she must defend or critique in a presentation to the class.

27-566 Special Topics in MSE
Fall and Spring: 9 units
This course is offered occasionally to present one or more topics, usually of timely or of practical engineering importance. Interested students should check with the Department to determine whether the course is being offered, and to obtain a syllabus if appropriate.

27-582 Phase Transformations in Solids
Spring: 9 units
In this course the fundamental aspects of solid state phase transformations are presented. The nucleation (homogeneous and heterogeneous) and growth of diffusional and non-diffusional heterogeneous solid state transformations are discussed from the point of view of crystallography, thermodynamics and kinetics, as are the same aspects of homogeneous transformations. Details of such transformations as precipitation, cellular, atomic ordering, massive, spinodal decomposition, displacive, etc. are discussed with specific examples from the Materials Science literature.

27-591 Mechanical Behavior of Materials
Spring: 9 units
Fundamentals of stress and strain. Linear elastic behavior. Tensile testing and yield criteria. Relationships between stress and strain for the case of plastic deformation. Theoretical strength. Tensile tests of single crystals and the idea of a slip system. Shear stress versus shear strain curves for single crystals and the effects of crystal orientation, temperature, atoms in solid solution and precipitates on the shapes of such curves. Taylor's connection between tensile curves of single crystals and those of polycrystalline samples. Dislocations and plastic deformation. Strengthening mechanisms including solid-solution strengthening, strengthening by precipitates, work hardening and grain size effects on strength. Approaches to quantifying the fracture resistance of materials, including the Griffith approach, the energy release rate approach and the stress intensity factor approach. Crack tip behavior including stresses and strains at crack tips and the plastic zone. Fracture mechanisms including ductile fracture, cleavage fracture and intergranular fracture. The fracture of highly brittle materials. Time permitting fatigue and creep of materials will be discussed.
Course Descriptions

27-592 Solidification Processing
Spring: 12 units
The goal of this course is to enable the student to solve practical solidification processing problems through the application of solidification theory. The objectives of this course are to: (1) Develop solidification theory so that the student can understand predict solidification structure; (2) Develop a strong understanding of the role of heat transfer in castings; (3) Develop an appreciation for the strengths and weaknesses of a variety of casting processes. The first half of the course will be theoretical, covering nucleation, growth, instability, solidification microstructure: cells, dendrites, eutectic and peritectic structures, solute redistribution, inclusion formation and separation, defects and heat transfer problems. The second part of the course will be process oriented and will include conventional and near net shape casting, investment casting, rapid solidification and spray casting where the emphasis will be on process design to avoid defects.

27-594 Electrochemical Processes in Materials
Fall: 9 units
This undergraduate course is designed to provide an introduction to electrochemistry in materials science. The fundamentals of electrochemical cells, electrode kinetics will be introduced along with electrochemical techniques such as potentiostatic, galvanostatic and electrochemical impedance spectroscopy. Electrochemical applications that will be discussed will include: corrosion, electrochemical processing of materials and electrochemically based devices such as fuel cells, batteries and sensors. This class will be co-taught with 27-794. Undergraduates taking the course will have separate homeworks and exams from the graduate students and will be graded separately from the graduate students.
Prerequisites: 27215

Military Science (ROTC)
Undergraduate Courses

30-101 Introduction to Military Leadership
Fall: 5 units
In this course, students will be introduced to the fundamentals of Army leadership, management and basic military skills. The course emphasizes the Army’s “Principles of Leadership” and familiarizes the student with rifle marksman, orienteering and map reading, rappelling, basic lifesaving skills and the wear of the Army uniform. In addition, students will enhance their time management, decision-making and physical fitness abilities. Each student must participate in physical training, field training exercises and is expected to wear the Army uniform, which will be provided.

30-102 Foundations of Leadership
Spring: 5 units
This course is a continuation of the subjects and skills taught in 30101. In addition to extending the student’s abilities in the areas of leadership, orienteering and map reading, lifesaving and other basic military concepts, the course also introduces the student to the employment of military units. Individual topics covered include the Army’s emerging technological enhancements, the Army organization and structure and the wartime policies and principles. Each student must participate in physical training, field training exercises and is expected to wear the Army uniform, which will be provided.

30-201 Leadership Dynamics and Application
Fall: 5 units
In this course, students will delve more deeply into the Army’s leadership and management techniques, including the application of those techniques in faculty-supervised practical exercises. The course also seeks to enhance the student’s abilities in orienteering and map reading, terrain analysis, advanced lifesaving techniques and physical fitness. Students are introduced to the values that define the United States Army as an American institution, and each student continues to enhance his or her physical development under the supervision of the faculty. Each student must participate in physical training, field training exercises and is expected to wear the Army uniform, which will be provided.

30-202 Applications in Leadership and Combat Power Operations
Spring: 5 units
This course continues the study of the topics covered in 32021 and focuses upon practical application of the leadership and management techniques learned in the fall semester. The student develops and applies advanced map reading, terrain analysis, problem-solving and decision-making skills in practical exercises. Additionally, the student is introduced to the Army’s formal orders process, used to maneuver and sustain Army forces on the modern battlefield. Each student must participate in physical training, field training exercises and is expected to wear the Army uniform, which will be provided.

30-301 Basic Leader Planning and Combat Operations
Fall: 5 units
This course offers an in-depth analysis and focused practical application of leadership and management techniques. The emphasis in the course is on leader development and the goal is to enhance the student’s ability to perform effectively in a stressful decision-making environment. As such, time management, decision-making, advanced military skills, troop-leading procedures and advanced physical training are emphasized. The course requires participation in a demanding physical training program to prepare contracted students for the Army’s R.O.T.C. Leader Development and Assessment Course (LDAC). Each student must participate in field training exercises and is expected to wear the Army uniform, which will be provided.

30-302 Advanced Leader Planning and Combat Operations
Spring: 5 units
This course builds upon the foundation laid in the fall semester with the objective of fully preparing contracted students for participation in the Army’s challenging R.O.T.C. Leader Development and Assessment Course (LDAC). The course extends and enhances the student’s leadership, management, communication, fitness and basic military skills in preparing the student for commissioning as an officer in the United States Army. Practical exercises are used to reinforce all of the skills that the student has developed over the course of the military science instruction. Each student must participate in physical training, field training exercises and is expected to wear the Army uniform, which will be provided.

30-401 Progressive Leadership Theory and Applications
Fall: 5 units
This course is the first of two semester courses that serve as a capstone designed to transition the student from cadet to U.S. Army officer. Students are assigned and interact with the other cadets as part of a functioning cadet battalion, corresponding to those found in United States Army units. Students perform the duties of the staff or command as assigned and interact with the other cadets as part of a functioning command organization. In addition to studying the operations and organizations of the U.S. Army, students are required to plan and execute the required training and activities in leading the underclass cadets. A variety of topics of current interest are covered. Guest speakers are commonly invited to discuss their military experiences or their perspectives on military-related topics. Each student must participate in physical training, field training exercises and is expected to wear the Army uniform, which will be provided.

30-402 Transition to the Profession of Arms
Spring: 5 units
This capstone course completes the transition from cadet to Army officer and concludes with the student’s commissioning into the United States Army. During the semester, students continue to act in accordance with their assigned staff and command responsibilities and they prepare for their duties as a Lieutenant in the Army. This course covers personal and performance counseling, evaluation of subordinate leaders and team-building skills as well as military justice and discipline. Students bring to bear all of the skills and knowledge that they have accrued over the prior semesters in the Department of Military Science. Each student must participate in physical training, field training exercises and is expected to wear the Army uniform, which will be provided.
Aerospace Studies (ROTC)

Undergraduate Courses

31-101 Foundations of the United States Air Force
Fall: 3 units
AS100 is a survey course designed to introduce cadets to the United States Air Force and Air Force Reserve Officer Training Corps. Featured topics include: mission and organization of the Air Force, officer professionalism, military customs and courtesies, Air Force officer opportunities, and an introduction to communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followerhip experiences.

31-102 Foundations of the United States Air Force
Spring: 3 units
AS100 is a survey course designed to introduce cadets to the United States Air Force and Air Force Reserve Officer Training Corps. Featured topics include: mission and organization of the Air Force, officer professionalism, military customs and courtesies, Air Force officer opportunities, and an introduction to communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followerhip experiences.

31-105 Air Force Leadership Laboratory
All Semesters: 0 units
The AS100 and AS200 Leadership Laboratory courses (LLABs) include a study of Air Force customs and courtesies, drill and ceremonies, and military commands. The LLAB also includes studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. The AS300 and AS400 LLABs consist of activities classified as leadership and management experiences. They involve the planning and controlling of military activities of the cadet corps, and the preparation and presentation of briefings and other oral and written communications. LLABs also include interviews, guidance, and information, which will increase the understanding, motivation, and performance of other cadets.

31-106 Air Force Leadership Laboratory
All Semesters: 0 units
The AS100 and AS200 Leadership Laboratory courses (LLABs) include a study of Air Force customs and courtesies, drill and ceremonies, and military commands. The LLAB also includes studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. The AS300 and AS400 LLABs consist of activities classified as leadership and management experiences. They involve the planning and controlling of military activities of the cadet corps, and the preparation and presentation of briefings and other oral and written communications. LLABs also include interviews, guidance, and information, which will increase the understanding, motivation, and performance of other cadets.

31-107 Air Force Leadership Laboratory
All Semesters: 0 units
The AS100 and AS200 Leadership Laboratory courses (LLABs) include a study of Air Force customs and courtesies, drill and ceremonies, and military commands. The LLAB also includes studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. The AS300 and AS400 LLABs consist of activities classified as leadership and management experiences. They involve the planning and controlling of military activities of the cadet corps, and the preparation and presentation of briefings and other oral and written communications. LLABs also include interviews, guidance, and information, which will increase the understanding, motivation, and performance of other cadets.

31-108 Air Force Leadership Laboratory
All Semesters: 0 units
The AS100 and AS200 Leadership Laboratory courses (LLABs) include a study of Air Force customs and courtesies, drill and ceremonies, and military commands. The LLAB also includes studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. The AS300 and AS400 LLABs consist of activities classified as leadership and management experiences. They involve the planning and controlling of military activities of the cadet corps, and the preparation and presentation of briefings and other oral and written communications. LLABs also include interviews, guidance, and information, which will increase the understanding, motivation, and performance of other cadets.

31-201 The Evolution of Air and Space Power
Fall: 3 units
The AS200 course designed to examine general aspects of air and space power through a historical perspective. Utilizing this perspective, the course covers a time period from the first balloons and dirigibles to the space-age global positioning systems of the Persian Gulf War. Historical examples are provided to extrapolate the development of Air Force capabilities (competencies), and missions (functions) to demonstrate the evolution of what has become today's USAF air and space power. Furthermore, the course examines several fundamental truths associated with war in the third dimension: e.g. Principles of War and Tenets of Air and Space Power. As a whole, this course provides the cadets with a knowledge level understanding for the general element and employment of air and space power, from an institutional doctrinal and historical perspective. In addition, the students will continue to discuss the importance of the Air Force Core Values with the use of operational examples and historical Air Force leaders and will continue to develop their communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followerhip experiences.

31-202 The Evolution of Air and Space Power
Spring: 3 units
The AS200 course designed to examine general aspects of air and space power through a historical perspective. Utilizing this perspective, the course covers a time period from the first balloons and dirigibles to the space-age global positioning systems of the Persian Gulf War. Historical examples are provided to extrapolate the development of Air Force capabilities (competencies), and missions (functions) to demonstrate the evolution of what has become today's USAF air and space power. Furthermore, the course examines several fundamental truths associated with war in the third dimension: e.g. Principles of War and Tenets of Air and Space Power. As a whole, this course provides the cadets with a knowledge level understanding for the general element and employment of air and space power, from an institutional doctrinal and historical perspective. In addition, the students will continue to discuss the importance of the Air Force Core Values with the use of operational examples and historical Air Force leaders and will continue to develop their communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followerhip experiences.

31-301 Air Force Leadership Studies
Fall: 9 units
AS300 is a study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and the communication skills required of an Air Force junior officer. Case studies are used to examine Air Force leadership and management situations as a means of demonstrating and exercising practical application of the concepts being studied. A mandatory Leadership Laboratory complements this course by providing advanced leadership experiences in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

31-302 Air Force Leadership Studies
Spring: 9 units
AS300 is a study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and the communication skills required of an Air Force junior officer. Case studies are used to examine Air Force
leadership and management situations as a means of demonstrating and exercising practical application of the concepts being studied. A mandatory Leadership Laboratory complements this course by providing advanced leadership experiences in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

31-401 National Security Affairs and Preparation for Active Duty

Fall: 9 units
AS400 examines the national security process, regional studies, advanced leadership ethics, and Air Force doctrine. Special topics of interest focus on the military as a profession, officership, military justice, civilian control of the military, preparation for active duty, and current issues affecting military professionalism. Within this structure, continued emphasis is given to refining communication skills. A mandatory Leadership Laboratory complements this course by providing advanced leadership experiences, giving students the opportunity to apply the leadership and management principles of this course.

31-402 National Security Affairs and Preparation for Active Duty

Spring: 9 units
AS400 examines the national security process, regional studies, advanced leadership ethics, and Air Force doctrine. Special topics of interest focus on the military as a profession, officership, military justice, civilian control of the military, preparation for active duty, and current issues affecting military professionalism. Within this structure, continued emphasis is given to refining communication skills. A mandatory Leadership Laboratory complements this course by providing advanced leadership experiences, giving students the opportunity to apply the leadership and management principles of this course.

Naval Science (ROTC)

Undergraduate Courses

32-100 Naval Laboratory

Fall and Spring: 3 units
Military drill, physical fitness, and leadership seminars.

32-101 Introduction to Naval Science

Fall: 6 units
A general introduction to the naval profession and to concepts of Seapower. Instruction emphasizes the mission, organization, and wartime components of the Navy and Marine Corps. Included is an overview of officer and enlisted ranks and rates, training and education, and career patterns. The course also covers naval courtesy and customs, military justice, leadership, and nomenclature. This course exposes the student to the professional competencies required to become a naval officer.

32-102 Seapower and Maritime Affairs

Spring: 6 units
This course surveys US naval history from its European origins to the present with emphasis on major developments and the geopolitical forces shaping these developments. Also included is discussion of the theories and writings of naval historian and strategist Alfred Thayer Mahan. The course will finish by covering present day concerns in seapower and maritime affairs including the economic and political issues of merchant marine commerce, the law of the sea, the navy and merchant marine of the former Soviet Union (FSU), and a comparison of US and FSU maritime strategies to include the rise and decline of the Soviet Navy.

32-200 Naval Laboratory

Fall and Spring: 3 units
Military drill, physical fitness, and leadership seminars.

32-201 Leadership & Management

Fall: 9 units
This course is a comprehensive advanced-level study of organizational behavior and management. Topics include a survey of the management functions of planning, organizing, and controlling; an introduction to individual and group behavior in organizations; an extensive study of motivation and leadership. Major behavioral theories are explored in detail. Practical applications are explored by the use of experiential exercises, case studies, and laboratory discussions. Other topics developed include decision-making, communication, responsibility, authority and accountability.

32-202 Naval Ships Systems I

Spring: 9 units
A detailed study of ship characteristics and types including ship design, hydrodynamic forces, stability, compartmentalization, propulsion, electrical and auxiliary systems, interior communications, ship control, and damage control. Included are basic concepts of the theory and design of steam, gas turbine, internal combustion, and nuclear propulsion. Shipboard safety and firefighting are also discussed.

32-300 Naval Laboratory

Fall and Spring: 3 units
Military drill, physical fitness, and leadership seminars.

32-301 Navigation and Naval Operations I

Fall: 9 units
An in-depth study of piloting and celestial navigation including theory, principles, and procedures. Students learn piloting skills including the use of charts, visual and electronic aids, and the theory and operation of magnetic and gyro compasses. Celestial navigation is a major topic including the celestial coordinate system, an introduction to spherical trigonometry, sextant theory and operation, and a step-by-step treatment of the sight reduction process. Students develop practical skills in both piloting and celestial navigation. Other topics discussed include tides, currents, effects of wind and weather, plotting, use of navigation instruments, types and characteristics of electronic navigation systems, and the typical day’s work in navigation.

32-302 Navigation and Naval Operations II

Spring: 9 units
A study of the international and inland rules of the nautical road, relative motion, vector analysis theory, relative motion problems, formation tactics, and ship employment. Also included is an introduction to naval operations and shipboard evolutions, vessel behavior and characteristics in maneuvering, applied aspects of ship handling, and afloat communications.

32-400 Naval Laboratory

Fall and Spring: 3 units
Military drill, physical fitness, and leadership seminars.

32-401 Naval Ships Systems II

Fall: 9 units
This course outlines the theory and employment of weapons systems. The student explores the processes of detection, evaluation, threat analysis, weapon selection, delivery, guidance and explosives. Fire control systems and major weapon types are discussed, including capabilities and limitations. The physical aspects of radar and underwater sound are described in detail. The facets of command, control, and communications are explored as a means of weapons system integration.

32-402 Leadership and Ethics

Spring: 6 units
The study of naval junior officer responsibilities. The course exposes the student to a study of ethics, decision making and responsibility as well as counseling methods, military justice administration, naval human resources management, directives and correspondence, naval personnel administration, material management and maintenance and supply systems. This capstone course in the NROTC curriculum builds on and integrates the professional competencies developed in prior course work and professional training.
### Course Descriptions

#### 32-410 Amphibious Warfare
**Fall and Spring:** 9 units
A historical survey of the development of amphibious doctrine and the conduct of amphibious operations. Emphasis is placed on the evolution of amphibious warfare in the twentieth century, especially during World War II. Focus is applied to four main themes: political/strategic situation, sea-to-land transitions, tactics ashore, and development of amphibious technology. Present day potential and limitations on amphibious operations, including the rapid deployment force concept, are explored.

#### Physics Undergraduate Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Offered</th>
<th>Units</th>
<th>Prerequisites</th>
<th>Corequisites</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-100</td>
<td>Basic Experimental Physics</td>
<td>6</td>
<td>Fall and Spring</td>
<td>6</td>
<td>This course provides students with a basic introduction to experimental physics. The content of the course and the particular experiments to be carried out are chosen to be especially useful for students who intend to work in the health sciences. Specific topics will range from mechanics to nuclear and atomic physics.</td>
<td>21-122</td>
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<tr>
<td>33-101</td>
<td>Experimental Physics First Year Seminar:</td>
<td>3</td>
<td>Fall, Mini Session</td>
<td>3</td>
<td>Various seminars are offered that introduce first-year students to current topics of modern physics. These are mini courses that meet for half a semester. In the past, seminar topics have included: Science and Science Fiction, Astrophysics, Black Holes, Cosmology, and Supernovae, Elementary Particles, and The Building Blocks of Matter. These seminars are only open to MCS first year students.</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>33-102</td>
<td>Concepts of Modern Physics</td>
<td>9</td>
<td>Spring</td>
<td>9</td>
<td>This course is designed to provide non-technical students with an opportunity to learn about some of the frontier areas of physics in which active research is now going on. Topics that may be covered include the current models of elementary particles, how the fundamental forces are understood in terms of quantum physics, wave mechanics and atomic physics, Einstein's Special and General Theories of Relativity, and Astrophysics and Cosmology. Although the emphasis is on concepts rather than mathematical methods, algebra and trigonometry are used in order to enable students to reach a deeper and more quantitative knowledge of the concepts. Students write brief reports about current topics in science and give a seminar on a topic of current interest in physics.</td>
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<tr>
<td>33-104</td>
<td>Experimental Physics</td>
<td>9</td>
<td>Fall and Spring</td>
<td>9</td>
<td>This course introduces first year students and sophomores to the methods of experimental physics. Particular emphasis is placed on three aspects of experimentation: laboratory technique, including both the execution and the documentation of an experiment; data analysis, including the treatment of statistical and systematic errors and computer-aided analysis of experimental data; and written communication of experimental procedures and results. The concepts and skills for measurement and data analysis are acquired gradually through a series of experiments covering a range of topics from mechanics to nuclear and atomic physics.</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td>33-106</td>
<td>Physics for Engineering Students I</td>
<td>12</td>
<td>All Semesters</td>
<td>12</td>
<td>This is a first semester, calculus-based introductory physics course. Basic principles of mechanics and thermodynamics are developed. Topics include vectors, displacement, velocity, acceleration, force, equilibrium, mass, Newton's laws, gravitation, work, energy, momentum, impulse, temperature, heat, equations of state, thermodynamic processes, heat engines, refrigerators, first and second laws of thermodynamics, and the kinetic theory of gases.</td>
<td>33-107</td>
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<tr>
<td>33-107</td>
<td>Physics for Engineering Students II</td>
<td>12</td>
<td>All Semesters</td>
<td>12</td>
<td>This is the second half of a two-semester calculus-based introductory physics sequence for engineering students. One fifth of the course covers waves, including standing and travelling waves, superposition, beats, reflection, and interference. Two fifths of the course covers electricity, including electrostatics and electric fields, Gauss’ law, electric potential, and simple circuits. The remaining two fifths cover magnetism, including magnetic forces, magnetic fields, induction and electromagnetic radiation.</td>
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<tr>
<td>33-108</td>
<td>Physics for Science Students I</td>
<td>12</td>
<td>Fall and Spring</td>
<td>12</td>
<td>This calculus based course combines the basic principles of mechanics with some quantum physics and relativity to explain nature on both a microscopic and macroscopic scale. The course will build models to describe the universe based on a small number of fundamental physics principles. Some simple computer modeling will be done to develop insight into the solving of problems using Newton’s laws. Topics covered will include vectors, momentum, force, gravitation, oscillations, energy, quantum physics, center of mass, angular momentum, statistical physics, and the laws of thermodynamics. No computer experience is needed.</td>
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<tr>
<td>33-109</td>
<td>Physics for Science Students II</td>
<td>12</td>
<td>Fall and Spring</td>
<td>12</td>
<td>This is the second semester course that follows 33-111. Electricity and magnetism is developed, including the following topics: Coulomb’s law, polarization, electric field, electric potential, DC circuits, magnetic field and force, magnetic induction, and the origins of electromagnetic waves.</td>
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<td>33-110</td>
<td>Physics of Musical Sound</td>
<td>9</td>
<td>Spring</td>
<td>9</td>
<td>An introduction to the physics and psychophysics of musical sound: elementary physics of vibrating systems, propagation of sound: traveling waves, reflection, and diffraction, addition of waves: interference and beats. Anatomy of the ear and the perception of sound: loudness, pitch, and timbre. Standing waves and natural modes. Qualitative description of general periodic systems by Fourier analysis: the harmonic series and complex musical tones. The acoustics of musical instruments including percussion instruments, such as drums, bars, and struck and plucked strings; and instruments exhibiting self-sustained oscillations, including bowed strings, blown pipes, reeds, brasses, and singing. Intervals and consonance, musical scales, tuning and temperament. Basic room and auditorium acoustics. There are no formal prerequisites, but an ability to read music and having some previous musical experience will be very useful.</td>
<td>33-111</td>
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<td>33-111</td>
<td>Energy and Environmental Issues</td>
<td>10</td>
<td>Fall</td>
<td>10</td>
<td>An introduction to the fundamental principles and methodology of physics. The course will introduce and use the physics concepts of energy and the laws of thermodynamics to analyze environmental issues, such as fossil fuel use, nuclear power, solar power and others. Issues of risk assessment will also be discussed. This course is intended for students in the Colleges of H&amp;SS and Fine Arts and does not require calculus, however, students are expected to have some facility with basic algebra.</td>
<td>33-112</td>
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<td>33-112</td>
<td>Introduction to Astronomy</td>
<td>9</td>
<td>Fall</td>
<td>9</td>
<td>Astronomy continues to enjoy a golden age of exploration and discovery. This course presents a broad view of astronomy, straightforwardly descriptive and without any complex mathematics. The goal of the course is to encourage non-technical students to become scientifically literate and to appreciate new developments in the world of science, especially in the rapidly developing field of astronomy. Subjects covered include the solar system, stars, galaxies and the universe as a whole. The student should develop an</td>
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</table>

#### 33-124 Introduction to Astronomy
**Fall:** 9 units
Astronomy continues to enjoy a golden age of exploration and discovery. This course presents a broad view of astronomy, straightforwardly descriptive and without any complex mathematics. The goal of the course is to encourage non-technical students to become scientifically literate and to appreciate new developments in the world of science, especially in the rapidly developing field of astronomy. Subjects covered include the solar system, stars, galaxies and the universe as a whole. The student should develop an...
Course Descriptions

33-131  Matter and Interaction I
Fall:  12 units
A more challenging alternative to 33-111, Physics for Science Students I. Students with particularly strong physics backgrounds may take this course. Modeling of physical systems, including 3D computer modeling, with emphasis on atomic-level description and analysis of matter and its interactions. Momentum, numerical integration of Newton’s laws, ball-and-spring model of solids, harmonic oscillator, energy, energy quantization, mass-energy equivalence, multiparticle systems, collisions, angular momentum including quantized angular momentum, kinetic theory of gases, statistical mechanics (temperature, entropy, and specific heat of the Einstein solid, Boltzmann factor).  
Prerequisites:  Corequisites: 21-120

33-132  Matter and Interactions II
Spring:  12 units
A more challenging alternative to 33-112, Physics for Science Students II. Emphasis on atomic-level description and analysis of matter and its electric and magnetic interactions. Coulomb’s law, polarization, electric field, plasmas, field of charge distributions, microscopic analysis of resistor and capacitor circuits, potential, macroscopic analysis of circuits, Gauss’ law, magnetic field, atomic model of magnetism, Ampère’s law, magnetic force, relativistic issues, magnetic induction with emphasis on non-Coulomb electric field, Maxwell’s equations, electromagnetic radiation including its production and its effects on matter, re-radiation, interference. Computer modeling and visualization; desktop experiments.  
Prerequisites: 21120 and 33131  Corequisites: 21-122

33-201  Undergraduate Colloquium I
Fall:  1 unit
All physics majors meet together for 1 hour a week to hear discussions on current physics research from faculty, undergraduate and graduate students, and outside speakers. Other topics of interest such as application to graduate school, areas of industrial research and job opportunities will also be presented.

33-202  Undergraduate Colloquium II
Spring:  1 unit
All physics majors meet together for 1 hour a week to hear discussions on current physics research from faculty, undergraduate and graduate students, and outside speakers. Other topics of interest such as application to graduate school, areas of industrial research and job opportunities will also be presented.

33-211  Physics III: Modern Essentials
Fall and Spring:  10 units
Physics III is primarily for third-semester students of physics, including all physics majors, but is open to any qualified student who wants an introduction to the physics of the 20th century. The course will have a strong component of Special Relativity, dealing with kinematics and dynamics, but not electricity and magnetism. (See 33-213 description.) It will introduce students to a conceptual theory, which is mathematically simple but (initially) non-intuitive. The course also provides a broad exposure to quantum phenomena and early quantum theory without getting overly mathematical. It leads into the more formal Quantum Physics course.  
Prerequisites: 33112 or 33132

33-213  Mini-Course in Special Relativity
Fall and Spring:  Mini Session - 4 units
This course spans the first six weeks of 33-211, Physics III: Modern Essentials. It treats the Mechanics aspects of Special Relativity, including topics such as simultaneity, the Lorentz transformation, time dilation, length contraction, space-time geometry, resolving some famous puzzles, and the momentum, mass, and energy relations. The Electricity and Magnetism portions of the subject are deferred until the junior/senior courses in E&M (33-338/33-339).  
Prerequisites: 33112 or 33132

33-224  Stars, Galaxies and the Universe
Fall:  9 units
The study of astronomy has blossomed over the past few decades as a result of new ground-based and space-based telescopes, and with the advantage of fast computers for analysis of the huge quantities of data. As our astronomical horizon expands, we are still able to use the laws of physics to make sense of it all. This course is for students who want to understand the basic concepts in astronomy and what drives astronomical objects and the universe. The course emphasizes the application of a few physical principles to a variety of astronomical settings, from stars to galaxies to the structure and evolution of the universe. Introductory classical physics is required, but modern physics will be introduced as needed in the course. The course is intended for science and engineering majors as well as students in other disciplines with good technical backgrounds. Computer lab exercises will be used to gain practical experience in astronomical techniques. In addition, small telescopes are available for personal sign-out for those who would like to use them, and outdoor observing sessions will be organized as weather permits.  
Prerequisites:  Corequisites: 33-131, 33-111, 33-106

33-225  Quantum Physics and Structure of Matter
Fall:  9 units
This course introduces the basic theory used to describe the microscopic world of electrons, atoms, and photons. The duality between wave-like and particle-like phenomena is introduced along with the deBroglie relations which link them. We develop a wave description appropriate for quanta which are partially localized and discuss the interpretation of these wavefunctions. The wave equation of quantum mechanics is developed and applied to the hydrogen atom from which we extrapolate the structure of the Periodic Table. Other materials-related applications are developed, for example, Boltzmann and quantum statistics and properties of electrons in crystals.  
Prerequisites: 33107 or 33112 or 33132

33-228  Electronics I
Spring:  10 units
An introductory laboratory and lecture course with emphasis on elementary circuit analysis, design, and testing. We start by introducing basic circuit elements and study the responses of combinations to DC and AC excitations. We then take up transistors and learn about biasing and the behavior of amplifier circuits. The many uses of operational amplifiers are examined and analyzed; general features of feedback systems are introduced in this context. Complex functions are used to analyze all of the above linear systems. Finally, we examine and build some simple digital integrated circuits.  
Prerequisites: 33107 or 33112 or 33132

33-231  Physical Analysis
Fall:  9 units
This course aims to develop analytical skills and mathematical modeling skills across a broad spectrum of physical phenomena, stressing analogies in behavior of a wide variety of systems. Specific topics include dimensional analysis and scaling in physical phenomena, exponential growth and decay, the harmonic oscillator with damping and driving forces, linear approximations of nonlinear systems, coupled oscillators, and wave motion. Necessary mathematical techniques, including differential equations, complex exponential functions, matrix algebra, and elementary Fourier series, are introduced as needed.  
Prerequisites: 21122 and (33112 or 33132)

33-232  Mathematical Methods of Physics
Spring:  9 units
This course introduces, in the context of physical systems, a variety of mathematical tools and techniques that will be needed for later courses in the physics curriculum. Topics will include, linear algebra, vector calculus with physical application, Fourier series and integrals, partial differential equations and boundary value problems. The
techniques taught here are useful in more advanced courses such as Physical Mechanics, Electricity and Magnetism, and Advanced Quantum Physics.

Prerequisites: 33231

33-234 Quantum Physics
Spring: 10 units
An introduction to the fundamental principles and applications of quantum physics. The semester begins with a review of the experimental evidence for the quantization of energy, the particle and wave properties of matter, and the early quantum picture of the atom as discussed in Physics III (Modern Essentials). Wave mechanics is then developed in an elementary way, but in sufficient detail to provide a semiquantitative description of the structure and spectra of one-electron atoms and other single particle systems. These methods are extended to the description of many-electron atoms and molecules. Many-particle systems are described using both classical and quantum statistics.
Prerequisites: 33211

33-241 Introduction to Computational Physics
Fall: 9 units
The course emphasizes the formulation of physical problems for machine computation with exploration of alternative numerical methods. Work will be done on a range of computers from workstations to high performance computing platforms. Examples are drawn from Physics I and II, and Experimental Physics, as well as concurrent physics courses.
Prerequisites: 15100 and 21122 and 33104 and (33112 or 33132)

33-301 Undergraduate Colloquium III
Fall: 1 units
A continuation of 33-201, 202 for juniors. All physics majors meet together 1 hour per week to discuss topics of interest.

33-302 Undergraduate Colloquium IV
Spring: 1 units
A continuation of 33-201, 202 for juniors. All physics majors meet together 1 hour per week to discuss topics of interest.

33-331 Physical Mechanics I
Fall: 10 units
Students explore fundamental concepts of classical mechanics. Conservation laws, momentum, energy, angular momentum, Lagrange's and Hamilton's equations, motion under a central force, scattering, cross section, and systems of particles.
Prerequisites: 21259 and 33232

33-332 Physical Mechanics II
Spring: 10 units
This is the second semester of a two-semester course on classical mechanics. The course will use the tools developed in 33-331 to examine motion in non-inertial reference frames; in particular, rotating frames. This then leads to the development of general rigid body motion, Euler's Equations. Finally, the course will cover coupled oscillations with particular emphasis on normal modes.
Prerequisites: 33331

33-338 Intermediate Electricity and Magnetism I
Fall: 10 units
This course includes the basic concepts of electro- and magnetostatics. In electrostatics, topics include the electric field and potential for typical configurations, work and energy considerations, the method of images and solutions of Laplace's Equation, multipole expansions, and electrostatics in the presence of matter. In magnetostatics, topics include the magnetic field and vector potential, magnetostatics in the presence of matter, properties of dia-, para- and ferromagnetic materials.
Prerequisites: 21259 and 33232

33-339 Intermediate Electricity and Magnetism II
Spring: 10 units
This course focuses on electro- and magnetodynamics. Topics include Faraday's Law of induction, electromagnetic field momentum and energy, Maxwell's equations and electromagnetic waves including plane waves, waves in non-conducting and conducting media, reflection and refraction of waves, and guided waves. Electromagnetic radiation theory includes generation and characteristics of electric and magnetic dipole radiation. The Special Theory of Relativity is applied to electrodynamics: electric and magnetic fields in different reference frames, Lorentz transformations, four-vectors, invariants, and applications to particle mechanics.
Prerequisites: 33338

33-340 Modern Physics Laboratory
Spring: 10 units
Emphasis is on hands-on experience observing important physical phenomena in the lab, advancing the student’s experimental skills, developing sophisticated data analysis techniques, writing thorough reports, and improving verbal communication through several oral progress reports given during the semester and a comprehensive oral report on one experiment. Students perform three experiments which are drawn from the areas of atomic, condensed matter, classical, and nuclear and particle physics. Those currently available are the following: Zeeman effect, light scattering, optical pumping, thermal lensing, Raman scattering, chaos, magnetic susceptibility, nuclear magnetic resonance, electron spin resonance, X-ray diffraction, Mössbauer effect, neutron activation of radioactive nuclides, Compton scattering, and cosmic ray muons.
Prerequisites: 33241 and (33331 or 33338 or 33341)

33-341 Thermal Physics I
Fall: 10 units
The three laws of classical thermodynamics, which deal with the existence of state functions for energy and entropy and the entropy at the absolute zero of temperature, are developed along phenomenological lines. Elementary statistical mechanics is then introduced via the canonical ensemble to understand the interpretation of entropy in terms of probability and to calculate some thermodynamic quantities from simple models. These laws are applied to deduce relationships among heat capacities and other measureable quantities and then are generalized to open systems and their various auxiliary thermodynamic potentials; transformations between potentials are developed. Criteria for equilibrium of multicomponent systems are developed and applied to phase transformations and chemical reactions. Models of solutions are obtained by using statistical mechanics and are applied to deduce simple phase diagrams for ideal and regular solutions. The concept of thermodynamic stability is then introduced and illustrated in the context of phase transformations.
Prerequisites: 33111 and 33234

33-342 Thermal Physics II
Spring: 10 units
This course begins with a more systematic development of formal probability theory, with emphasis on generating functions, probability density functions and asymptotic approximations. Examples are taken from games of chance, geometric probabilities and radioactive decay. The connections between the ensembles of statistical mechanics (microcanonical, canonical and grand canonical) with the various thermodynamic potentials is developed for single component and multicomponent systems. Fermi-Dirac and Bose-Einstein statistics are reviewed. These principles are then applied to applications such as electronic specific heats, Einstein condensation, chemical reactions, phase transformations, mean field theories, binary phase diagrams, paramagnetism, ferromagnetism, defects, semiconductors and fluctuation phenomena.
Prerequisites: 33341

33-350 Undergraduate Research
Fall and Spring: 1-12 units
The student undertakes a project of interest under the supervision of one of the members of the faculty.

33-353 Intermediate Optics
Course Descriptions

Fall: 12 units
Geometrical optics: reflection and refraction, mirrors, prisms, lenses, apertures and stops, simple optical instruments, fiber optics. Scalar wave optics: wave properties of light, interference, coherence, interferometry, Huygens-Fresnel principle, Fraunhofer diffraction, resolution of optical instruments, Fourier optics, Fresnel diffraction. Laser beam optics: Gaussian beams. Vector wave optics: electromagnetic waves at dielectric interfaces, polarized light. The course will use complex exponential representations of electromagnetic waves. Prerequisites: 33112

33-401 Undergraduate Colloquium IV
Fall: 1 units
A continuation of 33-301, 302 for seniors. All physics majors meet together one hour per week to discuss topics of interest.

33-402 Undergraduate Colloquium VI
Spring: 1 units
A continuation of 33-301, 302 for seniors. All physics majors meet together one hour per week to discuss topics of interest.

33-441 Introduction to Biophysics
Fall: 10 units
This course introduces physical methods used in studying biological systems. The biological systems to which the methods are applied will be surveyed and current interpretations of their structure and function will be discussed. Biological systems that have been discussed in recent years include membranes, nerves, muscle, photosynthetic systems and visual systems; not all these topics can be covered in a given term, and the particular selection can be influenced by student interest. The treatment of biophysical methods will be based on physical principles, which will be treated with appropriate mathematics when necessary. The biophysical methods will be selected from among the techniques of x-ray and neutron diffraction, light scattering, birefringence, microscopy, Raman and IR spectroscopy, dielectric response and calorimetry. Prerequisites:

33-444 Introduction to Nuclear and Particle Physics
Spring Alternate Years: 9 units
We describe our understanding of nuclei, elementary particles, and quarks, with equal emphasis on the nuclear and particle aspects of sub-atomic matter. We discuss the physics of accelerators, and how particle interactions with matter lead to various kinds of detector instrumentation. Then we discuss methods for measuring sub-atomic structure, symmetries and conservation laws, and the electromagnetic, weak, and strong interactions. We examine the quark model of the mesons and baryons, as well as several models of the atomic nucleus. Prerequisites: 33234 and 33338

33-445 Advanced Quantum Physics I
Fall: 9 units
Mathematics of quantum theory, linear algebra and Hilbert spaces; review of classical mechanics; problems with classical mechanics; postulates of quantum theory; one dimensional applications; the harmonic oscillator; uncertainty relations; systems with N degrees of freedom, multi-particle states, identical particles; approximation methods. Prerequisites: 33234 Corequisites: 33-331

33-446 Advanced Quantum Physics II
Spring: 9 units
Classical symmetries; quantum symmetries; rotations and angular momentum; spin; addition of angular momentum; the hydrogen atom; quantum "paradoxes" and Bell's theorem; applications. Prerequisites: 33445

33-448 Introduction to Solid State Physics
Spring: 9 units
This course gives a quantitative description of crystal lattices, common crystal structures obtained by adding a basis of atoms to the lattice, and the definition and properties of the reciprocal lattice. Diffraction measurements are used as tools to quantify crystal lattices, including Bragg's law and structure factors. Diffraction from amorphous substances and liquids is also introduced. The various types of atomic bonding, e.g., Van der Waals, metallic, ionic, covalent and hydrogen are surveyed. Bonding energies of some crystalline structures are calculated. Models of crystal binding are generalized to include dynamics, first for classical lattice vibrations and then for quantized lattice vibrations known as phonons. These concepts are used to calculate the heat capacities of insulating crystals, to introduce the concept of density of states, and to discuss phonon scattering. The band theory of solids is developed, starting with the free electron model of a metal and culminating with the properties of conductors and semiconductors. Magnetic phenomena such as paramagnetism and the mean field theory of ferromagnetism are covered to the extent that time permits. Prerequisites: (33234 or 33225) and 33341

33-451 Senior Research
Fall and Spring: 1-12 units
Open to all senior physics majors. May include research in a lab, extending the capabilities of a teaching lab, or a theoretical or computational physics project. The student experiences the less structured atmosphere of a research program where there is much room for independent initiative. Modern Physics Laboratory, 33-340, should precede this course, though it is not required. A list of research projects will be available before pre-registration in spring of the junior year so that student project pairings can be set. Reports on results are required at end of semester.

33-456 Advanced Computational Physics
Spring: 9 units
This course emphasizes applying practical numerical techniques to the types of problems encountered by practicing physicists. The student will be expected to understand the principles behind numerical methods such as SVD decomposition, chi-squared minimization, Fast Fourier Transforms and Monte Carlo simulation of experiments. Applications will include data analysis and eigenvalue problems. Emphasis will be placed on the ability to implement complex algorithms accurately by devising methods of checking results and debugging code. The students will be expected to become proficient in Fortran or C programming. Prerequisites: 33241

33-458 Special Problems in Computational Physics
Fall and Spring: 9 units
The student will work under the direction of a Department faculty member on a computational physics problem of mutual interest. Prerequisites: 33456

33-466 Extragalactic Astrophysics and Cosmology
Spring: 9 units
Starting from the expanding universe of galaxies, this course lays out the structure of the universe from the Local Group of galaxies to the largest structures observed. The observational pinnacle of the Big Bang theory, the microwave background radiation, provides us with many clues to conditions in the early universe and to the parameters which control the expansion and fate of the universe. Current theories for the development of galaxies and clusters of galaxies are outlined in terms of our current understanding of dark matter. Observational cosmology continues to enjoy a golden era of discovery and the latest observational results will be interpreted in terms of the basic cosmological parameters. Prerequisites: 33224 and 33234

33-467 Astrophysics of Stars and the Galaxy
Fall: 9 units
The physics of stars is introduced from first principles, leading from star formation to nuclear fusion to late stellar evolution and the end points of stars: white dwarfs, neutron stars and black holes. The theory of stellar structure and evolution is elegant and impressively powerful, bringing together all branches of physics to predict the life cycles of the stars. The basic physical processes in the interstellar medium will also be described, and the role of multi-wavelength astronomy will be used to illustrate our understanding of the structure of the Milky Way Galaxy, from the massive black hole at the center to
Course Descriptions

Statistics

Undergraduate Courses

36-201 Statistical Reasoning and Practice
All Semesters: 9 units
This course will introduce students to the basic concepts, logic, and issues involved in statistical reasoning, as well as basic statistical methods used to analyze data and evaluate studies. The major topics to be covered include methods for exploratory data analysis, an introduction to research methods, elementary probability, and methods for statistical inference. The objectives of this course are to help students develop a critical approach to the evaluation of study designs, data and results, and to develop skills in the application of basic statistical methods in empirical research. An important feature of the course will be the use of the computer to facilitate the understanding of important statistical ideas and for the implementation of data analysis. In addition to three lectures a week, students will attend a computer lab once a week. Examples will be drawn from areas of applications of particular interest to H&SS students. Not open to students who have received credit for 36-207/70-207, 36-220, 36-225, 36-625, or 36-247.

Prerequisites: 36201 or 36207 or 36220 or 36247 or 70207

36-202 Statistical Methods
Spring: 9 units
This course builds on the principles and methods of statistical reasoning developed in 36-201. The course will cover simple and multiple regression and analysis of variance methods. Other topics will be selected from the following: Logistic regression, non-parametric methods, probability models. The objectives of this course is to develop the skills of applying the basic principles and methods that underlie statistical practice and empirical research. Not open to students who have received credit for: 36-208/70-208, 36-309, 88-250.
Prerequisites: 36201 or 36207 or 36220 or 36247 or 70207

36-207 Probability and Statistics for Business Applications
Fall: 9 units
This is the first half of a year long sequence in basic statistical methods that are used in business and management. Topics include exploratory and descriptive techniques, elementary probability theory, statistical inference in simple settings, basic categorical analysis, and statistical methods for quality control. In addition to two lectures a week, students will attend a computer lab once a week. Not open to students who have received credit for 36-201, 36-220, 36-625, or 36-247. Cross-listed as 70-207.
Prerequisites: 21112 or 21116 or 21120 or 21121

36-208 Regression Analysis
Spring: 9 units
This is the second half of a year long sequence in basic statistical methods that are used in business and management. Topics include time series forecasting, and regression analysis. Not open to students who have received credit for 36-202, 36-626. Cross-listed as 70-208.
Prerequisites: (21116 or 21120 or 21121 or 21112) AND (36207 or 70207 or 36201 or 36220 or 36227)

36-211 General Relativity
Fall Alternate Years: 9 units
General Relativity (GR) is the foundation upon which we build a theory for the universe. The course will outline GR and provide the students with a solid physical understanding of the elegant theory. The course will also use GR to explain the observable universe and students will get an appreciation of this theory through modern-day experiments.
Prerequisites: 33211 and 33339

36-217 Probability Theory and Random Processes
All Semesters: 9 units
This course provides an introduction to probability theory. It is designed for students in electrical and computer engineering. Topics include elementary probability theory, conditional probability and independence, random variables, distribution functions, joint and conditional distributions, limit theorems, and an introduction to random processes. Some elementary ideas in spectral analysis and interpolation theory will be given. The use of a computer package will be an integral part of this course (depending on the instructor). Not open to students who have received credit for 36-225, or 36-625.
Prerequisites: 21118 or 21122 or 21123 or 21256

36-220 Engineering Statistics and Quality Control
All Semesters: 9 units
This is a course in introductory statistics for engineers with emphasis on modern product improvement techniques. Besides exploratory data analysis, basic probability, distribution theory and statistical inference, special topics include experimental design, regression, control charts and acceptance sampling. In addition to two lectures a week, students will attend a computer lab once a week. Not open to students who have received credit for 36-201, 36-207/70-207, 36-226, 36-626, or 36-247.
Prerequisites: 21112 or 21116 or 21120 or 21121

36-225 Introduction to Probability and Statistics I
Fall: 9 units
This course is the first half of a year long course which provides an introduction to probability and mathematical statistics for students in mathematics and statistics. The use of probability theory is illustrated with examples drawn from engineering, the sciences, and management. Topics include elementary probability theory, conditional probability and independence, random variables, distribution functions, joint and conditional distributions, law of large numbers, and the central limit theorem. Not open to students who have received credit for 36-217 or 36-625.
Prerequisites: 21112 or 21118 or 21222 or 21123 or 21256

36-226 Introduction to Probability and Statistics II
Spring: 9 units
This course is the second half of a year long course in probability and mathematical statistics. Topics include maximum likelihood estimation, confidence intervals, and hypothesis testing. If time permits there will also be a discussion of linear regression and the analysis of variance. Not open to students who have received credit for 36-626.
Prerequisites: 36217 or 36225

36-625, or 36-247. Cross-listed as 70-207.
Prerequisites: 21112 or 21116 or 21120 or 21121

36-208 Regression Analysis
Spring: 9 units
This is the second half of a year long sequence in basic statistical methods that are used in business and management. Topics include time series forecasting, and regression analysis. Not open to students who have received credit for 36-202, 36-626. Cross-listed as 70-208.
Prerequisites: (21116 or 21120 or 21121 or 21112) AND (36207 or 70207 or 36201 or 36220 or 36227)

36-211 General Relativity
Fall Alternate Years: 9 units
General Relativity (GR) is the foundation upon which we build a theory for the universe. The course will outline GR and provide the students with a solid physical understanding of the elegant theory. The course will also use GR to explain the observable universe and students will get an appreciation of this theory through modern-day experiments.
Prerequisites: 33211 and 33339

36-217 Probability Theory and Random Processes
All Semesters: 9 units
This course provides an introduction to probability theory. It is designed for students in electrical and computer engineering. Topics include elementary probability theory, conditional probability and independence, random variables, distribution functions, joint and conditional distributions, limit theorems, and an introduction to random processes. Some elementary ideas in spectral analysis and interpolation theory will be given. The use of a computer package will be an integral part of this course (depending on the instructor). Not open to students who have received credit for 36-225, or 36-625.
Prerequisites: 21118 or 21122 or 21123 or 21256

36-220 Engineering Statistics and Quality Control
All Semesters: 9 units
This is a course in introductory statistics for engineers with emphasis on modern product improvement techniques. Besides exploratory data analysis, basic probability, distribution theory and statistical inference, special topics include experimental design, regression, control charts and acceptance sampling. In addition to two lectures a week, students will attend a computer lab once a week. Not open to students who have received credit for 36-201, 36-207/70-207, 36-226, 36-626, or 36-247.
Prerequisites: 21112 or 21116 or 21120 or 21121

36-225 Introduction to Probability and Statistics I
Fall: 9 units
This course is the first half of a year long course which provides an introduction to probability and mathematical statistics for students in mathematics and statistics. The use of probability theory is illustrated with examples drawn from engineering, the sciences, and management. Topics include elementary probability theory, conditional probability and independence, random variables, distribution functions, joint and conditional distributions, law of large numbers, and the central limit theorem. Not open to students who have received credit for 36-217 or 36-625.
Prerequisites: 21112 or 21118 or 21222 or 21123 or 21256

36-226 Introduction to Probability and Statistics II
Spring: 9 units
This course is the second half of a year long course in probability and mathematical statistics. Topics include maximum likelihood estimation, confidence intervals, and hypothesis testing. If time permits there will also be a discussion of linear regression and the analysis of variance. Not open to students who have received credit for 36-626.
Prerequisites: 36217 or 36225

36-201 Statistical Reasoning and Practice
All Semesters: 9 units
This course will introduce students to the basic concepts, logic, and issues involved in statistical reasoning, as well as basic statistical methods used to analyze data and evaluate studies. The major topics to be covered include methods for exploratory data analysis, an introduction to research methods, elementary probability, and methods for statistical inference. The objectives of this course are to help students develop a critical approach to the evaluation of study designs, data and results, and to develop skills in the application of basic statistical methods in empirical research. An important feature of the course will be the use of the computer to facilitate the understanding of important statistical ideas and for the implementation of data analysis. In addition to three lectures a week, students will attend a computer lab once a week. Examples will be drawn from areas of applications of particular interest to H&SS students. Not open to students who have received credit for 36-207/70-207, 36-220, 36-225, 36-625, or 36-247.

Prerequisites: 36201 or 36207 or 36220 or 36247 or 70207

36-202 Statistical Methods
Spring: 9 units
This course builds on the principles and methods of statistical reasoning developed in 36-201. The course will cover simple and multiple regression and analysis of variance methods. Other topics will be selected from the following: Logistic regression, non-parametric methods, probability models. The objectives of this course is to develop the skills of applying the basic principles and methods that underlie statistical practice and empirical research. Not open to students who have received credit for: 36-208/70-208, 36-309, 88-250.
Prerequisites: 36201 or 36207 or 36220 or 36247 or 70207
Course Descriptions

36-247 Statistics for Lab Sciences
Spring: 9 units
This course is a single-semester comprehensive introduction to statistical analysis of data for students in biology and chemistry. Topics include exploratory data analysis, elements of computer programming for statistics, basic concepts of probability, statistical inference, and curve fitting. In addition to two lectures, students attend a computer lab each week. Not open to students who have received credit for 36-201, 36-207/70-207, 36-220, 36-226 or 36-626.
Prerequisites: 21112 or 21116 or 21120 or 21121

36-295 Independent Study
Fall and Spring: 0-36 units
Statistics majors are given the opportunity to conduct original research under the direction of a faculty member. Students are expected to propose a research topic, design and implement the study, analyze the data, and prepare a written report describing the investigation and results.
Prerequisites: 36201

36-303 Sampling, Survey and Society
Spring: 9 units
This course will revolve around the role of sampling and sample surveys in the context of U.S. society and its institutions. We will examine the evolution of survey taking in the United States in the context of its economic, social and political uses. This will eventually lead to discussions about the accuracy and relevance of survey responses, especially in light of various kinds of nonsampling error. Students will be required to design, implement and analyze a survey sample.
Prerequisites: 36202 or 36208 or 36226 or 36309 or 36625 or 70208 or 73260 or 73261 or 88250

36-309 Experimental Design for Behavioral and Social Sciences
Fall: 9 units
Statistical aspects of the design and analysis of planned experiments are studied in this course. A clear statement of the experimental factors will be emphasized. The design aspect will concentrate on choice of models, sample size and order of experimentation. The analysis phase will cover data collection and computation, especially analysis of variance and will stress the interpretation of results. In addition to a weekly lecture, students will attend a computer lab once a week. Not open to students who have received credit for 36-202.
Prerequisites: 36201 or 36207 or 36217 or 36220 or 36247

36-310 Fundamentals of Statistical Modeling
Spring: 9 units
This course provides a one-semester introduction to the theory of probability and mathematical statistics, suitable as background for more advanced 400-level statistics courses such as 36-401 and 36-402 (Modern Regression and Topics in Data Analysis). The course will emphasize probability models and distribution theory; the practice of statistical inference based on the use of maximum likelihood estimation; and applications of statistical modeling and inference, using case studies drawn from the social, physical and biomedical sciences. The use of a computer software package will be an integral part of this course. Students who have taken 36225 or 36-625 may not receive credit for this course. Students who have taken 73-261 or 73-360 need permission of the instructor.
Prerequisites: (21112 or 21116 or 21121 or 21120) AND (36303 or 36309 or 36247 or 36208 or 36202 or 88250)

36-315 Statistical Graphics and Visualization
Spring: 9 units
Graphical displays of quantitative information take on many forms as they help us understand both data and models. This course will serve to introduce the student to the most common forms of graphical displays and their uses and misuses. Students will learn both how to create these displays and how to understand them. As time permits the course will consider some more advanced graphical methods such as computer-generated animations. Each student will be required to engage in a project using graphical methods to understand data collected from a real scientific or engineering experiment. In addition to two weekly lectures there will be lab sessions where the students learn to use software to aid in the production of appropriate graphical displays.
Prerequisites: 36202 or 36208 or 36226 or 36303 or 36309 or 36625 or 88250

36-350 Data Mining
Fall: 9 units
The course will focus on how to construct hypotheses from a large data set and confirm them statistically. Exploratory methods include discriminant analysis, principal component analysis, projection pursuit, clustering, and nonparametric density estimation. Confirmatory methods include confidence intervals, posterior distributions, and Bayes factors. In addition, students will learn how to think in terms of probabilistic models and use data mining software effectively. Some computer programming required.
Prerequisites: 36226 or 36310 or 36626

36-401 Modern Regression
Fall: 9 units
The material in this course concentrates on methods for the analysis of data. The emphasis is on description, validation, and interpretation. Topics include exploratory data analysis, statistical computing, and regression analysis. Real-world examples will be drawn from engineering and the various physical and social sciences. Students will do projects and write reports. Students who have taken 73-261 or 73-360 need permission of the instructor.
Prerequisites: 36226 or 36310 or 36626

36-402 Advanced Data Analysis
Spring: 9 units
This is a project course in data analysis. Students work in teams on a semester-long data analysis problem. Past projects have been drawn from current research in neuroscience, genetics, finance and psychology. Data analysis requires the application and extension of statistical methods and computing skills learned in 36-401. A key objective of the course is to expose students to the variety of challenges faced by the data analyst. Students research the scientific background of their problem, consult with subject-area scientists, and communicate their methods and results both in writing and in class presentations. At the end of the semester, each team presents a poster of their project at the "Meeting of the Minds" undergraduate research symposium.
Prerequisites: 36401

36-410 Introduction to Probability Modeling
Spring: 9 units
An introductory-level course in stochastic processes. Topics typically include Poisson processes, Markov chains, birth and death processes, random walks, recurrent events, and renewal theory. Examples are drawn from reliability theory, queuing theory, inventory theory, and various applications in the social and physical sciences.
Prerequisites: 36217 or 36225 or 36625

36-461 Topics in Statistics
Fall: 9 units
The format and content of this course are flexible and vary from year to year depending on the instructor and demand. Past topics included statistics and the law, Bayesian statistics, non-parametric statistics, decision theory, biostatistics, and time series analysis. The objective of the course is to expose students to important topics in statistics and/or interesting applications which are not part of the standard undergraduate curriculum.
Prerequisites: 36226 or 36310 or 36626

36-462 Topics in Statistics
Intermittent: 9 units
The format and content of this course are flexible and vary from year to year depending on the instructor and demand. Past topics included statistics and the law, Bayesian statistics, non-
parametric statistics, decision theory, biostatistics, and time series analysis. The objective of the course is to expose students to important topics in statistics and/or interesting applications which are not part of the standard undergraduate curriculum. Prerequisites: 36309 or 36310 or 36626

36-625 Probability and Mathematical Statistics I
Fall: 12 units
This course is a fast-paced, rigorous introduction to the mathematical theory of probability, and statistical inference. It is ideal for students who want a crash-course in probability and mathematical statistics. A good working knowledge of calculus and basic linear algebra is required. Topics include sample spaces, probability, conditional probability, generating functions, sampling distributions, law of large numbers, the central limit theorem, maximum likelihood, the bootstrap, hypothesis testing, Bayesian inference, decision theory. Students studying Computer Science, or considering graduate work in Statistics or Operations Research, should carefully consider taking this course instead of 36-225 after consultation with their advisor. Not open to students who have received credit for 36-217 or 36-225. Prerequisites: 21118 or 21122 or 21123 or 21256

36-626 Probability and Mathematical Statistics II
Spring: 12 units
A continuation of 36-625 emphasizing statistical models and methods. Topics include regression, multivariate models, causal inference, directed graphs, undirected graphs, curve estimation, classification, simulation. Students studying Computer Science should carefully consider taking this course instead of or 36-226 after consultation with their advisor. Prerequisites: 36625

CIT Interdisciplinary Undergraduate Courses

39-200 Business for Engineers
Fall and Spring: 9 units
This course is intended to prepare CIT graduates for the fast paced world of modern industry. There have been paradigm shifts that complicate career selection and compound the difficulty of becoming a productive member of an organization. Graduates of a technical program can benefit from an understanding of modern business concepts when they begin their careers. The content of this course will include both specific financial analysis topics and certain business administration topics such as program management, entrepreneurship and ethics. Students will become familiar with analyzing financial statements, stock market reports and stock options while developing their verbal and written presentation skills.

39-250 CIT Undergraduate Projects
Fall: 0-18 units
This course number is to be used for Fall CIT freshman research projects only. Student must complete a CIT Undergraduate Project Approval form (located in Scaife Hall 110) and submit for approval. The form must include a complete description and a signature approval from the research advisor/instructor. If the project is approved, the CIT Undergraduate Studies Office will add the course to the student's fall schedule.

39-251 CIT Undergraduate Projects
Spring: 0-18 units
This course number is to be used for Spring CIT freshman research projects only. Student must complete a CIT Undergraduate Project Approval form (located in Scaife Hall 110) and submit for approval. The form must include a complete description and a signature approval from the research advisor/instructor. If the project is approved, the CIT Undergraduate Studies Office will add the course to the student's fall schedule.

39-390 CIT Co-Op
All Semesters: 0-3 units
The college of engineering at Carnegie Mellon considers experiential learning opportunities important educational options for its undergraduate students. One such option is cooperative education, which provides a student with an extended period of exposure with a company. Therefore projects can be of significant depth in experience. To participate, students must complete a CIT Co-op Approval form (located in Scaife Hall 110) and submit for approval. Students must possess at least junior status and have an overall grade point average of 3.0 or above. All co-ops must be approximately 8 months in uninterrupted length. If the co-op is approved, the CIT Undergraduate Studies Office will add the course to the student's schedule, and the student will be assessed tuition for 0-3 units. Upon completion of the co-op experience, students must submit a 1-2 page report of their work experience, and a 1-2 page evaluation from the company supervisor to the CIT Undergraduate Office. If the reports are approved, a "P" grade will be assigned. International students should also be authorized by the Office of International Education (OIE). More information regarding CPT is available on OIE's website.

39-405 Engineering Design: The Creation of Products and Process
Fall: 12 units
Introduction of concepts, methods and tools for successful engineering design, providing a fundamental understanding of the design process. Emphasis on the interdisciplinary nature of the design process and on design methods applicable to a broad range of engineering disciplines. Major topics: the design process, current industrial practices, design activities and problem-solving techniques, problem representations, design management and computer-based design environments. Individual or group projects on selected aspects of the design process.

39-499 Summer Curricular Practical Training
Summer: 3 units
The college of engineering at Carnegie Mellon considers experiential learning opportunities important educational options for its undergraduate students. One such option is an internship, normally completed during the summer. Students do not need to officially register for an internship unless they want it listed on their official transcripts. CIT students interested in registering their internship for course credit on their transcript may enroll in this course. To do so, students must complete a CIT Internship form (located in Scaife Hall 110) and submit for approval. The CIT Undergraduate Studies Office will add the course to the student's schedule, and the student will be assessed tuition for 3 units. Upon completion of the internship, students must submit a 1-2 page report of their work experience, and a 1-2 page evaluation from the company supervisor to the CIT Undergraduate Office. After the reports have been reviewed and approved, a "P" grade will be assigned. This process should be used by international students interested in Curricular Practical Training (CPT) or by any other engineering undergraduate wishing to have their internship experience reflected on their official University transcript. International students should also be authorized by the Office of International Education (OIE). More information regarding CPT is available on OIE's website.

39-500 Honors Research Project
All Semesters: 1-36 units
This course, open by invitation only, will provide the opportunity for close interaction with a faculty member through independent research in a number of disciplinary and interdisciplinary areas.

39-600 Integrated Product Development
Fall: 12 units
The IPD course focuses on team-based integrated product development among engineering, business, and design disciplines. The course is open to seniors and graduate students in engineering, industrial and communication design, and MBA students. The course generally has about a dozen students from each discipline. The course consists of four modules including identifying, understanding,
conceptualizing and introducing a product opportunity. In recent years we have partnered with industrial sponsors to address a customer opportunity, resulting in patent applications. The emphasis in the course is on the early, "fuzzy" stage of product development. The course gives structure to these stages and helps direct the process to be more efficient downstream.

Students are expected to produce four phase written and oral reports. At the end of the semester the team will develop a form prototype, function prototype, marketing plan and manufacturing plan for the product. This course has gained an international reputation as a leading course in new product development. Course admission by permission of professor only; all students will be waitlisted until admission decisions are made. Students should contact the professor for an application for the course.

39-606 Engineering Product Design Projects
Spring: 12 units
In this project course students form interdisciplinary teams, each of whose goal is the design of a product. Industry and government (often local) help us to define projects of real interest to them. They also help with their time and financial support. Projects typically run for two semesters. This course can be taken one or two semesters, as their schedules allow. Students must consider many issues for their products — What are the product opportunities? What makes their product special? How must it look and feel? Is it technically legitimate? Can it be manufactured economically? How should it be marketed?

39-647 Special Topics in Design
All Semesters: 3-18 units
This course is to be used for Interdisciplinary Engineering Design Independent Study. It can be added by permission only through collaboration with the student, Independent Study project advisor, and the CIT Dean's Office.

39-648 Rapid Design and Prototyping of Computer Science
Spring: 12 units
This course deals with rapid prototyping, manufacture, and applications of a new generation of wearable computers, with head-mounted display. The design of wearable computers is a multidisciplinary process including: Electronic design, mechanical design, software development, and human-computer interaction. Two classes of wearable computers will be further developed: embedded, custom designed VuMan series, and general purpose Navigator series. Electronic design includes the custom designed computer board, electronic interfacing, and power supply. Industrial designers and mechanical engineers team to design and manufacture with in-house facilities a variety of conformable/lightweight housings. A software development environment and user interface builders support software and application development. Current applications include: Global Position Sensing, Hypertext documents, speech recognition, wireless communications, and digital imaging.

39-650 Special Topics: Sensor Networks
Fall: 3-12 units
This is a project-oriented course with emphasis on the analysis and design of sensor networks. Topics include problem definition, requirements analysis, design, and deployment. Particular attention will be paid to: the management of the strategic and operational impacts of a systems project, systematic and structured methodologies used for system analysis, and the evolutionary and reliability needs of a deployed sensor network. Currently available sensor networks will be overviewed along with the CMU-developed critepr sensor network. This course is open to any student. Prior exposure to computers including a first programming course is important.

Biomedical Engineering
Undergraduate Courses

42-101 Introduction to Biomedical Engineering
Fall and Spring: 12 units
This course will provide exposure to basic biology and engineering problems associated with living systems and health care delivery. Examples will be used to illustrate how basic concepts and tools of science & engineering can be brought to bear in understanding, mimicking and utilizing biological processes. The course will focus on two areas (1) synthesis and integration of molecular and cellular level information for the purpose of understanding function (regulatory circuits, biomaterials, and organs) and designing therapies, and (2) designing information acquisition technology to enable model building and/or diagnosis. Exercises in model building and simulation are required to help students begin to build an integrated understanding of biological systems. Prerequisites: None

42-201 Biomedical Engineering Seminar
Fall and Spring: 3 units
This seminar course introduces students to the applications of technology in medicine and biology. In a one hour weekly meeting, speakers describe real world problems in biotechnology and bioengineering, and their progress toward a solution. Students also have the opportunity to visit laboratories performing state-of-the art research in such areas as biological/medical imaging, musculoskeletal biomechanics, rapid prototyping and manufacturing, and cardiac assist devices. The course acts as an introduction to the physiological and analytical techniques which help students learn to understand the challenges bioengineers face working in these environments.

42-301 Physiology
Fall: 9 units
This course is an introduction to human physiology and includes units on all major organ systems. Particular emphasis is given to the musculoskeletal, cardiovascular, respiratory, digestive, excretory, and endocrine systems. Modules on molecular physiology, tissue engineering and physiological modeling are also included. Due to the close interrelationship between structure and function in biological systems, each functional topic will be introduced through a brief exploration of anatomical structure. Basic physical laws and principles will be explored as they relate to physiologic function. Prerequisite: 03-121 Modern Biology, or permission of instructor.

42-334 Introduction to Computational Biology
Spring: 9 units
This course covers the application of computers to solve problems in biology and medicine. Since computers are increasingly used in biological research, the course is valuable for all biological sciences majors and double majors in biomedical engineering. It is intended for students without computer programming experience. Students with a desire to apply programming methods to these problems should take the more advanced course 42-534 Computational Biology. Topics covered: computational molecular biology (analysis of protein and nucleic acid sequences), biological modeling and simulation (including computer models of neuron behavior, biochemical kinetics, and simulation of mutation), and biological imaging. Course work consists primarily of homework assignments making use of software packages for these applications. Also known as 03-310. Prerequisites: (21-118 or 21-121) AND 03-121 AND (99-101 or 99-102 or 99-103), or permission of instructor. Prerequisites: (21118 or 21112) AND 03121 AND (99101 or 99102 or 99103)

42-377 Rehabilitation Engineering
Fall: 12 units
Rehabilitation engineering involves the application of engineering sciences to design, develop, adapt, and apply assistive technologies to problems confronted by individuals with disabilities in functional areas, such as mobility, communications, hearing, vision, and cognition, and
in activities associated with employment, independent living, education, and integration into the community. It differs from classical biomedical engineering by its focus on improving the quality of people’s lives, rather than improving their medical treatment. This course will require participation in simulations of disabilities and projects to develop new technologies. No textbook is required.

Prerequisite: Physiology

42-401 BME Design
Spring: 12 units

The Biomedical Engineering Design course focuses on integrated product development for biomedical products. Teams will consist of a variety of BME engineering students. The course consists of four modules including identifying, understanding, conceptualizing and realizing a product opportunity. All products developed will respond to the needs of appropriate market segments; resulting products will be deemed useful, usable and desirable by those segments.

Students develop a formal model, functional prototype, marketing plan, and manufacturing plan of their product. Prerequisite: BME Double Major Senior status.

42-501 Special Topics
Fall: 9-12 units

Description: The course will include a description of the micro- and macro-anatomy of bone, its embryology, and wound healing. Traditional bone grafting materials will be discussed and reviewed and presented with clinical challenges. In vitro methods and animal wound models will be discussed for designing and developing bone regeneration therapies. Pertinent literature articles will be reviewed and grant writing will be discussed, using the NIH R01 format.

Prerequisites: 42-301 Physiology OR 42-735 Physiology, 42-101 Introduction to Biomedical Engineering (42-101) will be useful. Also known as 06-905.

42-502 Special Topics: Cellular Biomechanics
Spring: 9 units

This course discusses how mechanical quantities and processes such as force, motion, and deformation influence cell behavior and function, with a focus on the connection between mechanics and biochemistry. Specific topics include: (1) the role of stresses in the cytoskeleton dynamics as related to cell growth, spreading, motility, and adhesion; (2) the generation of force and motion by motor molecules; (3) stretch-activated ion channels; (4) protein and DNA deformation; (5) mechanoechemical coupling in signal transduction; (6) protein trafficking and secretion; and (7) the effects of mechanical forces on gene expression. Emphasis is placed on the biomechanics issues at the cellular and molecular levels; their clinical and engineering implications are elucidated. Also known as 24-759.

42-503 Special Projects: Biomedical Image Analysis
Fall and Spring: 12 units

This course will cover state-of-the-art signal processing techniques, especially those based on wavelets and related developments. Wavelets unite brilliant theory, efficient algorithms and successful applications. The stress will be on biomedical and communications systems. The students will be expected to complete an independent project during the course. Prerequisites: 18-791 Digital Signal Processing, or permission of the instructor. Also known as 18-797.

42-504 Special Topics: Biomaterial Interfaces
Spring: 12 units

This course will address basic and applied concepts of metals and ceramics as biomaterials. The students will be exposed to the principles, properties and applications of amorphous and crystalline inorganic and metallic systems for biological applications. Specific emphasis will be placed on biodegradation mechanisms, mechanical properties and surface chemistry of polymeric materials. Cellular interactions with various surfaces and immunological responses will be covered. Applications of biomaterials to be discussed include tissue engineering and artificial organs. Part II of this course is offered in the fall and the focus will be on the principles, properties and applications of ceramics and metals as biomaterials. Prerequisites: None, but 09-105 Introduction to Modern Chemistry and 42-101 Introduction to Biomedical and Health Engineering will be useful. Also known as 27-510.

42-511 Biomaterials II
Fall: 9 units

The course addresses basic and applied concepts of metals and ceramics as biomaterials. The students will be exposed to the principles, properties and applications of amorphous and crystalline inorganic and metallic systems for biological applications. Specific emphasis will be placed on processing biochemical activity, biodegradation mechanisms, and various properties relevant for biological response. Cellular interactions with various surfaces and immunological responses will also be covered. Applications of biomaterials to be discussed include tissue engineering and artificial organs. Cellular interactions with various surfaces and immunological responses will also be covered. Applications of biomaterials to be discussed include tissue engineering, artificial implants and devices. Part I of this course is offered in the Spring and focuses on the principles, properties and applications of polymers as biomaterials. Prerequisites: None, but 09-105 Introduction to Modern Chemistry and 42-101 Introduction to Biomedical Engineering will be useful. Also known as 27-511.

42-560 Undergraduate Projects
Fall and Spring: 6-12 units

Students elect to do a Biomedical Engineering project for credit either with a CMU faculty member, a faculty member of the University of Pittsburgh School of Medicine, or researcher at a hospital. If the student does a project off-campus, the student must have a Carnegie Mellon faculty member co-advising the project. Arrangements are made with Hilda Diamond, Associate Director. Units vary from 9 units to 12 units.

42-604 Biological Transport
Spring: 9 units

Analysis of transport phenomena in life processes on the molecular, cellular, organ, and organism levels. Material covered: Fick's Laws; electrolyte diffusion; coupled diffusion and chemical reaction; membrane transport mechanisms; osmosis; Donnan equilibrium; receptor-mediated binding; lateral diffusion in membranes and reduction of dimensionality; ultra filtration and nephron function; compartmental modeling; pharmacokinetics. Prerequisites: Ordinary differential equations.

42-621 Biotechnology and Environmental Processes
Fall: 9 units

This course has two sections: The first half of the course covers microbial physiology and metabolism, fermentation and restoration, metabolic regulation, bioconversions, recombinant DNA methodology and gene cloning. The second half of the course covers separation and purification, kinetics, and design of biological reactors, mass transfer limitations within cell suspensions, and control of fermentation processes. This course meets concurrently with 42-721/06-721. Prerequisites: 03-121 Modern Biology OR 03-231/03-232 Biochemistry AND 06-262 Math. Methods of Chemical Engineering OR 21-260 Differential Equations OR permission of instructor.

42-622 Bioprocess Design
Spring: 9 units

This course is designed to link concepts of cell culture, bioseparations, formulation and delivery together for the commercial production and use of biologically-based pharmaceuticals; products considered...
Course Descriptions

include proteins, nucleic acids, and fermentation-derived fine chemicals. Associated regulatory issues and biotechnology industry case studies are also included. The format of the course is a mixture of equal parts lecture, open discussion, and participant presentation. Course work consists of team-oriented problem sets of an open-ended nature and individual-oriented industry case studies. The goals of the course work are to build an integrated technical knowledge base of the manufacture of biologically based pharmaceuticals and U.S. biotechnology industry. Working knowledge of cell culture and modern biology, biochemistry and differential equations is assumed. The course meets concurrently with 42-722/06-722. Pre-requisite: 42-621/06-621 Biotechnology and Environmental Processes or permission of instructor. Useful, but not required, background in 03-231 Biochemistry I. Prerequisites:

42-644 Medical Devices
Spring: 9-12 units
This course is an introduction to the engineering, clinical, legal and regulatory aspects of medical device performance and failure. Topics covered include phenomenological and mechanistic descriptions of processes such as wear, corrosion fatigue, fretting, in addition to the characterization of bone and other biological materials as it relates to device performance requirements including biocompatibility. The course also involves case studies of orthopedic fixation devices and prostheses, pacemakers, heart valves and artificial organs. A portion of the course is a final design project which involves the design of a new medical device or the redesign of an existing device. Prerequisites: Junior or Senior status.

42-652 Introduction to Biomechanics
Spring: 9 units
This course provides a general survey of the application of solid mechanics and rigid body dynamics to the study of the human cardiovascular and musculoskeletal systems. The mechanical properties and behavior of heart, blood vessel, bone, muscle and connective tissues are discussed and methods for the analysis of human motion are developed. Both analytic and experimental results are presented through readings from reports in recent journals and the relevance of these results to the solution of unsolved problems is highlighted. The development of appropriate models for particular problems is also considered. Prerequisites: 21-260 Differential Equations; 24-263 Mechanics of Materials OR permission of instructor. Useful, but not required: 24-141 Statics and Dynamics and 24-202 Mechanics of Deformable Solids. Course offered if a minimum of students sign up for the course. Prerequisites: 21260

42-723 Biological Processes in Environmental Systems
Spring: 12 units
42-723 is a 12 credit course that presents the theory of microbiological processes relevant to environmental systems. Fundamental microbiology, kinetics of suspended growth and fixed film systems, and processes in environmental biotechnology are the major topics. The microbiological theory presented is applicable to biological processes engineered and natural systems. The major applications discussed in this course focus on pollution prevention and waste water treatment including: activated sludge, biofilm processes, tertiary nutrient removal and methanogenesis. While applications in this course focus on traditional environmental engineering and wastewater treatment, the fundamental model development for suspended and attached growth is directly applicable to large scale bioprocesses in many fields. The textbook is Rittmann and McCarty (2001). If you have any questions or want more details, please feel free to contact Dr. Jeanne VanBriesen (jeanne@andrew.cmu.edu) Also known as 12-723.

42-735 Physiology
Fall: 9-12 units
This course is an introduction to human physiology and includes units on all major organ systems. Particular emphasis is given to the musculoskeletal, cardiovascular, respiratory, digestive, excretory, and endocrine systems. Modules on molecular physiology tissue engineering and physiological modeling are also included. Due to the close interrelationship between structure and function in biological systems, each functional topic will be introduced through a brief exploration of anatomical structure. Basic physical laws and principles will be explored as they relate to physiologic function. If taken at the graduate level, additional work is assigned by the instructor. Pre-requisite: 03-121 Modern Biology, or 03-231/03-232 Biochemistry, or permission of instructor.

42-801 Biomedical Engineering Seminar
Fall and Spring: 0 units
Graduate Seminar, 0 units

42-882 Directed Study
All Semesters: 9-48 units
Students work with a faculty member affiliated with the Program at the University. Emphasizing resourcefulness and initiative, the students with their advisors evolve a project with both research and development aspects. Pre-requisite: Consent of advisor. Variable units.
Architecture

Undergraduate Courses

48-095 | Architecture for Non-Majors
Fall and Spring: 9 units

This course serves as an architectural appreciation course for students from other disciplines. The course is dedicated to understanding historical, technological, and social forces that shape contemporary architecture. A large portion of the course is focused on the actual studio experience that architecture students undertake. Form-making, problem solving, and visual literacy are explored through discussions and a variety of drawing and three-dimensional exercises. Students are encouraged to explore their own areas of interest with respect to their work in class.

The course will consist primarily of design and drawing exercises augmented by contemporary history and theory discussions based upon readings and slide presentations. In addition, students will visit a significant work of architecture in the region and in architecture firms. The student will complete a small non-residential architectural project that will integrate previous exercises. No prior architectural, engineering or artistic experience is required. Students are expected to perform work (readings, drawings and model building) both inside and outside of class. Students should be prepared to purchase various drawing and model making supplies throughout the course. This course fulfills requirements for an Architectural Minor.

48-100 | Architecture Design Studio: Methods and Transformations in Form
Fall: 12 Units

The intent of studio is to provide a conceptual understanding of architecture without the necessity of talking through buildings. Emphasis is placed on the teasing out or the discovery of architecture (as opposed to architecture) inherent in systems of both landscape environments and natural form, and the infrastructures. Focus is placed not so much in the observation of the autonomous object but rather the sets of relationships and elements at work, between and contained within objects and systems.

The semester is divided into two halves: The first half of the semester is devoted to observations and formal manipulation of systems from natural specimens. You will document, diagram, and map out these systems initially, also taking note of spatial/temporal qualities of natural systems. The design process then shifts into methods of transformation to turn these observed systems into dynamic systems of architectural syntax that you are formally authoring. Similarly, the second half of the semester is devoted to observations of specific landscape environments. You are asked to quantitatively map elements and relationships between elements that begin to define the use and ambient qualities of the environment (movement, light, etc.). You are then given a program to be adapted to these environments using mappings as a formal design catalyst.

48-105 | Architecture Design Studio: Methods and Transformations in Space
Spring: 12 units

The spring semester, "methods and transformations in SPACE" of the first year architecture program extends from experiences in the fall semester "methods and transformations in FORM." Architecture as a spatial practice is introduced. Design projects evolve from previous studies of STRUCTURE SURFACE and VOLUME in plant and landscape paradigms. SYSTEMS and SEQUENCES previously explored in NATURE will be developed in CULTURAL contexts through a progressive series of projects. Spatial/temporal experiences and "narratives" are created by mapping human behavior and studying precedents. Architectural and interdisciplinary analyses launch each project as a vehicle for generative design strategies. Design methods and process are made explicit. Fluid connections between drawing (freehand and drafted) and modeling (physical, computer, and shop) are continued. Prerequisite: 48-100

48-120 | Introduction To Digital Media I (IDM I)
Fall: 6 units

It's been said that the architect's product is not the physical building but the drawings and imagery describing the architecture. The computer affords a unique environment for the generation of these data sets. As incoming students' inherent familiarity with computers increases concurrent with Moore's Law, academia's responsibility to the evolution of digital tools and their integration into standard curricula must follow suit.

The goal of CM1 / IDM is to familiarize first year students with the use of 2D and 3D digital processes to manufacture conceptually saturated designs. By fusing the potential of digital design methods with traditional studio environments, the opportunity for more direct relationships between design and execution will emerge. Creating an atmosphere in the design studio in which all tools (analog or digital) are exploited allows the student to move beyond the fetishization of the medium and into the digital dialog. Our goal is to understand that 'drawing' is not an exclusive term signifying pencil and paper; it is a dynamic term that has morphed throughout the years.

The most recent paradigmatic shift has been its digitization. Integral to this pedagogical stance is the positioning of IDM within the studio curriculum. Whereas previous methods separated the digital component from the design studio, the syllabi of IDM and the design studio have been carefully synchronized to address parallel issues. In this way, the disconnect between the pedagogy of analog design processes and the use of the computer will be eliminated.

48-125 | Introduction to Digital Media II (IDM II)
Spring: 6 units

"The impact of new technologies on architecture is formidable. As architects today, we are compelled to work on many fronts simultaneously. Space, be it physical or virtual - alarmingly indistinguishable at times - is being redefined despite the context and boundaries of the actual site. Whether on the Web or within an existing structure, the notion of fluid form, materiality and the architect to possess an omnipotent view of the spectrum of possibilities afforded by the digital medium." 1

1. Hani Rashid

"Animation is a term that differs from, but is often confused with, mappings while motion implies movement and action, animation implies the evolution of a form and its shaping forces; it suggests animalism, animism, growth, actuation, vitality and virtuality. In its manifold implications, animation touches on many of architecture's most deeply embedded assumptions about its structure." 2


Prerequisite: 48-120

48-130 | Architectural Drawing I: A Tactile Foundation
Fall: 6 units

Architectural Drawing I is the introductory course in a sequence of three drawing courses required by the School of Architecture for its professional degree program. It consists of exercises in free-hand perspective and general life-drawing, focusing on volume, contour, and mass. Topics are introduced through figure drawing and lecture demonstrations and subsequently applied to architectural subjects. Work is submitted in three portfolio submissions of approximately four weeks duration each. This course is open to other disciplines.

48-135 | Architectural Drawing II: Understanding Appearance
Spring: 9 units

Architectural Drawing II is a studio course that builds upon the free-hand drawing experience within 48-130 (or 48-132) Architectural Drawing I. It is aimed at building students' knowledge of the appearance and representation of architecture in light. Coursework includes free-hand and constructed perspective, shade and shadow construction, chiaroscuro drawing of surface illumination on objects and interiors, and color pastel drawings of interior and exterior conditions. Topics are introduced through lecture demonstrations and in-class exercises with subsequent application to architectural subjects. Work is submitted in three portfolio submissions of approximately five weeks each. Consistent with the nine units credited to the class, students can expect to spend nine hours per week on in-class and outside of class work. Three hours of out of class work per week is the norm.

48-200 | Architecture Design Studio: Composition
Fall: 18 units

This studio is an introduction to architectural language and composition stressing concept generation and development, design process, and spatial experience. Understanding the compositional principles which characterize the buildings of the past is foremost, and the unique creative environment in the design studio are the central thrusts of this studio. Building on the 1st year studios that explored "Methods & Transformations
in Form & Space," the studios in the 2nd year will explore design problems that investigate the complexity and integrated nature of the architectural object and the architectural design process. We will explore the artistic, conceptual, poetic, creative, and experiential side of architecture as a way of developing ideas on architectural composition. By becoming and remaining conscious about the process that is architectural design, and developing methods, parameters and alternatives that shape architectural form, we will experiment with a variety of techniques such as conventions, perception, experience, and representation. Each of the four studios will approach the theme of composition differently, but all students are expected to explore a broad spectrum of design strategies at every opportunity. Prerequisite: 48-105

48-205 | Architecture Design Studio: Materials Spring: 18 units
This studio is concerned with more in-depth understanding and detailing for small scale buildings informed by the technical knowledge related to the act of construction. The creative opportunities and design implications of using varied materials, structural systems, and assembly techniques are elaborated. The studio will focus on the application and integration of knowledge acquired in the parallel "Materials & Assembly" course. Prerequisite: 48-200

48-210 | Statics Fall: 9 units
This course will cover vector mechanics, forces and moments, equilibrium of rigid bodies, reactions, internal forces on free bodies, analysis of simple beams and trusses, stress and strain, elasticity, bending and shear stresses, and beam design. Material is taken directly from the required texts, which present the scientific background of each concept accompanied by numerous examples. The lectures, texts, readings, problem sets, and examinations will cover the material thoroughly. Students master the material by completing weekly problem sets. The prerequisites for this course are calculus and physics.

48-215 | Materials and Assemblies Spring: 9 units
The fourth semester of architectural studies is concerned with the detailed development and refinement of architectural design as informed by the technical and aesthetic knowledge related to the meaning and usage of materials and the act of construction. This course focuses on the principles of building construction utilizing contemporary systems. Materials and Assembly, taught in parallel with the design studio and with Structures I, allows in-depth examination of the essentials of contemporary construction systems, while the studio provides a simultaneous setting for the application of this knowledge. The materials science content of the course examines construction materials with regard to their process of manufacture, their physical properties, their environmental performance and their methods of selection and specification. The assembly content of this course examines the selection, design, preliminary sizing and methodology of construction systems in wood, masonry, steel, site-cast concrete and pre-cast concrete, including the applicable fundamentals of enclosure systems.

48-217 | Structures I Spring: 9 units
This course treats topics of structural behavior and member design, including loads, materials, internal stress, beams, columns, trusses, frames, cables, arches, grids, shells, membranes, and space frames. The goal of synthesizing complete structures with basic structural subsystems is also introduced. Emphasis is placed on continuity with the analytical established in the Statics course, 48-210. Prerequisite: 48-210 or 12-207

48-230 | Architectural Drawing III: Perspective Fall: 9 units
This is a studio course which emphasizes free-hand drawing in general and free-hand perspective techniques in particular. Understandings of perspective are developed first in figure drawing exercises and then transferred to drawings of buildings and other architectonic objects. A key, if somewhat contradictory, objective of the course is that drawings retain a compelling gestural life even as it attains geometric control.

48-240 | Architectural History I: Historical Survey of World Architecture and Urbanism Fall: 9 units
Reflecting the inseparable relation between building and human needs, this course is not only a history of architecture, but also a history through architecture. The design, use, meaning and legacy of a building is conditioned not only by the architect's will or the patron's desire, but also by a complex web of technological, social, cultural, economic, and political factors of the time. This course examines world architecture and urbanism from prehistoric times through the 20th century, including the built environment of Europe, the Middle East, Asia, and the Americas.

48-300 | Architecture Design Studio: Site Fall: 18 units
The subjects of this semester are the reciprocal orders of buildings and landscapes and the development of the building site. The work builds on knowledge gained in prerequisite and co-requisite courses including 48-317 Site Engineering and Field嘻嘻嘻!
of the western civilization in the late 19th century. It begins with a look at the crisis of modernity that plagued most countries, primarily on Europe but extending also to non-western countries. and literature of the first half of the twentieth century, focusing on major movements of both the avant-garde and other discuss formal tendencies, theoretical issues, and social & cultural influences that led to the development of most importantly, occupied space. We will quickly review basic precepts of psychology to understand biases in how we analyze existing environmental needs for people, and in how we judge the quality of space. The class will develop a research question and begin to test it in field research using observation, interviews, and surveys. And in the second half of the semester, from these findings, we will draw conclusions about the quality of a space and place, but also how one might improve it. Assignments will be geared to individual work and occasionally for small groups of students. There will be an emphasis on field investigations and understanding research methods for applications in practice. Students from other disciplines are encouraged to enroll.

48-400 | Architecture Design Studio: Occupancy Fall: 18 units
The premise of this studio is that under certain conditions individuals and group behaviors can be accurately predicted. Examining the psychological perceptual and physical factors that effect building design, the course develops an understanding of relevant methods of observation. Through this understanding and the design process it considers the building program with respect to characteristics of occupancy: building typology, human factors, and regulatory codes. Typical projects include: courthouse, specialized-use medical-care facility, academic library, and other institutional buildings. Prerequisites: 48-305

48-405 | Architecture Design Studio: Systems Integration Spring: 18 units
This studio examines the complex interrelationships between performance criteria, building subsystems and their integration, specification, evaluation, and the design of complex buildings. This studio is concerned with the detailed design development relating to the spatial, visual, acoustic and thermal performance of buildings as well as the long-term integrity of the integrated systems. The focus of the studio is the design integration of at least two building systems and their interdisciplinary objectives - structure, enclosure, interior, mechanical, and the safety systems - addressing the issues of constructability and technical innovation. Prerequisites: 48-412; Corequisite: 48-415

48-410 | Environment II: Acoustics and Light Fall: 9 units
This course introduces theoretical foundations and computational methods in architectural acoustics and lighting. Topics in acoustics include: review of physiological and psychological acoustics, computation of outdoor and indoor airborne sound propagation, interaction of air-borne and structure-borne sound with building structures, sound transmission between rooms, design methods in room and building acoustics, fundamentals of vibration control, and the application of computer-aided simulation tools in building and room acoustics.

Topics in lighting include: review of visual comfort criteria and lighting psychology, analytical and numeric methods for the computation of lighting conditions in interior spaces, application of computer-aided lighting simulation tools in architecture, and lighting engineering and design methods.

48-412 | Environment III: Mechanical Systems Fall: 9 units
An investigation of heating ventilating and air conditioning systems including:

1) system selection;
2) study of the basic systems available for residential, commercial and industrial buildings;
3) of design selection and equipment;
4) heat loss and gain calculations;
5) duct and piping design;
6) basic comfort provided by various systems;
7) available products;
8) their purchase and operating costs.

The course develops: knowledge of the vocabulary of the industry; knowledge of the size and function of equipment. The course includes field trips to see various systems in operation as well as discussions with suppliers. Readings are supplemented with design systems, tests, and development of a reference notebook.
48-415 | Advanced Building Systems  
Spring: 9 units  
This course introduces the concept of Total Building Performance, delineating the full range of performance mandates required for today's architecture, including building integrity, thermal quality, acoustic quality, visual quality, air quality, spatial quality, and building integrity. The course highlights the state-of-the-art and major innovations in building technologies for structure, environment, mechanical, telecommunications, lighting, and interior systems. The course will explore the relationships, opportunities, and conflicts of the performance mandates, and development of building systems necessary to achieve total building performance. Through this course, students should be able to bring leadership to multi-disciplinary design processes, towards creating high-performance buildings.

48-439 | History and Preservation  
Spring: 9 units  
This course investigates issues in historic preservation from a variety of historical, theoretical, and practical view points. Through intensive reading, class discussion, invited speaker and field travel, we will explore, discuss and write about such topics as: The Role of Preservation and Preservationists, Designating and Documenting Historic Structures, Interpreting History in Historic Houses, Villages, and City History Museums, Historic Preservation and Urban Renewal 1) Main Street Manager Program, Preservation and the Architect, and Staged History and Cultural Tourism.

48-440 | The American Built Environment To 1860  
Fall: 9 units  
This course examines the history of the American built environment from approximately 1000 through 1860. In addition to establishing the evolution of stylistic properties in architecture, we will be examining regional patterns in settlement and building, the use of building technologies, the architecture of a variety of social groups including Native American and immigrant cultures, the design of urban, suburban, and rural landscapes, the rise of the architect, the role of the client, and the relationship among high-style, vernacular, and popular traditions. The built environment will be analyzed both as an artifact and as a signifier of broader social, cultural, and economic trends in America.
Prerequisite: 48-240

48-441 | Frank Lloyd Wright and his Times  
Spring: 9 units  
This architectural history seminar investigates the career, context, and legacies of the famous American architect Frank Lloyd Wright. We will attempt to understand the great variety of work and ideas produced by Wright over seven decades, as well as the context in which the architect lived and worked. The seminar will focus on two main areas: 1) Wright’s buildings and projects; 2) the concept of organic architecture; 3) the historical and intellectual climate that gave rise to FLW’s work; 4) investigations of Wright's progressive clients, innovative use of building materials, changing design theories, invented building systems, radical social & political theories, broad urban experiments, and publishing prowess; 5) the influences Wright had on modern architecture worldwide, especially the tremendous influence he had in America through his own buildings, writings and lectures, as well as some 1200 disciples he trained through his Taliesin Fellowship.

48-448 | History of Sustainable Architecture  
Fall: 9 units  
While the Modern Age has created a view of nature as separate from the built environment, relatively recent advances in theory and practice of environmentally conscientious or sustainable architecture have led architects and other designers to think otherwise. Architecture separate from environmental considerations is a luxury that we can’t afford and shouldn’t desire. In fact, architecture separate from nature is an unusual outlook specific to the Industrial Revolution and its consequences: industrialization, rich, disparate and changing concepts of nature were fundamental elements in understanding the both the theory and practice of building. Furthermore, even though many Modernist historians have proposed the factory and the machine as ideal models for building, some critics and detractors in architecture, landscape design and city planning even during the era of industrialization have frequently provided counterpoint or direct social protest to the despoiled cities and landscapes that have too often been the by-products of the industrial mindset.

The purpose of the History of Sustainable Architecture is to examine designs and contexts created either before or in response to the Industrial Revolution that productively inform today's renewed efforts to build with minimal impact of the natural environment. Materials will be drawn from ancient Rome, Renaissance Italy, Enlightenment France, nineteenth century Germany, England and Italy, as well as numerous twentieth and twenty-first century examples.

48-452 | Design Economics  
Fall: 9 units  
This course investigates the feasibility of an architectural project, focusing on financial, cost and design considerations. Its primary objective is twofold: to provide students with quantitative skills for political, economic, and social interests of their design decisions and to foster development of a critical perspective in making these decisions. The need for economic analysis to develop concurrently with design is emphasized throughout the course. Topics include site selection, building design, construction cost estimation, and real estate finance.

48-453 | Urban Design  
Spring: 9 units  
This seminar will explore urban design as a discipline within the profession of architecture as a result of the continuing evolution of our cities. This seminar title, Felicity/city, is intended as a general expression of the goal of urban designers: the evolution of the good city in which the inhabitants are happy as individuals in relation to their environment and society; in which the spaces and places are appropriate in specifically local, physical, and cultural terms; in which social interrelationships are based on traditions that are at once historical and aspirational; and in which civic pride is related to a language of local beauty.

48-500 | Architecture Design Studio: The Urban Laboratory  
Fall: 18 units  
The fifth year urban laboratory takes the optimistic view that the work of the architect derives its significance from interaction with the society at large. The competing and even contradictory pressures of political, economic, and social interests are welcomed as the true source of complexity in architecture. This studio focus on comprehensive urban design and architectural intervention in Pittsburgh as a laboratory, in light of the rich historical, contextual, economic, and political factors affecting its form. The studio employs a multi-disciplinary team structure to characterize and explore the opportunities for urban rejuvenation and sustainability. Students from the Heinz School of Public Policy and Management collaborate with architecture students to develop architectural plans and policy plans to foster development in blighted neighborhoods within Pittsburgh.
Prerequisite: 48-405

48-505 | Studio X: Design in the Urban Context  
Spring: 18 units  
This studio focuses on changing projects presented by fifth year students. The goal of the studio is to take a project from a contextual beginning to a fully explored and detailed conclusion. Evidence and application of knowledge gained through other studios and courses is required in the design resolution and presentation.
Prerequisite: 48-500

48-550 | Issues of Practice  
Fall: 9 units  
This course examines the practice of Architecture in light of the legal and ethical responsibilities of the Architect. It analyzes the management of the Architects office as required to provide the services that must be performed to produce a quality product for the client and an adequate income for the Architect. Students work with firms to develop a case study that documents the building process from inception to completion. These case studies are a model for a national case studies program, supported by the AIA. In addition, students learn how to market themselves, creating a quality Package including a resume, cover letter and portfolio.

48-551 | Ethics and Decision Making in Architecture  
Spring: 9 units  
This course is an introduction to decision-making methods in architecture design. It aims to develop an understanding of concepts of decision-making in architectural design rational
methods and their use in architecture problems, and the relationship of computing and immersive (heme-based) interactive virtual worlds. The goal of the course is to take students with varying talents, backgrounds, and perspectives and put them together to work. They couldn't do it alone. The key thing is that there are no "idea people" in the course; everyone must have a role in the mechanical creation of the worlds. Students use Discreet's 3d max and Right Hemisphere's software to create the interaction. Note that we don't try to teach everyone to program, or engineers to paint; we form teams where different worlds. Students use Discreet's 3D Studio MAX and Right Hemisphere's software. This course covers underlying geographic concepts (world coordinate system and projections, vector map files,就不对 layered maps, standard computer map file formats, urban applications, etc.) and provides computer lab tutorials and case studies on the leading GIS software, ArcView 3.2 from Environmental Systems Research Institute, CAFM (Computer Aided Facilities Management) facilitates problem solving techniques using CAD and CAFM software address both analytical and spatial information. Relational databases illustrate how departments in an organization share data to actively create accurate and up-to-date reports. Hypertext links between software applications will show how data can be stored and retrieved in different formats accessible to everyone. EIS (Executive Information Systems) and data/drawing access play an important role in the course.
Moreover, the design of the integrated systems can contribute to enhanced sustainability through material, energy and water conservation, enhanced environmental quality and even energy generation. In this course, students will identify, design, develop and mock-up robust, integrated solutions for external modular service cores that address persistent demands in existing and new construction. After conducting product reviews and field studies, students will develop performance specifications and design variations for components and integrated assemblies. The students will take the best design solutions for modular, plug and play, and sustainable stacking infrastructures into final documentation. The integrated kit-of-parts will be based on specification, visualization and mock-ups capable of inspiring the manufacturing community to market new high performance integrated solutions.

This course is intended for upper level undergraduate and graduate students with strong understanding of systems and 3D visualizing capabilities.

48-592 | Construction Drawings, Details and Prototypes
Fall: 9 units
This elective course will expand upon the basic principles of architectural detailing from 48.215, Materials and Assembly and proceed to the development of working drawings as per the standards of the AIA and the Construction Specifications Institute. During the first two thirds of the class, students will finalize the design and develop a full set of working drawings for the Pittsburgh Synergy Solar Decathlon House. The last third of the course will be dedicated to constructing prototypes of various systems and components of the house at appropriate scales.

48-595 | Under the Influence: Architecture and Art
Spring: 9 units
Today, many of the world’s leading architects cite art and cinema and other cross-disciplinary factors among their most significant influences. Rather than basing their successful architectural practices on narrowly focused foundations, these architects boldly cross borders into the worlds of music, fashion, photography, film, art. New York architects Scarfido & Diller reference Marcel Duchamp, Rem Koolhaas designs for Prada, Peter Eisenman has acknowledged the writings of conceptual artist Robert Morris among others, and Bernard Tschumi has based building designs on the editing principles of Sergei Eisenstein.

The list goes on.

At the same time, many contemporary filmmakers and artists look to architecture for their conceptual framework. Why are these artists and architects looking outside of their disciplines to cross over into each others worlds for direction? What are they learning and how are they applying their discoveries? What can we learn from these leading figures and how can we ourselves begin to cross borders to develop new working methods approaches that will advance our own professional and creative processes? These are some of the questions that “Under the Influence: Architecture and Art” will address.

Meeting one evening per week for three hours, “Under the Influence: Architecture and Art” will present a series of themes illustrated by relevant architects, artists and films. Classes will feature presentations, discussions, and the viewing of relevant films and videos. Students will be asked to write short (one-page) responses each week and participate actively in class discussions. Selected theoretical writings will supplement many of the presentations.

### Design

#### Undergraduate Courses

**51-101 Design Studio I**

*Fall: 9 units*

This studio course introduces students to the fundamentals of two- and three-dimensional design. Through a wide range of exercises and projects students explore what it means to communicate with form and images. The course will cover the use of visual and physical elements in design, with emphasis placed on idea and form development, visual organization, construction, understanding materials, and considering how people draw meaning from form.

**51-102 Design Studio II**

*Spring: 9 units*

This course is designed to provide a series of experiences that prepare students for a major in Industrial or Communication Design. Through the exploration of form and content students begin to develop their abilities to design in more complex social situations. This course seeks to develop perceptions and understanding of interpretation of design problems. Students work in groups and as individual teams to develop an understanding of design process. Student evaluation is based on faculty critique of projects at different stages of development in a studio setting, with the participation of students. 

Prerequisites: 51101

**51-121 Design Drawing I**

*Fall: 9 units*

Drawing is an essential tool that designers use to communicate, develop, and test their ideas. This basic drawing course is designed to introduce students to a variety of drawing approaches related to the design process. Students learn methods of representation, communication, idea generation, and form development. A sequential approach to the understanding of structure, form, space and the effects of light through the use of line, tone and texture will be stressed. Students will be introduced to a variety of simple drawing media. Drawing in this context is viewed as a means of design thinking, with emphasis placed on the analysis and interpretation of existing man-made and organic forms. Demonstrations and group and individual critiques augment concepts presented in class.

**51-122 Design Drawing II**

*Spring: 9 units*

This course introduces drawing systems and diagrammatic conventions while further developing the principles covered in Design Drawing I. Exploration, analysis, refinement and communication of design concepts are the main issues covered in this course. Perspective systems and diagramming are used to understand, communicate and express various forms of information. Projects reinforce hand sketching and provide the basis for introduction to more complex drawing media. Demonstrations and group and individual critiques reinforce concepts presented in class. 

Prerequisites: 51121

**51-132 Introduction to Photographic Design**

*Spring: 9 units*

Introduction to photography for designers through slidemaking. Using color slide film, students learn how to extend their ‘seeing’ with the slide camera, both in the world and in a shooting studio. Through shooting assignments in the world we will see how photography is another means of image-making for designers who need to know how to read photographs as well as how to make them. In the shooting studio, students will learn basic documentation skills and how to make slide
assignments in and out of the studio, critiques, and library research. Photographs effectively communicate information. Shooting scientific, fine art-to gain an overview of the medium and learn how existing photographic imagery, e.g. documentary, advertising, addition to making photographs, we will look at different kinds of portfolios of their two-dimensional and three-dimensional work. In

Prerequisites: 51101

51-171 Human Experience in Design
Fall: 9 units
This course introduces the central theme of design and the design professions: the importance of human beings in all aspects of design thinking and practice. We will begin by exploring design and the human dimension, discussing the nature of human beings and their physical, psychological, and spiritual or cultural needs. Then, we will consider the role of human beings in the design process, exploring how designers respond to human needs and issues of value. Finally, we will discuss the scope of design in our personal, social, and cultural environment, observing how thoroughly design has permeated our lives through images, physical objects, services, and environmental systems, extending even to a profound impact on the ecological system of the planet. This is the first course in the Design Studies sequence of the department. Lectures, discussions, and written assignments, with readings and extensive visual materials. Required for all design majors.

51-174 History of Objects & Images
Spring: 9 units
History of Objects and Images The primary goal of this course is to give students an introduction to the evolution of human designed objects and images and their connection to the development of different cultures around the world. This course will build on the awareness developed in Human Experience in Design and create a basis for the Design History Course sequence in the second year. It is important to give design students the same sense of heritage in the development of objects and images that art students learn in art history courses. The current design history sequence in the School of Design covers the period between 1800 and 2000. This course will emphasize the development of pre-modern objects and images and the cultural ideas that influenced them. The second major theme in this course is a better understanding of the global dimension of the development of objects and images. This course will extend the idea of SET (Social, Economic and Technical) factors introduced in design history and give students an understanding of how different cultures throughout history made distinct donations to the development of communication, visualization and tools for work, war and everyday life.

51-201 Basic Typography Communication Design I
Fall: 9 units
This is the first studio for students in the communication design program. Students explore the fundamental principles of typography, where type is regarded as an image that serves a variety of communicative purposes. Projects allow students to explore issues of form and meaning, hierarchy, legibility and readability, structure and composition, and the design process. While typography is a highly focused branch of communication design, this introduction to type as image serves to open a path for students to study all facets of communication design in subsequent courses. Students use both traditional materials and design tools as well as computers. Special tutorials provide basic instruction in software such as InDesign and Adobe Illustrator. In addition, we will also discuss some of the key figures, philosophies, and technologies that have shaped typography. The course will also include a demonstration of letterpress operation in the Design Department?7s Lab Press and a guided visit to the Hunt Library?7s Rare Book Room.
Prerequisites: 51102

51-202 Intermediate Typography
Spring: 9 units
The theme of this course is the integration of type and image. The primary goal of the projects is to achieve a harmonious and effective interplay of typography and imagery to express meaning. Through a confident use of grids, color, images, type, and visual hierarchy, students will explore a variety of solutions to design problems that require both expressiveness as well as an understanding of the practical uses of communication design. With an emphasis on formal and semantic issues, assignments will demonstrate how typography, photography, and other forms of image making may be combined to shape the form and content of communication.
Prerequisites: 51201

51-203 Imaging
Fall: 9 units
This new sophomore level Communication Design course introduces students to the rich and diverse process of making images. Communication Design faculty will each work with students on short projects over the course of the semester. Students will make images working with different means and technologies such as mark-making, working with found images and different materials, computer and hand-generated drawing, and the camera.

51-211 Generation of Form: Industrial Design I
Fall: 9 units
Generation of Form is the first studio for students in the industrial design major program. Students explore product design as a creative process that addresses human needs and issues of value. This studio course introduces students to semantic and symbolic aspects of industrial design. Several projects are given and students are required to develop studies that express the functional and cultural meanings of products. Students use various methods of conceptual sketching, detailed documentation, and prototyping for the purpose of exploring, analyzing, refining and communicating design concepts. Required of ID students; lab fee.
Prerequisites: 51102

51-212 Meaning of Forms: ID Studio II
Spring: 9 units
This studio course introduces students to semantic and symbolic aspects of industrial design. Several projects are given and students are required to develop studies that express the functional and cultural meanings of products. Students use various methods of conceptual sketching, detailed documentation, and prototyping; lab fee.
Prerequisites: 51211

51-221 Darkroom I
Fall: Mini Session - 4.5 units
This mini-course is an introduction to black and white photography through the darkroom. In addition to covering technical skills that include film exposure/development and print enlargement, major emphasis is placed on the language of the photographic medium and how it communicates information. Through shooting exercises, darkroom work, oral presentations and critiques, photography is explored as both a medium of personal expression and as a visual language, the understanding of which is indispensable to the communication designer. The role of electronic publishing tools in the printing industry as they support and condition the work of the communication designers who make and work with images. Extensive shooting and darkroom work, library research. Required for communication design majors. 35mm camera necessary; lab fee.
Prerequisites: 51122

51-222 Color and Communication
Spring: 9 units
As a communication tool, color can signal, enhance, and speak in ways that type and images cannot. Combined with type and images, color can contribute to the persuasive and communicative force of design. Beginning with a perceptual understanding of color, this course will explore the many ways that color communicates. Students will work with traditional materials and tools as well as computers to understand the strengths and limitations of each, comparing their similarities and differences in the context of theoretical and applied projects.
Prerequisites: 51201 or 51211

51-224 Digital Pre-Press Production
Spring: 9 units
A lecture/lab exploration of the processes and materials of the printing industry as they support and condition the work of the communication designer. The role of electronic publishing tools in the
51-225 Darkroom II
Fall: Mini Session - 4.5 units
A continuation of Communication Design Darkroom I, for students who want further exploration of photography and design. After acquiring basic darkroom skills in Darkroom I, students work in-depth on photographic projects. Oral presentations on issues in photography and critiques continue. Extensive shooting and darkroom work. 35mm camera necessary; lab fee. Prerequisites: 51122

51-227 Marks, Signs and Communications
Intermittent: 9 units
In this studio course you will design a variety of marks ranging from trademarks, (logos), logotypes, icons, wayfinding devices and potential symbols. You will be exposed to many examples of marks for reference, acquire an understanding of the design process and develop the confidence of how marks fit into a communication strategy. Prerequisites: 51-121 & 51-122; or permission of the instructor.

51-231 Calligraphy I
All Semesters: 9 units
Working with pure unadorned Roman letterforms, this course will introduce the student to the theory and practice of hand-generated letters, employing a variety of mark-making tools. This course provides an in-depth understanding of the basic principles and techniques of the art of formal writing. Rhythm, texture and composition are achieved through routine, elementary exercises using geometric forms, demanding concentration and manual discipline with the development of hand-eye coordination. The function, use, and harmonious sequencing of letterforms will be taught through weekly projects. Awareness of rhythm, texture and letterform structure are achieved through routine exercises. Drills, demonstrations, discussions, individual and class critiques are on-going. Additional related topics and activities introduced in class include Books: binding and design. Brief introduction to the historical development of our Western alphabet through film, slides, demonstrations, with discussion of twentieth-century type designs. Letter vocabulary, paleography, monoprints, words and punctuation. Classical page design. Publications past and present. Calligraphy’s role in design today. Thinking with hands and eyes, the manual placement and spacing of letters practiced in this course awakens sensitivity and judgment in the designer.

51-232 Calligraphy II
All Semesters: 9 units
Continuation of Introduction to Calligraphy I. Advanced problems in calligraphy and lettering. New hands are introduced, to be decided by student and instructor. Prerequisites: 51231

51-241 How People Work
Fall: 9 units
This course is an introduction to the general field of applied human factors. It centers on anthropometry, perception and simple human-product interaction while providing the student with an introduction to the practice and roots of the human factors profession. Over the course of the semester, the focus shifts from the application and use of existing factors and data to the generation of new studies and data. Lecture, discussion, and projects are employed. Required of ID students.

51-242 How Things Work: Mechanics and Electronics
Spring: 9 units
This course investigates the basic principles of mechanics and electronics. Through the combination of lectures, investigations, and lab experiments, students develop simplified representations of complex systems. The skills of freehand drawing, mechanical drawing and three-dimensional models are employed and developed during the project sequence. Required of ID students. Prerequisites: 51211

51-243 Prototyping
Fall: Mini Session - 4.5 units
A half-semester laboratory mini-course introducing a range of materials, methods, and workshop techniques by which designers prototype designs in three dimensions. Basic competence in shop techniques is established by bringing to realization a series of simple artifacts. Studio and model shop tools are required; lab fee.

51-246 Photo Documentation
Spring: Mini Session - 4.5 units
This course teaches Industrial Design students basic lighting and camera techniques for documenting three dimensional design work on slides. Required for all ID students.

51-250 Basic Typo for 1D & Minors
Spring: 9 units
This course is intended for Industrial Design majors and design minors. Students explore the fundamental principles of typography, where type is regarded as an image that serves a variety of communicative purposes. Projects allow students to explore issues of form and meaning, hierarchy, legibility and readability, structure and composition, and the design process. Projects require some knowledge of Adobe InDesign, Illustrator and Photoshop.

51-251 Digital Prototyping
Fall: Mini Session - 4.5 units
A half-semester laboratory mini-course introducing 3D modeling software. Course Structure Each class meeting will consist of an introduction to and demonstration of specific aspects and functions of SolidWorks. At the end of each class session, work related to the covered topic(s) will be assigned for completion by the next class meeting. This course is a requirement for all ID majors.

51-261 Communication Design Fundamentals
Fall: 9 units
A one-semester course that introduces non-majors to the field of communication design. Through studio projects, lectures, and demonstrations, students become familiar with the visual and verbal language of communication designers, the design process, and the communicative value of world and image. Macintosh proficiency required.

51-262 Communication Design Fundamentals
Spring and Summer: 9 units
A one-semester course that introduces non-majors to the field of communication design. Through studio projects, lectures, and demonstrations, students become familiar with the visual and verbal language of communication designers, the design process, and the communicative value of world and image. Macintosh proficiency required.

51-263 Industrial Design Fundamentals
Fall: 9 units
A one-semester course that introduces non-majors to product development from the industrial designer’s point of view. Through studio projects, lectures, and discussions, students will gain experience in visualizing a product for mass production. Case histories and the analysis of existing products will supplement hands-on experience in developing product concepts.

51-265 Beginning Photography
Summer: 9 units
Introduction to the methods and practices of black and white photography, including darkroom practices. 35mm camera required; lab fee.

51-271 Design History I
Fall: 9 units
This course provides an overview of design history from 1850 to 1950, the critical period for the formation and development of design and the design professions. There are three primary goals. The first is to provide an understanding of the role that design has played in the
Course Descriptions

51-272 Design History II
Spring: 9 units
This course focuses on the development of design from 1950 to the present, with further exploration of the themes introduced in Design History I as well as the introduction of new themes that have emerged to influence the direction of design thinking. The themes range from design for communities, to personal visions of individual designers, to the needs and expectations of society. The course explores the relationship between design and gender, race, the environment, political systems and social change. Students develop an in-depth understanding of these themes through lecture, research and presentations. This course is open to Design majors, BHA Design students, Design Minors, and by permission of the instructor.

51-301 Advanced Typography CD III
Fall: 9 units
This course develops advanced skills in typography and communication design, including the study of type and motion. Students learn to conceptualize and visualize more complex bodies of information for a variety of communicative purposes. Projects encourage students to develop a deeper understanding of the expressive potential of type and image and to develop critical and creative thinking skills with which to assess the effectiveness of their own work and that of their peers. Course objectives are to encourage an active exchange of ideas and information which allow students to develop the ability to clearly articulate their ideas and thought processes in relation to their work. This leads to a more focused method for developing and expressing ideas effectively.

Prerequisites: 51202

51-302 Information Design: CD IV
Spring: 9 units
The world is complex, and we have made it so. This course is a creative venture that deals with complexity, in particular the complexity of visual information that surrounds us in our daily lives. From train schedules to tax forms to the user guide for a VCR, humans have created a typographic labyrinth within which we are often lost. This course deals with the basic principle that communication designers employ when they represent complex information, making it visible and accessible. Assignments are specific, but their lessons are fundamental, providing students with conceptual and visual tools that will help to solve any information design problem.

Prerequisites: 51301

51-311 Product Design ID III
Fall: 9 units
Course projects are chosen to give students an opportunity to use their creative, technical and theoretical skills in a business application. The primary emphasis is on the use of a systematic process for the design and development of products that are useful, usable, desirable and feasible. Attention is also given to designers? interaction with engineering, marketing, and other professionals who influence the product development process. Studio, model shop tools and a 35 mm camera are required; lab fee.

Prerequisites: 51212

51-312 Products in Systems: ID IV
Spring: 9 units
This course introduces the themes of product planning and the development of products within systems and as systems. The projects are broad in scope and require students to develop products that reflect an understanding of the entire development cycle. Tools and skills for the studio and model shop are required; lab fee.

Prerequisites: 51311

51-316 Designing Spaces
Intermittent: 9 units
Stop. Look around you. Where are you and what are you doing? Are you in a lecture hall? A gallery? The check-out line at the "O"? How does the layout of the space support the activity that's supposed to happen there? How big is the space, and how is it proportioned? If you added ten feet to the ceiling height, how would it change the way it feels? Look down at your feet. What material are you standing on? Does it feel soft beneath your feet? How does it affect the sound quality of the room? Imagine it as a bright orange surface. What if the walls were rough instead of smooth—how would they catch the light differently? Does the sunlight come into the space, casting shadows? Or is the light predominantly artificial, and what does that mean? What, in sum, does it feel like to be in this space and what are the elements that define it? This course will present you with the opportunity to consider some of these questions, and will allow you to look at spatial issues from your perspective as a designer. The semester will be divided into sections exploring issues such as program, site, structure, material, and light, and each section will be supported by a series of exercises, lectures, and short projects. Designing Spaces should be of particular interest to those interested in pursuing exhibit design, interior design, and wayfinding design, but it may also be useful simply as a way of expanding your design framework. This course is open to junior and senior ID and CD students, and has no prerequisites.

51-321 Photography and Communications
Intermittent: 9 units
An advanced photo-imaging course to further develop proficiency in making and understanding photographs in the context of communication design. Photography will be seen as a medium of communication through which personal aesthetics and individual style are expressed. We will work in a variety of photo-image forms, including traditional black and white, altered, and digital. We will also explore different formats for presenting photographs, including book, collage, sequence. In addition, we will examine photography from the nineteenth century to the present to understand how the medium has evolved and how individuals have used photography for personal expression. Extensive shooting and darkroom work, library research. 35mm camera necessary; lab fee.

Prerequisites: 51221 and 51221

51-323 Drawing and Communication
Intermittent: 9 units
This course explores drawing as a means of communicating and expressing ideas. We will explore drawing by hand, but there will be some integration of other imaging technologies. Themes will center around objects, people, and places in various contexts. Emphasis is placed on individual interpretation and exploration of the assigned projects. Each project has several components that cause the student to generate and develop ideas as they work towards more refined images. Specific conceptual and technical skills will be discussed both individually and in groups as students examine the relationship between images and meaning.

Prerequisites: 51122

51-324 Basic Prototyping Methods for CD
Spring: Mini Session - 4.5 units
A half-semester laboratory mini-course introducing a range of materials, methods, and workshop techniques by which designers prototype designs in three dimensions. Basic competence in shop techniques is established by bringing to realization a series of simple artifacts. Studio and model shop tools are required; lab fee.

Prerequisites: 51201
51-325 Signs/Symbols/Marks
Intermittent: 9 units
This course focuses on the formal development of pictorial signs (icons, symbols, marks, etc.) either as individual elements or as families and systems of compatible forms. Through a variety of projects, students will employ an analytical process, which includes research, observation, idea generation, development, selection, and refinement of images. We will explore the personal, social, and cultural messages that such images carry. There will be applications in two- and three-dimensional formats.
Prerequisites: 51202

51-326 Documenting the Visual
Intermittent: 9 units
A critical look at documentary photography. We will examine 19th and especially 20th century images to see how photographers have shaped and extended a tradition that continues into the present. We will discuss theoretical issues?e.g. how cultural context influences photography and understanding of photographs; how photographers use both conscious as well as unconscious strategies in image-making; how documentary images take different forms-ranging from seemingly literal and objective descriptions, to intensely personal statements, to images coupled with text. In exploring these issues, we will look at a variety of image-types: family and candid photos, company and advertising photos, political and humanistic or social photo-essays. Extensive visual materials, readings, written and optional photo assignments. Intended for students majoring in the Department of Design or the Department of English, or by permission of the instructor.

51-330 Photo Book Design
Intermittent: 9 units
The Photo Book Photographs are often made into books. In this course, students will make photographs with the intention of presenting them as a book. We will deal with theme and content, image sequence and size, and the use of text with image. In addition to making their own, students will look at historical and contemporary photo books to see how the rich tradition of photo book has evolved through time and continues today. For Communication Design majors, or by the permission of the instructor. Extensive shooting and darkroom work, library research. Prerequisite: black and white darkroom 51-221.

51-331 Advanced Calligraphy I
All Semesters: 9 units
Continued study in the discipline of calligraphy. (Meets with Introduction to Calligraphy I.) Two directions may be taken. (1) Enlarging the student's repertoire of scripts, contemporary or traditional, for use in limited areas of work such as book or display work. (2) Concentrating on more intensive problem solving using a limited repertoire of scripts such as Roman, Italic, Sans Serif. Prerequisites: 51232

51-332 Advanced Calligraphy II
All Semesters: 9 units
Continued study in the discipline of calligraphy. (Meets with Introduction to Calligraphy II.) Advanced problems or new direction determined by student and instructor. Prerequisites: 51331

51-334 Packaging
Intermittent: 9 units
Packaging 51-334 A MW 9:00-11:20 MM111 Robert O. Swinehart, Professor Packaging is the medium that enables a product to pass from the manufacturer to the consumer through a variety of channels. The package contains a number of messages including identity, branding, advertising, instructions, contents, warnings and warranties. Packaging can embody and communicate strategic concepts through the materials used and the kinds of messages designed. This course will begin with some basic structural exercises and move to more complex projects. Student work in the first half of the semester will be done through desktop modeling and the second half will also include working in the shop. This course is intended to be a comprehensive exposure to packaging. This course is open to all 3rd year CD or ID students or above. CD students must have taken Basic Prototyping for CD, 51-324 that can be taken concurrently in the first half of the Spring 2002 semester. Look for Basic Prototyping for CD, A3, Friday 8:30 ~ 11:20, PH 27, a mini taught by Tom Merriman. Limit 12 - 14

51-335 Mapping and Diagramming
Fall: 9 units
This course explores the different ways in which we communicate complex information, through maps and diagrams. Students will design maps and diagrams using subject matter of their choice.

51-336 Web Design Practicum
Intermittent: 9 units
Web Design Practicum All you need to know to set up your web-based portfolio, including basic HTML, image prep, templating structures, template strategies, directory maintenance and style sheets. Intended for design majors only. Prerequisites:

51-337 Using the Human Factors Design Tool
Intermittent: 9 units
Using the Human Factors Design Tool This course is an introduction to human factors, and especially 20th century human factors. Communication Design students, and graduate design students interested in human factors are encouraged to take this course.

51-338 Documentary Photography
Intermittent: 9 units
Documentary Photography: the Social and Built Landscape Documentary photography explores issues, often social, humanistic and/or political, in man-made culture. This course examines the work of many major nineteenth and twentieth century documentarians while students photographically investigate their own topics. Among the many ethical areas of a documentarian's concern, the course examines (through looking at the documentary tradition and through the student's own work) the following: the photographer's relationship to the subject; the choices involved in representing the subject; the act of selectivity in framing the subject; the reasons for making documentary photographs; the intended audience for documentary photography; and the appropriate final display of the photographs. Should they be on museum walls, are they accessible to and/or have the approval of the subject? Extensive shooting and darkroom work, library research. Prerequisite: black and white darkroom 51-221, or by the permission of the instructor.

51-341 How Things are Made
Fall: 9 units
This course introduces students to the alternatives of materials and manufacturing processes that are considered in product design and development. Through the combination of lecture, demonstrations and field trips students learn the advantages and disadvantages of various material and processes, and how to choose and specify them in a particular product application. Required of ID students.

51-342 How People Work with Things
Spring: 9 units
This course presents an opportunity to define a project of your own choice, to explore and understand human factors issues in design through research and application. Term work will progress toward a completed project, with final deliverables that will include a thorough report that describes your process of research and design explored throughout the semester. This will include verbal and visual material that clearly articulates the user groups and product categories you identify and research, focus and intent of your project, context of human-product use, observations and research, testing and results. This course is open to all juniors and seniors in Design, both ID and CD. All others will be waitlisted and admitted only with the permission of the instructor.
**51-343 Product Morphology**  
Intermittent:  9 units  
"Morphology" refers to the the systematic study of form; "Product" means that we will be studying the form of products, as compared to buildings or rocks, for example. This course provides ID students an opportunity to develop their form vocabulary and form sophistication beyond the sophomore year. This course will require a lot of drawing, modeling, and other kinds of visual studies, focusing on what makes a superior product form...issues of form language, visual and tactile usability, expression and emotion, cultural appropriateness. There will be little time put into solving the engineering or marketing aspects of products. Instead, students should be prepared to spend many hours in form variation and revision.  
Prerequisites: 51243 or 51324

**51-344 Advanced Digital Prototyping**  
Spring: Mini Session -  6 units  
This course is an advanced course using SolidWorks computer modeling. It is a prerequisite for Production Prototyping.  
Prerequisites: 51211

**51-346 Production Prototyping**  
Spring: Mini Session -  6 units  
This course is the 2nd half of Advanced Digital Prototyping, using your work in SolidWorks to produce hard models.  
Prerequisites: 51341

**51-349 Visual Notation, Journal**  
Intermittent: Mini Session -  4.5 units  
Visual Notation, Journal 51-349 A1 1st mini This course is about keeping a daily visual journal. The importance of its use will be placed on ways of seeing, ordering, discovering and making relationships while involved in the process of visualizing, exploring and recording. We will use a variety of drawing media; some that may be new to you and through experimentation we’ll look at the impact media has on your image making process. We will examine a variety of subjects both man made and natural, large and small. One major goal of the course is to have you see the journal as not just a compilation of notations but as a comprehensive tool for visual thought and expression. We will also examine journals done by a variety of designers, architects and artists and discuss how making visual assessments condition the way we think and see the world. Consistent with the credits given for this course a total of 5-6 hours of work, both in and out of class will be expected each week. Your journal will be turned in for evaluation the last day of class.

**51-350 Visualization**  
Intermittent: 9 units  
Visualization This advanced drawing course introduces visualization and presentation techniques and strategies often used in the practice of industrial design. The course goal is to prepare students with elevated abilities to see, create and communicate complex product forms through rigorous drawing activities of observation and construction. It will further introduce traditional communication techniques used in professional practice such as marker, pastel, and pantone paper rendering. Discussion on presentation strategies, including approach to layout, text, and supporting imagery, will place in context the skills achieved. Prerequisite: 51-121, 51-122.

**51-351 Drawing, Expression and Communication**  
Intermittent: Mini Session -  4.5 units  
Drawing, Expression and Communication 51-351 A2 2nd mini This course explores the use of drawing as a means of visualizing, communicating and expressing form, space and ideas and as such is seen as a fundamental activity used to develop visual thought in the design process. Weekly themes will be introduced, along with presentation and accompanying questions that require responses through the generation and development of work done primarily through freehand drawing. Specific conceptual and technical skills will be discussed both individually and in groups with emphasis placed on individual interpretation and exploration of the assignments with the goal of developing visual fluency. A part of the course will be spent looking at how designers have used drawing in the design process at various times through history and within a variety of contexts. Emphasis is placed on draftsmanship and more on the role drawing may play in the complex process of visual thinking and notation. Consistent with the credits allocated to this course a total of 5-6 hours of work, both in and outside of class, will be expected each week. A portfolio of work will be expected the last day of class.

**51-353 Writing & Photography: Magazine Writing & Journalism**  
Intermittent: 9 units  
Revealing Place: Photographers and Writers Working Together 9 units Instructors: Jane McCafferty, English Department; Charlee Brodsky, School of Design Writers and photographers have skills, strengthen the student’s ability to articulate his or her ideas, and gain greater familiarity with a wide range of contemporary design work and related design issues. Extensive readings, lectures, and discussions of the work of contemporary industrial and communication designers.

**51-371 Learning to Look: Significant Images**  
Intermittent: Mini Session -  4.5 units  
Topics courses address important themes in the history, theory, and criticism of design. Offerings vary from year to year. Lectures and discussions. Extensive readings. No prerequisites.

**51-372 Contemporary Design**  
Spring: 9 units  
This course presents important issues, ideas, trends, and movements in contemporary design. The objective is to encourage an active exchange of ideas and information which broaden and deepen our conception of design, develop a clearer understanding of the relationship of design to society and contemporary culture, strengthen critical and creative thinking skills, strengthen the student’s ability to articulate his or her ideas, and gain greater familiarity with a wide range of contemporary design work and related design issues. Extensive readings, lectures, and discussions of the work of contemporary industrial and communication designers.

**51-373 Language in Design**  
Intermittent: 12 units  
In this project- based course, students will learn how classical and contemporary rhetorical theory can inform visual and verbal communication. Students will look at the role of (1) language IN the design process (how writers use language to describe designs and specify solutions) and (2) language WITHIN designs (how writers construct language to accompany visual illustrations, brochures, online information systems, and other communication and industrial design projects). We will pay particular attention to the features of language (voice, tone, color, depth, and hierarchy) that make rhetoric one of the design arts. In the final project, students will work with a client to construct a solution to a specific rhetorical/design problem.

**51-378 History of the Book and Printing**  
Intermittent: Mini Session -  6 units  
Course Introduction This course studies the evolution of the printed book through a survey of the origins of recorded communication; history of writing materials; study of manuscript production, type design, illustration, bookbinding, and book production from the earliest times to the present. Objectives The objective of the course is to enable you to analyze and appreciate the purposes and attributes of books and related technologies. Another objective is to provide a framework of the history of the book and its place in culture to enable you to study other aspects that interest you, such as types, illustration techniques, readership, document design, etc.

**51-379 Emotion and Reason in Design**  
Intermittent: 9 units  
51379 & 51779 Emotion & Reason in Design Emotion plays an important role in all forms of design, yet emotion is difficult to describe and analyze. The goal of this course is to study emotion in a
Course Descriptions

**Spring: 12 units**

51-405 Senior Project: Communication Design
Fall: 12 units
The senior year offers Design majors the opportunity to explore a variety of advanced topics through project-oriented courses. These project courses typically require an integration of skills and knowledge gained throughout the entire design program. Senior projects are often funded by outside companies or organizations, providing real world clients. This project focuses on new product development.

51-407 Senior Project: Product Design
Fall: 12 units
The senior year offers Design majors the opportunity to explore a variety of advanced topics through project-oriented courses. These project courses typically require an integration of skills and knowledge gained throughout the entire design program. Senior projects are often funded by outside companies or organizations, providing real world clients. This project focuses on new product development.

51-408 Senior Project: Environmental Design
Spring: 12 units
This is the spring offering of 51-409

51-409 Senior Project: Environmental Design
Fall: 12 units
The senior year offers Design majors the opportunity to explore a variety of advanced topics through project-oriented courses. These project courses typically require an integration of skills and knowledge gained throughout the entire design program. Senior projects are often funded by outside companies or organizations, providing real world clients. This project involves the design of a space, both indoors and outdoors, navigation of the space, and use of the space. Projects could include signage, exhibit design, navigation and wayfinding, furnishings within a space, or even park design.

51-414 Senior Project Integrated Product Development
Spring: 12 units
This course provides an integrated perspective on the many processes by which new products are designed, manufactured, and marketed. Under the direction of faculty from Design, Engineering, and Industrial Administration, students will work together in interdisciplinary groups on the development of real products. In addition to the product development project, the course includes lectures on innovation strategy, opportunity identification, designing products, object representation and manufacturability rules, computer-assisted design and prototyping, concept testing and protocol analysis, redesign issues, market testing, manufacturing and production, and product introduction and management. Open to graduate and senior-level engineering students, industrial administration students, and design students.

51-421 Introduction to Interaction & Visual Interface
Fall: 9 units
Introduction to visual interface design. This course highlights the role that visual interface designers play in the multi-disciplinary attempt to bridge the gap between functionality and usability and to introduce students to some of the unique challenges of designing within the realm of a digital, interactive medium.

51-422 Visual Interface
Spring: 9 units
Intended for HCI double majors, this is the spring offering of 51-421 Introduction to visual interface design. This course highlights the role that visual interface designers play in the multi-disciplinary attempt to bridge the gap between functionality and usability and to introduce students to some of the unique challenges of designing within the realm of a digital, interactive medium.

51-425 Letterpress and Bookbinding
Fall and Spring: 9 units
This course provides opportunities to work on an antique letterpress and learn the fine art of bookbinding. Emphasis is placed on good craftsmanship, while allowing students to work on individual projects as well as a group project.

51-427 Time Motion and Communication
Intermittent: 9 units
In the digital medium, we are no longer limited to static forms for expressing information. This digital studio course explores the use of kinetic forms - visual forms expressed over time - to understand their unique qualities in communication design.

51-441 Product Planning & Development
Fall: Mini Session - 4.5 units
Product Planning and Development The course will explore examples of case studies of product planning strategy from several levels. The first level will explore how companies establish brand strategies and determine the markets that they
Course Descriptions

want to compete in. The second level will look at how companies develop overall product lines that express corporate brand and then also connect with consumers in product markets. The third level is the planning of specific product programs. The course will began as a seminar discussion of case studies and evolve into team research on the development of a product strategy using an actual company’s brand identity. This course is for seniors or graduate students in design, BHA and engineering, and graduate business students.

51-451 Fundamentals of Joinery & Furniture Design
Fall: 9 units
Intensive introduction to traditional joinery techniques and the properties of wood through the use of textbook studies and lab experiments. Emphasis placed on how these techniques and properties influence design decisions. Students will learn how to set up, sharpen and use traditional hand powered tools. This acquired knowledge will be applied in the design and realization of a piece of wooden furniture. Limited enrollment. Lab fee and material purchases required.
Prerequisites: 51243

51-452 Furniture Design II
Spring: 9 units
A continuation of 51-451, this course explores a much broader range of issues related to furniture design. Students will identify and define in a proposal the area of furniture design they intend to investigate and then produce one or more furniture pieces developed from their findings. Materials and processes applied to the project are limited only by the resources the student can bring to bear. Assigned readings and a series of in-class discussions will focus on the influence of workmanship in design, and on how the behavior of the user is influenced by the formal esthetic language of the artifact. Lab fee & material purchases required.
Prerequisites: 51451

51-471 Practicing Design
Fall: 9 units
This is a lecture course covering all aspects of design practice. Students learn to formulate a plan for professional practice, market creative services, manage projects, and understand the legal and ethical issues associated with design practice. This course will also address the changing role of the design professions. Visiting professionals, case studies, and supplementary readings provide resources for class discussion. This course is required for all seniors.

51-472 Globalization and Design
Intermittent: Mini Session - 4.5 units
This mini course explores the various ways that designers, engineers and marketing interact and plan products on a global level. Designers must often plan for products that will be sold in markets around the world. As a result of global markets, design teams must conduct user research on markets in several countries simultaneously. Product programs often require the coordination of designers and other disciplines from around the world. Designers must integrate global manufacturing and assembly and plan for global distribution of products. Globalization has required designers to think and work in new ways. Case studies discussed in a seminar format and research into successes and failures of global product programs will be the two primary methods used in the class. This course is for upper level design majors, and masters students in design, engineering and business.

51-481 Visualizing Stories
Intermittent: Mini Session - 4.5 units
Students This course is open to HCl and Design graduate students and senior-level Design students. Students need a basic knowledge of communication and interaction design. Experience with interactive prototyping, digital video editing, and graphic layout are encouraged but not required. Course Description When viewers watch a TV news story, they never see the whole story. Instead they see, a short synopsis of the back-story, a quick update of the latest findings, and speculations on the future outcome. Will be he be found guilty? Will she be re-elected? Will the hurricane damage more property than last time? What viewers never get from TV news is a complete view of how a story evolves over time from beginning to end. In this project course students will work in small teams to develop visualizations of both individual current news stories as well as the evolution of these stories over time. Working with a small set of CNN video clips, students will produce both static and interactive visualizations that offer insights into the story that a traditional linear video broadcast can never provide. In much the same way Minard’s map on Napoleon’s march to Moscow captures an entire story in a single image, students in this course will reveal the relevant features that best communicate both what is happening in the individual news story as well as the larger story evolving over many weeks.

51-488 Design, Management and Organizational Behavior
Intermittent: 9 units
Design, Management, and Organizational Behavior 51-488/51-788 The goal of this course is to help Design students better understand how organizations affect the practice of design and, in turn, how the practice of design and affect organizational life. Topics covered will include the history and theory of management, some of the current practices of management that have direct bearing on design (such as strategic planning), and some of the central concepts of organizational theory that will help students learn to interpret and work within organizations. Pre-requisites: this course is intended primarily for design graduate students, with a few seats reserved for undergraduate Design majors. Non-Design majors must obtain the instructor’s permission to register for this course.

51-499 Senior Independent Study
All Semesters: 3-12 units
Guidelines for independent study in the Design Office. Proposals must be approved by faculty before pre-registration.

Drama

Undergraduate Courses

54-101 Acting I
Fall: 10 units
A knowledge and beginning understanding of the components of acting. Basic exercises, improvisations and prepared work in relaxation, concentration, imagination, communication. The ability to create the reality of a given situation in theatrical terms. Craft fundamentals in preparation for scene study. The beginning development of the students creative resources.

54-102 Acting I
Spring: 12 units
A knowledge and beginning understanding of the components of acting. Basic exercises, improvisations and prepared work in relaxation, concentration, imagination, communication. The ability to create the reality of a given situation in theatrical terms. Craft fundamentals in preparation for scene study. The beginning development of the students creative resources.
Prerequisites: 54101

54-103 Speech I
Fall: 6 units
(Speaking Voice) The First Year students are introduced to concepts of vocal support and are encouraged to develop a process which will allow them to communicate on stage with open, free sound. Their regular warm-up sessions demonstrate the possibilities of full-range and strength. The voice work is designed to allow for creative and personal approach to text. (Speech & Phonetics) The speech work introduces students to the phonetic alphabet, isolating each sound and acquainting the students with a symbol for each vowel, diphthong and consonant, a process which will enable them to identify each for particular work to strengthen the production of sounds and/or personal corrective work. The process helps the student actors to eliminate regional characteristics. Both areas of voice and speech approach the application of these beginning techniques to prose and poetic texts.
Course Descriptions

54-104 Speech I
Spring: 6 units
(Speaking Voice) The First Year students are introduced to concepts of vocal support and are encouraged to develop a process which will allow them to communicate on stage with open, free sound. Their regular warm-up sessions demonstrate the possibilities of full-range and strength. The voice work is designed to allow for creative and personal approach to text. (Speech & Phonetics) The speech work introduces students to the phonetic alphabet, isolating each sound and acquainting the students with a symbol for each vowel, diphthong and consonant, a process which will enable them to identify each for particular work to strengthen the production of sounds and/or personal corrective work. The process helps the student actors to eliminate regional characteristics. Both areas of voice and speech approach the application of these beginning techniques to prose and poetic texts.

54-105 Voice I
Fall: 6 units
Voice I introduces basic principles of healthy, expressive voice work, the development of vocal warm-up for rehearsal and performance, the connection of voice/creativity and the connection of voice to exciting acting.

54-106 Voice I
Spring: 6 units
Second Semester: Prerequisite: Voice 1 Fall Semester Spring Voice 1 explores resonators, release, alignment and vocal strength and stamina as it relates to challenging text. In addition, students are assigned creative writing and reflective assignments which relate to vocal development.

54-107 Movement I
Fall: 4 units
This first semester of Movement concentrates primarily on developing the students’ awareness of physical messages, how much their movement can add or distract in a scene. First, we look at what they bring to the situation, their personal physical habits and we begin the corrective work to rid them of these unconscious tics and introduce them to balanced alignment. Through a series of non-verbal improvisations, they begin to see that the body can reflect a complex inner life, subtle changes in environment, shifts in status and relationship, history and hidden agendas. By stripping away the verbal, they begin to make physical choices that aid the character and scene. The other components of the first semester address spatial relationships, movement on a stage, rhythm and spontaneity.

54-108 Movement I
Spring: 4 units
The second semester of Movement deals more specifically with the movement corrective work, incorporates exercises to achieve isolation, control strength, balance and explores specific movement techniques. Non-verbal improvisations lead into animal movement work, to coincide with the animal project in First Year Acting. This is followed with mime techniques, both for the ability to handle imaginary objects and for a physical understanding of what the body does during various activities (analysis of movement), as well as aiding in visualization, concentration, focus and specificity. Pantomime Blanche introduces them to a highly disciplined, purely physical form of Jazz and Theatre styles. Focus on technique, vocabulary, alignment, style, stamina and strength. Warm up and dance sequences are giving utilizing all the above elements. Pre-requisites and Co-requisites Strong previous dance background is required. Permission from instructor required. An evaluation may be required for proper placement in course. Section B Beginning: Open Jazz dance class. Beginning level. Course explores learning dance vocabulary, alignment, dance technique to be utilized in dance sequences.

54-114 Non-Major Dance
Spring: 6 units
Section A Advanced: An advanced practical dance course study of Jazz and Theatre styles. Focus on technique, vocabulary, alignment, style, stamina and strength. Warm up and dance sequences are giving utilizing all the above elements. Pre-requisites and Co-requisites Strong previous dance background is required. Permission from instructor required. An evaluation may be required for proper placement in course. Section B Beginning: Open Jazz dance class. Beginning level. Course explores learning dance vocabulary, alignment, dance technique to be utilized in dance sequences.

54-121 Introduction to Directing
Fall: 9 units
An interdisciplinary exploration of the director's art through the study of modern art movements. Students will be required to do extensive research on one specific movement i.e. Surrealism or abstract expressionism, and create a performance piece based on the visual and social elements of that particular movement.

54-122 Directing I
Spring: 9 units
A continuation of the previous semester focusing on Music and Dance of the twentieth century and how they influence the directors art. Prerequisites: 54121

54-123 Dance I
Fall: 5 units
A class in Ballet fundamentals with an emphasis on proper skeletal alignment.

54-124 Ballet I
Spring: 5 units
A class in Ballet fundamentals with an emphasis on proper skeletal alignment.

54-125 Music Skills I
Fall: 3 units
These courses are designed to develop basic music skills of the Music Theater major. It is designed to provide the basics of building musical competencies with the foundational elements of music theory as the focus. The goal is to afford the student the ability to take any music score, ensemble part or solo score, to efficiently analyze its basic elements by sight and be able to learn and prepare the appropriate part independently for an audition or performance.

54-126 Music Skills II
Spring: 6 units
These courses are designed to develop basic music skills of the Music Theater major. It is designed to provide the basics of building musical competencies with the foundational elements of music theory as the focus. The goal is to afford the student the ability to take any music score, ensemble part or solo score, to efficiently analyze its basic elements by sight and be able to learn and prepare the appropriate part independently for an audition or performance.

54-151 Electrics Stagecraft
Fall: Mini Session - 3 units
An introduction to the tools of lighting that will serve as the foundation for all lighting design and technical lighting courses. Students are prepared in the skills necessary for crew and safe work practices including: the hang and focus of lighting instruments, basic electricity and wiring, dimmers and the operation of lighting consoles. Students will also learn the roles and responsibilities of each member of the lighting team involved in a production.
54-152 Scenery Stagecraft  
Spring: 6 units  
This is a hands-on class in basic shop construction techniques. Upon completion of this course, students should be familiar with shop safety procedures and practices, safe and proper tool use, proper use of fasteners, and basic rigging skills, lecture/lab format.

54-153 Costume Stagecraft  
Fall: Mini Session - 3 units  
This course deals with the costume approach to a production, including such elements as the figure and the actor, how fabric works with the figure, how the figure may be improved or altered and the psychology of costuming. Topics that present more hands-on work include an approach to patternning, the machinery used for costumes and the craft orient elements that might be involved.

54-163 Introduction to Production  
Fall: 6 units  
The producing of modern theatrical productions involves the participation of professionals in a wide range of disciplines. Introduction to Production provides students with insights and first-hand experience participating in the physical production of theatre. The skills learned here provide an invaluable foundation and context for future production work and are, of course, useful in their own right. Includes participation in School of Drama productions on shop, install, and run crews.

54-164 Introduction to Production  
Spring: 3 units  
Participation in School of Drama productions on shop, install, and run crews. Pre-requisites/Co-requisites: 54-163 or instructor’s permission. Prerequisites: 54163

54-165 Introduction to Sound Design for Theatre I  
Fall: 6 units  
Studies in the principles and basic theories of sound design from technical and aesthetic standpoints. Course work includes instruction in the use of simple and sophisticated sound systems and the practical planning of sound plots.

54-166 Introduction to Sound Design for Theatre  
Spring: 6 units  
Studies in the principles and basic theories of sound design from technical and aesthetic standpoints. Course work includes instruction in the use of simple and sophisticated sound systems and the practical planning of sound plots.

54-171 Media Studio  
Fall: 4,6 units  
Graphic communication of the theatrical design idea through finished drafting; designers elevations, working drawings, plans, elevations, sections, detail and prop drawings. Particular emphasis on theatrical drafting conventions, solutions of technical problems and computer aided design techniques.

54-172 Media Studio  
Spring: 4,6 units  
Graphic communication of the theatrical design idea through finished drafting; designers elevations, working drawings, plans, elevations, sections, detail and prop drawings. Particular emphasis on theatrical drafting conventions, solutions of technical problems and computer aided design techniques.

54-177 Text to Stage  
Fall: 6 units  
Text to Stage is a multi-disciplinary First Year course which introduces the Dramatic Text as central to the art of theater through the critical disciplines of Analysis, Interpretation, Evaluation, and Historical background. These disciplines are linked, when possible, to the School of Drama’s ongoing Main Stage and Studio productions.

54-178 Text to Stage  
Spring: 6 units  
Text to Stage is a multi-disciplinary First Year course which introduces the Dramatic Text as central to the art of theater through the critical disciplines of Analysis, Interpretation, Evaluation, and Historical background. These disciplines are linked, when possible, to the School of Drama’s ongoing Main Stage and Studio productions. Prerequisites: 54177

54-187 Introduction to Playwriting  
Fall: 9 units  
Students will be introduced to the major components of writing for the stage, including dramatic action, character and dialogue. Exercises designed to familiarize students with the tools available to the playwright — and to connect each student with the wellspring of his or her own creativity — will be assigned each week. Readings of exercises and works-in-progress will take place on a weekly basis. In addition to reading each other’s work, members of the class will also serve as the first test audience for your colleagues. Students will be expected to discuss their reaction to each exercise that is read. The final project for the course will be the completion of the first draft of a one-act play. It is possible that one-act scripts may grow out of assigned exercises.

54-188 Introduction to Playwriting  
Spring: 9 units  
Students will be introduced to the major components of writing for the stage, including dramatic action, character and dialogue. Exercises designed to familiarize students with the tools available to the playwright — and to connect each student with the wellspring of his or her own creativity — will be assigned each week. Readings of exercises and works-in-progress will take place on a weekly basis. In addition to reading each other’s work, members of the class will also serve as the first test audience for your colleagues. Students will be expected to discuss their reaction to each exercise that is read. The final project for the course will be the completion of the first draft of a one-act play. It is possible that one-act scripts may grow out of assigned exercises.

54-189 Advanced Playwriting  
Fall: 9 units  
This course is intended to continue the process of familiarizing students with the basic components of dramatic writing, paying particular attention to the most basic building block of all effective plays — dramatic action. We will also focus on the development of an effective structure for a full-length play, and on finding theatrical conventions which both suit the story and make it live on stage. In order to work with these concepts, students write a play featuring an historical character — someone who has done something noteworthy. Therefore, the elements of the story will already be on the record; it will be the student’s job to select which aspects of this person’s life should be depicted on stage, and to structure these scenes so that, taken together, they create a coherent narrative. A complete first draft of a full-length play based on this historical character is due on the last day of class. Prerequisites: 54187

54-190 Advanced Playwriting  
Spring: 9 units  
This course is intended to continue the process of familiarizing students with the basic components of dramatic writing, paying particular attention to the most basic building block of all effective plays — dramatic action. We will also focus on the development of an effective structure for a full-length play, and on finding theatrical conventions which both suit the story and make it live on stage. In order to work with these concepts, students write a play featuring an historical character — someone who has done something noteworthy. Therefore, the elements of the story will already be on the record; it will be the student’s job to select which aspects of this person’s life should be depicted on stage, and to structure these scenes so that, taken together, they create a coherent narrative. A complete first draft of a full-length play based on this historical character is due on the last day of class.
54-191 Acting for Non-Majors
Fall: 9 units
This class is designed for non-acting majors and introduces the student to the basic principles of acting, character study and improvisation. One semester course.

54-192 Acting for Non-Majors
Spring: 9 units
This class is designed for non-acting majors and introduces the student to the basic principles of acting, character study and improvisation. One semester course.

54-201 Acting II
Fall: 12 units
Scene study: the fundamental techniques needed to participate in the developing conflict within the imaginary world. Character building through unfamiliar behavior and beliefs; relationships; language.
Spring semester: The use of classical texts and ensemble playing. The deepening of the actors inner resources to be supported by the craft techniques.
Prerequisites: 54101 and 54102

54-202 Acting II
Spring: 12 units
Scene study: the fundamental techniques needed to participate in the developing conflict within the imaginary world. Character building through unfamiliar behavior and beliefs; relationships; language. Spring semester: The use of classical texts and ensemble playing. The deepening of the actors inner resources to be supported by the craft techniques.
Prerequisites: 54201

54-203 Voice and Speech II
Fall: 6 units
The actors take a more concentrated approach to elevated text. The course focuses on the effective production of classical text. The warm up sessions are geared towards preparing the student actors for the extravagant language from Shakespeare's plays and sonnets. Meter, imagery and further specific text work is also employed to encourage each student to find clear shape in the work. A repertoire of at least five classical monologues will come from the course work.
Prerequisites:

54-204 Voice and Speech II
Spring: 6 units
The actors take a more concentrated approach to elevated text. The course focuses on the effective production of classical text. The warm up sessions are geared towards preparing the student actors for the extravagant language from Shakespeare's plays and sonnets. Meter, imagery and further specific text work is also employed to encourage each student to find clear shape in the work. A repertoire of at least five classical monologues will come from the course work.

54-207 Movement II
Fall: 6 units
This entire term focuses on the Neutral Mask, a completely non-verbal masked movement form, through which students search for a neutral base, both physically and psychologically, a place of complete presence in the present. The mask allows them to uncover all that is emotional in the body; the "baggage" carried from role to role, and provides techniques to free them from these limitations. Identifications with other forms of energy, the four elements, seasons, materials, colors and plant life give students new insights into the process of character development. Movement work is immediately reinforced with applications to their scene work in Acting class.
Prerequisites: 54107

54-208 Movement II
Spring: 3 units
This term is divided between two classic physical forms: Commedia dell'Arte and Clowns. In the first half of the semester students wear the half-masks of the archetypal Commedia characters (Harlequin, Pantalone, et al), to learn their psychology and physicality, improvise on historical and contemporary scenarios, and apply Commedia technique to modern comedy. Commedia dell'Arte gives them the tools to tackle physical comedy from any era, past or present. In the second half of the term students discover their personal Clowns. This clown has nothing to do with the American Barnum & Bailey Circus clown; this is not a character or caricature, but rather a revelation of the clown each student hides under the mask of adulthood. Discovering this clown gives them all a way to laugh at themselves, to uncover what makes each individual uniquely funny; it also lets them see how we only laugh at truth and in the personal material lies universal humor. Inside this freedom is the technique to know what's funny and why, and the ability to apply these rules in comedy.
Prerequisites: 54108

54-214 Singing for Actors
Fall and Spring: 3 units
This course is designed to present the basics of the singing mechanism for actors in their junior year. General vocal exercises will be used to this end. The students will work on solo repertory and a presentation will be given at the end of the semester.

54-215 2nd Year Acting Lab: Forms and Formats
Fall: 4 units
This is a two-semester course for 3rd-Year Directors & 2nd-Year Actors concerning the application of fundamental staging & work script tools & fundamental acting tools in directing divergent dramatic Forms (Realistic Drama, Shaw Comedy, Farce, Shakespeare, Dialectical Theatre, The Ten-Minute Play) in various theatrical Formats including proscenium, three-quarter, thrust, & arena. Goals include: to encourage understanding & cooperation between disciplines; to develop expertise & confidence in preparation & rehearsal; to learn to play on the team with actors & designers; to develop a directorial vision toward giving the particular play's Content illuminating Form. There is a video project at top of second semester, & public performances at end of each semester.

54-216 2nd Year Acting Lab: Forms and Formats
Spring: 4 units
This is a two-semester course for 3rd-Year Directors & 2nd-Year Actors concerning the application of fundamental staging & work script tools & fundamental acting tools in directing divergent dramatic Forms (Realistic Drama, Shaw Comedy, Farce, Shakespeare, Dialectical Theatre, The Ten-Minute Play) in various theatrical Formats including proscenium, three-quarter, thrust, & arena. Goals include: to encourage understanding & cooperation between disciplines; to develop expertise & confidence in preparation & rehearsal; to learn to play on the team with actors & designers; to develop a directorial vision toward giving the particular play's Content illuminating Form. There is a video project at top of second semester, & public performances at end of each semester.

54-219 Music Theatre Ensemble Singing
Fall: 6 units
The students will review and build upon First Year competencies. Music from the standard Choral and Music Theater tradition will be used as lab example for study in Music Skills. The dynamics of ensemble singing will aid in the experience of developing disciplined musicianship.

54-220 Acting A Song
Spring: 3 units
The pre-requisite for Cabaret Class, this mini explores the personal relationships between performer and song. Exercises include Class Interrogation, Story Telling, and Text Analysis. Based primarily on the personal experience the actor brings to the text, rather than technical aspects.
Course Descriptions

54-221 Directing II
Fall: 9 units
THE FUNDAMENTALS OF DIRECTING: This is a Fall-semester course for 2nd-year students of all options introducing the fundamentals of the director's craft: text analysis; the work script with column method & blocking notation; determining the purpose of the writing; the concept of Action & Change (beats & transitions); practical use of the Six Aristotelian Elements of Drama: Genre & Style; the Dramatic Question; Levels in the Creative Process; Visual Vocabulary & Staging Tools including planes, levels, values of stage space, body positions; composition; picturization; emphasis; & movement; entrances & exits; the ground plan. Work includes unscripted exercises, then scripted exercises on an open stage & then within a detailed ground plan. Additional goals: to work in a professional manner; to value preparation, analysis & organization.

54-222 Directing II
Spring: 9 units
A continuation of the previous semester focusing on Music and Dance of the twentieth century and how they influence the directors art. Pre-requisite: 54-121

54-223 Dance II
Fall: 1-3 units
Dance 2 Section A, Ballet, 3 units: A ballet class continuing to build on proper alignment and musculature while increasing the dance vocabulary. Prerequisite: Dance 1 or permission of the instructor Dance 2 Section C, Tap, 1 unit: Beginning level of tap for Music Theatre majors. Prerequisites: 54123 and 54124

54-224 Dance II
Spring: 1-3 units
Dance 2 Section A, Ballet, 3 units: A ballet class continuing to build on proper alignment and musculature while increasing the dance vocabulary. Prerequisite: Dance 1 or permission of the instructor Dance 2 Section C, Tap, 1 unit Beginning level of tap for Music Theatre majors. Prerequisites: 54223

54-225 Music Skills II
Fall: 4 units
An introduction into music skills for the musical theatre student. The goal of this course is to develop good ear training and a foundation of basic harmony skills.

54-226 Acting a Song
Spring: 6 units
The pre-requisite for Cabaret Class, this mini explores the personal relationships between performer and song. Exercises include Class Interrogation, Story Telling, and Text Analysis. Based primarily on the personal experience the actor brings to the text, rather than technical aspects.

54-231 Design for the Stage
Fall: 6-9 units
This course introduces the student to developing a visual idea from a text.

54-232 Design for the Stage
Spring: 9 units
This course deals with the fundamental needs and responsibilities of the scenic and costume designer. Emphasis is on the development of ideas based on a dramatic text. Students are asked to interpret a text and create a visual statement based on that interpretation through the design process. Studio work is included in the course work.

54-237 Introduction to Scene Painting
Fall: 6 units
This is a studio course in the foundations of scenic painting for theater and related fields. Students will complete projects that address the following topics: preparation of and paint techniques for both soft goods and hard covered surfaces, drawing and painting to scale, representing textures in both 2 and 3 dimensions, and color mixing. Subject matter changes often and may include: architecture, natural and man-made textures, drapery, interior/exterior scenes, human figure, still life objects.

54-238 Introduction to Scene Painting
Spring: 6 units
This is a studio course in the foundations of scenic painting for theater and related fields. Students will complete projects that address the following topics: preparation of and paint techniques for both soft goods and hard covered surfaces, drawing and painting to scale, representing textures in both 2 and 3 dimensions, and color mixing. Subject matter changes often and may include: architecture, natural and man-made textures, drapery, interior/ exterior scenes, human figure, still life objects.

54-239 History of Architecture and Decor
Fall: 4,6 units
This slide/lecture course is a survey of architecture, interiors and furniture from ancient Egypt to the beginnings of the 20th Century.

54-240 History of Architecture and Decor
Spring: 4,6 units
This slide/lecture course is a survey of architecture, interiors and furniture from ancient Egypt to the beginnings of the 20th Century.

54-241 Improv Class
Fall: 4 units
This course for Sophomore Actors not only sharpens their skills as ensemble performers, but also allows for more playfulness, creativity and exploration, cultivating risk-taking and a certain abandon. Divided into two separate sections, the course concentrates on non-verbal, psychological improv to help the student actor achieve a kind of physical truth and spontaneity, while becoming aware of the importance of the body in conveying information; the second half is devoted entirely to comedy improv and may culminate in an original comedy improv show in the UC lobby.

54-245 History of Clothing
Fall: 4,6 units
Fall 4,6 Units This year-long course traces the development of garments of the Western World from Egypt to the beginning of the 20th Century. The shapes of the various elements are considered as well as the way they are worn, how they affect the body and the society from which they spring. A course that involves lectures, slides, research projects, quizzes and exams, the time line continues through the year. Second semester can be taken separately with permission of the instructor. Normally 6 units, a 4 unit option without research projects is available for non-majors.

54-246 History of Clothing
Spring: 4,6 units
Fall 4,6 Units This year-long course traces the development of garments of the Western World from Egypt to the beginning of the 20th Century. The shapes of the various elements are considered as well as the way they are worn, how they affect the body and the society from which they spring. A course that involves lectures, slides, research projects, quizzes and exams, the time line continues through the year. Second semester can be taken separately with permission of the instructor. Normally 6 units, a 4 unit option without research projects is available for non-majors.

54-251 Introduction to Lighting Design
Fall: 6 units
Students will learn to "see" light by studying the physical properties and directly applying them in lab exercises. In addition to practical hands-on work, students will read scripts and develop a theoretical design process on paper that precedes the practical implementation. Emphasis will be placed on verbal, written and visual communication of design ideas. Pre-requisites: Electrics Stagecraft 54-151 or permission of instructor
Prerequisites: 54151
Course Descriptions

54-252  Introduction to Lighting Design  
Spring: 6 units  
Students will explore the physical properties of light in various design applications. Emphasis will be placed on conceptualization of design ideas and developing a design process that involves analysis, research, exploration, questioning, problem solving, and implementation of a successful design product through the light plot and supporting paperwork. Pre-requisites: Intro to Lighting Design 54-251  
Prerequisites: 54251

54-259  Production Preparation II  
Fall: 6 units  
Participation in School of Drama productions, usually on shop fabrication or theatre installation crews. Some participants will fill assistant supervisor positions for other students filling creative or production roles. Pre-requisites/Co-requisites: Introduction to Production or instructors permission.  
Prerequisites: 54163 and 54164

54-260  Production Preparation II  
Spring: 9 units  
Hands on experience in most aspects of building and running a production.

54-261  Production Prep for Non-Majors  
Fall: 6 units  
Class meets twice a week on the days selected. The course work includes production assignments in the costume, scenery, metal, props or paint shops as well as production work on the stages. Students work for a 4-6 week period on the construction or load-in of a Chosky Theater or Rauh Studio Theater production. Must take 54-163/64 first or provide instructor with proof of prior experience.

54-262  Production Preparation II  
Spring: 9 units  
Participation in School of Drama productions, usually on shop fabrication or theatre installation crews. Some participants will fill assistant supervisor positions for other students filling creative or production roles. Pre-requisites/Co-requisites: Introduction to Production or instructors permission.  
Prerequisites: 54163 and 54164

54-263  Introduction to Welding Processes  
Fall: 4 units  
An introduction to the four most common metal joining processes, including Oxyfuel processes, SMAW, GMAW, and GTAW arc welding. Welding safety, equipment setup and basic welding techniques will be covered.

54-264  Welding  
Spring: 4 units  
An introduction to the four most common metal joining processes, including Oxyfuel processes, SMAW, GMAW, and GTAW arc welding. Welding safety, equipment setup and basic welding techniques will be covered.

54-266  Stage Managers Workshop  
Fall and Spring: Mini Session - 3 units  
Entry level stage management course investigates the planning and organization of a stage manager. Basic preparation for assignment as an assistant stage manager on a School of Drama production.

54-267  Sound Design I  
Fall: 9 units  
Continuation of 54165; two consecutive semesters. Emphasis on developing a theatrical design process through script analysis and exploration of the creative application of studio techniques. Weekly or biweekly projects and assignments on School of Drama productions.

54-268  Sound Design I  
Spring: 9 units  
Continuation of 54166; two consecutive semesters. Emphasis on developing a theatrical design process through script analysis and exploration of the creative application of studio techniques. Weekly or biweekly projects and assignments on School of Drama productions.

54-269  Computer Applications: Autocad  
Spring: 6 units  
This course is an introduction to the computer aided drafting program AutoCAD 2004. Principally the course presents how to operate the program in general. However, whenever possible, classroom examples and assignments are tailored to theatre design and production applications. Emphasis is placed on 2-D drafting, to build the skills that a student will use on production assignments here at the School of Drama. Time permitting, the course will move on to an introduction of 3-D modeling with AutoCAD. Pre-requisites/Co-requisites: Media Studio (Drafting) or instructor's permission.  
Prerequisites: 54171 and 54172

54-270  Computer Applications: Photoshop  
Fall: 6 units  
An in-depth study of Computer-Aided Design and Drafting for the theatre as well as an examination of applications for rendering, animation, imaging and simulation. Particular emphasis in the fall is on AutoCAD while the spring portion of the class examines several different software packages.

54-271  Standard Scenery Construction  
Fall: 6 units  
This class establishes the fundamentals of modern scenic fabrication techniques. Upon completion of this course, students should be familiar with common scenic materials and the criteria for their selection, qualitative understanding of basic structural design, basic "recipes" for construction of standard scenic elements, special considerations for flown and moving scenery, and shop drawings. Lecture/discussion format. Students in this course must have basic drafting skills.

54-273  Technical Direction  
Fall: 9 units  
This course is an exploration of techniques and practices of the Technical Director. The class has three main components: classroom presentation of School of Drama production technical direction process, classroom lectures centering on TD process, and project work. Over the course of the semester, students will work on two productions as paper projects. This is an opportunity to have a somewhat less stressful pass through a show, completing estimates, schedules, and drawings designed to help establish a professional foundation for the student as a technical director. All of the course components run concurrently. Pre-requisites/Co-requisites: Standard Scenic Construction & Production Planning or Instructors Permission.  
Prerequisites: 54271 and 54279

54-274  Production Planning and Organization  
Fall: 9 units  
This course presents the processes used by technical managers to plan productions. Emphasis in this presentation is placed on the structure and practice of the regional theatre. Information is presented on the staffing of production departments and the responsibilities of those staff members with regard to production planning. After establishing a basis for discussing planning tasks within the frame of the regional theatre, the class will look at how these tasks transfer and are impacted by factors in other parts of the industry. Pre-requisites/Co-requisites: Introduction to Production or Instructor's permission.  
Prerequisites: 54163 and 54164

54-277  Stage Management I  
Fall: 6 units  
This class introduces the student to the work of a stage manager on a theatrical production. Students learn the functions and responsibilities of the stage manager. Also covered: blocking notation, cue organization, rehearsal reports and AEA rules and regulations.

54-278  Stage Management  
Spring: 4 units  
This class introduces the student to the work of a stage manager on a theatrical production. Students learn the functions and responsibilities of the stage manager. Also covered: blocking notation, cue organization, rehearsal reports and AEA rules and regulations.
Course Descriptions

54-281 History of Drama I  
Fall: 6 units  
History of Drama seeks to recognize the evolution of drama through the study of the written texts and the development of dramatic movements. The innate characteristics of dramatic texts will be explored as part of an on-going lineage and related to stylistic traditions inherited from prior movements or as a genesis for what will follow. The craft of research will be employed as an essential tool for the theatre artist.

54-282 History of Drama II  
Spring: 6 units  
History of Drama is divided into seven week mini courses, each devoted to a particular genre, style, country, playwright or other historical theatre topic.

54-289 Speech and Theatre Community Outreach  
Fall: 9 units  
Students will develop a process of teaching theatre to middle school children. Elementary school children will work with drama students from several disciplines in a mentoring relationship and learn that theatre is a collaborative experience. The result will be joint artistic performances at CMU. The Children's Heritage Theatre will present classic text as well as newly scripted plays based on myths and fairy tales from international cultures.

54-290 Speech and Theatre Community Outreach  
All Semesters: 9 units  
Students will develop a process of teaching theatre to middle school children. Elementary school children will work with drama students from several disciplines in a mentoring relationship and learn that theatre is a collaborative experience. The result will be joint artistic performances at CMU. The Children's Heritage Theatre will present classic text as well as newly scripted plays based on myths and fairy tales from international cultures.

54-291 Speech and Phonetics Instruction and Outreach  
Fall: 6 units  
This course is designed for mentors to teach children at the 5th grade level to speak in a clear, efficient and pleasing manner with self-confidence. The children will also be able to understand the relationship between sound and speech; realize the differences between American English speech and spelling; relate symbols of IPA to phonemes we use in speech; improve their articulation of Vowels, Consonants and Diphthongs; develop the musical patterns their voices can make; follow directions and drills to learn to discriminate between correct and incorrect productions of Vowels, Consonants and Diphthongs; develop the techniques for memorization of challenging poetry.

54-292 Speech and Phonetics Instruction and Outreach II  
Spring: 6 units  
This course is designed for mentors to teach children at the 5th grade level to speak in a clear, efficient and pleasing manner with self-confidence. The children will also be able to understand the relationship between sound and speech; realize the differences between American English speech and spelling; relate symbols of IPA to phonemes we use in speech; improve their articulation of Vowels, Consonants and Diphthongs; discover the musical patterns their voices can make; follow directions and drills to learn to discriminate between correct and incorrect productions of Vowels, Consonants and Diphthongs; develop the techniques for memorization of challenging poetry and participate in a presentation for family and friends using the skills they have learned.

54-293 Make-up  
Fall: 2 units  
Basic techniques of stage make-up and their adaptation to theatrical styles.

54-294 Make-Up  
Spring: 2 units  
MAKE UP FOR ACTORS Basic techniques of stage make-up and their adaptation to theatrical styles. MAKE UP FOR DESIGNERS FOR:

Graduate and Undergraduate Costume Design majors

DESCRIPTION: This course deals with the basic approach and process of how to design makeup for a theatrical production. It covers the basic techniques of stage make-up application and their adaptation of theatrical styles as related to design. Pre-Requisites: Declared major in Costume Design

54-299 Special Topics in Playwriting  
Intermittent: 9 units  
This course allows students to expand their knowledge of basic playwriting principles as they refine existing scripts, taking material composed in Advanced Playwriting and working through several new drafts. Students learn how to enrich their characters, amplify dramatic tension and create structures that build toward an explosive climax. Work on student compositions is coupled with in-depth structural analysis of both classical and contemporary plays from the existing repertoire.

Prerequisites: 54189

54-300 Advanced Studies in Playwriting  
Intermittent: 9 units  
This course allows students to expand their knowledge of basic playwriting principles as they refine existing scripts, taking material composed in Advanced Playwriting and working through several new drafts. Students learn how to enrich their characters, amplify dramatic tension and create structures that build toward an explosive climax. Work on student compositions is coupled with in-depth structural analysis of both classical and contemporary plays from the existing repertoire.

Prerequisites: 54201 and 54202

54-301 Acting III  
Fall: 9 units  
This is a two-semester course in Acting for Third-Year Actors & MTs who will explore performance within directed structure in various non-Fourth-Wall forms of Theatre including: Greek Tragedy, the Greek Chorus, Moliere Comedy & Brecht. This is not a course that will aspire to provide any "correct" way to play various "styles". Rather, it is a course in which to acquire new tools & perspectives when working in new theatrical worlds. Goals include: to find the appropriate level of external expression to meet the demands of the particular text & its directed world, & to "fill the Form" believably & passionately; to make active choices within a directed framework; to learn to work within industry standards; to learn the nature of the actor's "homework" in a directed framework; to include the Audience in the work.

Prerequisites: 54201 and 54202

54-302 Acting III  
Spring: 12 units  
This is a two-semester course in Acting for Third-Year Actors & MTs who will explore performance within directed structure in various non-Fourth-Wall forms of Theatre including: Greek Tragedy, the Greek Chorus, Moliere Comedy & Brecht. This is not a course that will aspire to provide any "correct" way to play various "styles". Rather, it is a course in which to acquire new tools & perspectives when working in new theatrical worlds. Goals include: to find the appropriate level of external expression to meet the demands of the particular text & its directed world, & to "fill the Form" believably & passionately; to make active choices within a directed framework; to learn to work within industry standards; to learn the nature of the actor's "homework" in a directed framework; to include the Audience in the work.

Prerequisites: 54301

54-303 Speech III  
Fall: 6 units  
(Voice) The actors continue to strengthen their vocal technique with voice classes, which become specific in their purpose and require the students to become responsible for their own preparation process. The class also focuses on particular performance challenges in private tutorial work. (Dialects & Accents) Dialects and accents class meets twice weekly in order to build a repertoire of ten American, British, Irish dialects and/or European accents. Each actor also develops an independent project in order to discover a process of research for additional dialects he/she may encounter in the professional world.
Writing, Acting and Directing Options.

Thesis Productions. This class is co-taught by the Dramatic scripts, one acts, monologue dramas, and the texts for the MFA undergraduate directors. This work results in 10-minute play developed and realized by senior actors and by graduate and process of theatre — including the role of the living dramatic writer. New scripts are written by graduate dramatic writers, then the understanding of what the body does during various physical activities. Mime technique will also aid in visualization, concentration, focus and specificity, while Pantomime Blanche introduces a highly disciplined purely physical form. Prerequisites: 54207 and 54208

54-319 Cabaret
Fall: 4 units
The Study of the art of Cabaret- including themes, song programing, microphone technique, and singing without the imaginary fourth wall. Repertoire is selected through personal scrutiny by the individual performer. Outgrowth of the class includes the Final Friday Cabaret Series, presenting three cabarets per semester.
Prerequisites: 54220

54-320 Music Theatre Scenes
Spring: 4 units
Study of the marriage of spoken and sung text- i.e the marriage of drama and music. Class study includes Scenes extracted from the Musical Theatre canon, including Scenes from a variety of styles and eras. The class explores how the Singing Actor seques from speech to music, thus strengthening the scene through the emotional flight music brings to the script.

54-322 Directing III Seminar
Spring: 4 units
This two-semester class for 3rd-Year Directors is directly related to the work in Directing 3/Acting Lab 2. The Seminar consists of organizational meetings, lectures & discussions relevant to the current class work — such as ground planning, rehearsal organization, vision, genre differentiation, new formats, working with actors, etc.

54-323 Dance III
Fall: 1-3 units
Dance 3 Section A, Ballet, 3 units A ballet class aimed at developing greater technical strength, dexterity and flexibility. Prerequisite: Dance 2 or permission of the instructor Dance 3 Section C, Tap, 1 unit 2nd year level of tap for Music Theatre majors

with his/her peers, in a creative and experimental atmosphere, the principles and techniques developed in the classroom.

54-304 Speech III
Spring: 6 units
(Voice) The actors continue to strengthen their vocal techniques with voice classes, which become specific in their purpose and require the students to become responsible for their own preparation process. The class also focuses on particular performance challenges in private tutorial work. (Dialects & Accents) Dialects and accents class meets twice weekly in order to build a repertoire of ten American, British, Irish dialects and/or European accents. Each actor also develops an independent project in order to discover a process of research for additional dialects he/she may encounter in the professional world.

54-305 Voice III
Fall: 6 units
Fall: Linklater work is solidified with introduction to Fitzmaurice Voice work as it relates to Greek Text. Vocal diagnosis and personal warm ups are also part of curriculum.

54-306 Voice III
Spring: 3 units
Spring: Monofest personal writing projects, assigned monologues and independant vocal projects on voice related subjects.

54-307 Movement III
Fall: 6,12 units
The third year of Movement can include in-depth studies of various physical theatre styles, the synthesis of movement and text, and the creation of some original movement-theatre work. Physical vocabulary continues to increase.

54-308 Movement III
All Semesters: 0-99 units
The third year of Movement can include in-depth studies of various physical theatre styles, the synthesis of movement and text, and the creation of some original movement-theatre work. Physical vocabulary continues to increase.

54-309 Theatre Lab
Fall: 9 units
This is a two-semester class which teaches the collaborative process of theatre — including the role of the living dramatic writer. New scripts are written by graduate dramatic writers, then developed and realized by senior actors and by graduate and undergraduate directors. This work results in 10-minute play scripts, one acts, monologue dramas, and the texts for the MFA Thesis Productions. This class is co-taught by the Dramatic Writing, Acting and Directing Options.

54-310 Theatre Lab
Spring: 9 units
This is a two-semester class which teaches the collaborative process of theatre — including the role of the living dramatic writer. New scripts are written by graduate dramatic writers, then developed and realized by senior actors and by graduate and undergraduate directors. This work results in 10-minute play scripts, one acts, monologue dramas, and the texts for the MFA Thesis Productions. This class is co-taught by the Dramatic Writing, Acting and Directing Options.

54-311 Rehearsal & Performance
Fall: 12 units
Performance training through projects at different levels of difficulty and staging, directed by students and presented in the studio theatre. The actor has the opportunity to put into practice with his/her peers, in a creative and experimental atmosphere, the principles and techniques developed in the classroom.

54-312 Rehearsal & Performance
Spring: 12 units
Performance training through projects at different levels of difficulty and staging, directed by students and presented in the studio theatre. The actor has the opportunity to put into practice
Course Descriptions

Prerequisites: 54223 and 54224

54-324  Dance III
Spring:  1-3 units
Dance 3 Section A, Ballet - 3 units A ballet class aimed at developing greater technical strength, dexterity and flexibility. Prerequisite: Dance 2 or permission of the instructor Dance 3, Section C, Tap - 1 unit 2nd year level of tap for Music Theatre majors.
Prerequisites: 54323

54-330  Introduction to Stage Management
Spring:  4 units
This course is intended to provide students an opening to the knowledge and skills of the professional stage manager. It will also illuminate the qualities of a good stage manager specific to personality and human interaction. Within this course we will examine the role of the stage manager throughout the full scope of creating a production, including prep work, rehearsal period, technical rehearsal, performance and closing.

54-331  Scene Design I
Fall:  9 units
Students will spend the year in an exciting and intensive exploration of the process of Scene Design as well as an examination of the nature of creativity and storytelling. Students will also engage extensively in the skills a professional Scene Designer requires, such as drafting, drawing, model making, painting and general collaborative skills. Students will be expected to deal with in-depth research, scriptual examinations, careful arrangements of space, composition and groundplan, conceptual structure, real life obstacles and the elements of a successful final project. By the end of this course, students will have improved their overall design skills, have some projects they can include in their portfolio and have created new routes toward their creativity.

54-332  Scene Design I
Spring:  6,9 units
Studies in problems of design and the use of the design imagination through assignments in various styles and periods; practice in the use of research techniques of rendering, and the preparation of designer elevations. Basic design techniques. Groundplans, rough models, basic drawing skills. Concentration on the design process and the director-designer relationship.

54-335  Designer/Director Collaboration
Fall:  6 units
This is a one-semester course in clarifying and enriching the collaborative process of The Creative Team (Designers and Directors) in creating imaginary worlds and making theatre. The hope is to encourage greater understanding, respect and appreciation of the responsibilities of all collaborators in the process, with the goal of fruitful collaborations in the future. An instructor from the Design Option and an instructor from the Directing Option will lead the class. A model will be presented and tested to serve as a guide for future collaborations and how to address working problems. Specific goals of the class are: to determine how to create a base of trust in a creative team and co-ownership of a project; to define responsibilities within a project; to determine an order to the collaborative process; to effectively communicate among theatrical disciplines — working in a professional manner; to collaborate to create a theatrical form expressive of the content of the play; to create a mutually-satisfying project.

54-337  Advanced Scene Painting
Fall:  4 units
This is a year long course designed to explore more complex scene painting problems with an emphasis on professional standards. Projects in the first semester will address such topics as: translucency, tromp l’oiel, aging techniques, signage, perspective, and working 3 dimensionally. Adequate mastery of skills in the first semester will permit more freedom in the second semester to do independent projects or group projects for public display.
Prerequisites: 54237 and 54238

54-338  Advanced Scene Painting
Spring:  4 units
This is a year long course designed to explore more complex scene painting problems with an emphasis on professional standards. Projects in the first semester will address such topics as: translucency, tromp l’oiel, aging techniques, signage, perspective, and working 3 dimensionally. Adequate mastery of skills in the first semester will permit more freedom in the second semester to do independent projects or group projects for public display.
Prerequisites: 54237 and 54238 and 54337

54-339  Stage Combat
All Semesters:  3 units
This class will be taught in the spring semester as a mini by a guest instructor. Hand to hand combat, rapier/dagger and sword.

54-341  Costume Design I
Fall:  9 units
FOR: First year graduate costume majors and upper level undergraduates with declared majors. Non-major Design, PTM and Drama students and all others by Instructor Approval only.
DESCRIPTION: A two semester course that engages students with Paul Tazewell, Susan Tsu and guest designers. Principals and elements of design including color theory are examined in discreet costume projects. Strong process orientation. Final project covers play analysis, research, emotional response, deconstruction of script, character analysis, awareness of all design disciplines, drawing, painting, swatching, and spec sheets.
Prerequisites: 54245 and 54347

54-342  Costume Design I
Spring:  6 units
FOR: First year graduate costume majors and upper level undergraduates with declared majors. Non-major Design, PTM and Drama students and all others by Instructor Approval only.
DESCRIPTION: The second semester of a two semester course that engages students with Paul Tazewell, Susan Tsu and guest designers. A continuing exploration of the design process through project work focusing on different genres. In addition to the aesthetics of design, attendant paperwork and organizational aspects critical to the process will be incorporated.
Prerequisites: 54246 and 54348

54-343  Costume Construction I
Fall:  6 units
This course is a study of, and practical work in, primary construction principals with emphasis on the development of patterns from the basic costume shapes through history. Primary shapes this semester include men’s and women’s multi-piece bodices, historic sleeve shapes, breeches and skirts. The ability to look at a picture and know how to interpret it to start creating the shape in fabric is stressed.

54-344  Costume Construction I
Spring:  6 units
A continuation of the work in the Fall. Draping, boots and millinery are explored and some garments are patterned for actual productions. Techniques for communicating with the designer and fitting the actor are developed. Pre-Requisite: Costume Construction I, 54-343

54-349  Automated Lighting Technology
Fall:  6 units
Students are exposed to a range of automated lighting equipment and develop skills in the implementation of them in a production situation. Programming of automated fixtures on a variety of consoles is emphasized. Pre-requisites: Successful completion of Intro to Lighting Permission of Instructor Co-requisites: Lighting Design I
Prerequisites: 54351 and 54352
54-350 Pre-Visualization Lighting Software  
Spring: 6 units  
Students develop skills in the utilization of software designed for pre-visualization of lighting designs. Programs that are introduced include Martin Show Designer, Vari-Lite Visionary and Wysiwyg. Prerequisites: Successful completion of Automated Lighting Technology Permission of instructor Co-requirements: Lighting Design I.  
Prerequisites: 54349

54-351 Lighting Design I  
Fall: 9 units  
Students will read and analyze scripts followed by intense discussion about the ideas generated. Emphasis will be placed on developing a more in-depth process to analyze and translate information in a text to descriptive stage pictures. Students will explore the actualization of these ideas through lab work, realized lighting moments and light plots. The different challenges of designing in proscenium, thrust and arena spaces will also be discussed.  
Prerequisites: 54252

54-352 Lighting Design I  
Spring: 9 units  
Students will read and analyze scripts followed by intense discussion about the ideas generated. Emphasis will be placed on developing the student's ability to collaborate with designers and directors. In addition to designing frequently and fully verbalized lighting designs, focus will be placed on the information communicated via light plots and supporting paperwork. Students will also explore all phases of the design process in the theater.  
Prerequisites: 54351

54-353 Structural Design I  
Fall: 9 units  
This class introduces the fundamentals of Allowable Stress Design, including stress analysis, geometric properties, and the design of wood beams and columns. Upon completion of this course, students should be familiar with forces, stresses and strains, stress analysis for beams, geometric properties of structural sections, sawn lumber beam design and wood column analysis and design. Lecture/discussion format. Students should be conversant with Algebra, Geometry and Trigonometry. No Calculus is required.  
Prerequisites: 54253

54-354 Structural Design II  
Spring: 9 units  
This class continues the study of Allowable Stress Design with Steel Beam Design, Steel Column Analysis and Design, Combined Loading on beams and columns, and Truss analysis and Design. Lecture/discussion format. Students need to have successfully completed Structural Design I.  
Prerequisites: 54353

54-355 Software for Lighting Practicioner  
All Semesters: Mini Session - 3 units  
Software specifically designed for lighting applications is investigated. Ancillary programs for computer-aided drafting software as well as lighting-specific paperwork programs are covered. Prerequisites: Permission of Instructor Co-requisites: Autocad (54-269)

54-361 Production Preparation III  
Fall: 12 units  
Participation in School of Drama productions, usually as assistant supervisor positions for other students filling creative or production roles or in the actual supervisory roles. Prerequisites/Co-requisites: 54-259 & 54-262  
Prerequisites: 54259 and 54262

54-362 Production Preparation III  
Spring: 12 units  
Participation in School of Drama productions, usually as assistant supervisor positions for other students filling creative or production roles or in the actual supervisory roles. Prerequisites/Co-requisites: 54-259 & 54-262  
Prerequisites: 54259 and 54262

54-365 Stage Machine Design  
Fall: 9 units  
This class will guide students through the process of designing standard theatrical machinery, including winched effects (Turntables and Wagons) and Lifts. Upon completion of this course, students should be familiar with Standard theater winch design, Winch Parts Specification, Winch Application/Rigging, Implementation of Control Systems, Lift Mechanics, and Machine Design for Unconventional Applications. Lecture/discussion format. Students should have already successfully taken Physics of Stage Machinery and Technical Design 1. Students registered concurrently in Tech Design 2 will find considerable opportunity for cross-pollination of course content.  
Prerequisites: 54366 and 54378

54-366 Physics of Stage Machinery  
Spring: 9 units  
This class teaches the basic physics of dynamic mechanical systems, specifically in the context of lifts, winches, turntables and wagons used in theatrical production. Material covered consists of Newtonian Dynamics, elementary mechanics and fluid power. Upon completion of this course, students should be familiar with Analysis of Motion Profiles in Production context, Dynamics of systems in constant acceleration, Dynamics of rotational systems, Dynamic and static friction, Mechanical Power requirements of scenic effects, and the Physics of Fluid Power systems. Lecture/Discussion format. Students should be conversant with Algebra, Geometry and Trigonometry. No Calculus is required.

54-367 Lighting Design Skills  
Fall: 6 units  
Students work to develop valuable skills related to theatrical lighting design including focus and technical rehearsal etiquette and technique, in-depth training in the operation of control consoles, lighting-related paperwork and other skills specifically related to the success of assistant lighting designers. Prerequisites: Successful completion of Intro to Lighting Permission of Instructor  
Prerequisites: 54251 and 54252

54-368 Production Electrics  
Spring: 6 units  
Class content includes practical skills in lighting and electrical theory and practice as it pertains to entertainment lighting as well as development of managerial techniques used by Production Electricians in the industry. Students completing the class satisfactorily will be prepared for Master Electrician assignments on School of Drama productions as well as similar positions outside of the School. Prerequisites: Successful completion of fall semester of Intro to Lighting Permission of Instructor Co-requisites: Intro to Lighting (if sequence not completed)  
Prerequisites: 54251

54-371 Directing III Seminar  
Fall: 4 units  
This two-semester class for 3rd-Year Directors is directly related to the work in Directing 3/Acting Lab 2. The Seminar consists of organizational meetings, lectures & discussions relevant to the current class work — such as ground planning, rehearsal organization, vision, genre differentiation, new formats, working with actors, etc.

54-373 Technical Management  
Fall: 9 units  
Further study of advanced scenic techniques and processes. Detailed examination of the production process from design drawings to the stage. Introduction to the physics of stage machinery. Examination of alternative materials for theatrical construction. Project assignments in problem solving, analyzing, planning and drafting of productions.

54-374 Materials and Methods
Technical Designers. The class has four main components: an
This course is an exploration of techniques and practices of
productions while in development. Pre-requisites/Co-
intermittent:

Spring: 9 units
Further study of advanced scenic techniques and processes.
Detailed examination of the production process from design
drawings to the stage. Introduction to the physics of stage
machinery. Examination of alternative materials for theatrical
construction. Project assignments in problem solving, analyzing,
planning and drafting of productions.

54-376 Rigging Seminar
Spring: 6 units
This course is a survey of the techniques and practices of
theatrical rigging. The course has two main components:
permanently installed rigging systems typically found in theatres,
and background and technical information concerning the
components typically used for stage rigging. Discussion topics
include selection criteria for line, hardware, and terminations
stressing entertainment industry standards, workplace safety and
common industry misconceptions. Time permitting the course
will shift from a general discussion of components to their assembly
into custom rigging systems & solutions. Pre-requisites/Co-
requisites: Introduction To Production or instructor’s permission
Prerequisites: 54163 and 54164

54-378 Technical Design I
Spring: 12 units
This course is an exploration of techniques and practices of
Technical Designers. The class has four main components: an
exploration of the types of strategies used by Technical
Designers to arrive at solutions, building an expert vocabulary for
discussion of technical design issues, development of actual
technical solutions, on paper, in discussion, and in the shop,
discussion of any pertinent technical issues for any of the school
productions while in development. Pre-requisites/Co-requisites:
Technical Direction or instructor’s permission
Prerequisites: 54273

54-380 Music Reading for Drama Technicians
Intermittent: 6 units
This course is designed to prepare drama technicians for the
basics of musical score reading. The students will work primarily
with piano/vocal scores but will also be presented with orchestral
scores. Music from the musical theater, opera and ballet repertory
will be studied. Interfacing with current projects on campus and in
the community will be provided as permitted.

54-381 History of Drama
Fall: Mini Session - 3 units
These are eight-week Junior/Senior level dramatic literature
courses, meeting twice weekly, based around a single period,
author, genre, or theme. A typical theme might be ‘Drama and
Science ’ ‘Aggressive Comedy’; ‘Dialectics and Drama; ‘The Rebel
in Drama”; Greek drama; Arabic drama; non-realist drama, and
so on. The intention is that often very heterogenous plays can be
grouped together to reveal both comparisons and contrasts in
dramatic methods. At the conclusion of the course students write
a paper on its main themes.

54-382 History of Drama II
Spring: Mini Session - 3 units
These are eight-week Junior/Senior level dramatic literature
courses, meeting twice weekly, based around a single period,
author, genre, or theme. A typical theme might be ‘Drama and
Science ’ ‘Aggressive Comedy’; ‘Dialectics and Drama; ‘The Rebel
in Drama”; Greek drama; Arabic drama; non-realist drama, and
so on. The intention is that often very heterogenous plays can be
grouped together to reveal both comparisons and contrasts in
dramatic methods. At the conclusion of the course students write
a paper on its main themes.

54-383 Critical Writing
Fall: 4 units
A writing intensive course which focuses on developing skills for
the analysis and criticism of drama and performance.

54-384 Critical Writing
Spring: 4 units
A writing intensive course which focuses on developing skills for
the analysis and criticism of drama and performance.

54-389 Speech and Theatre Community Outreach
Fall: 9 units
Students will develop a process of teaching theatre to middle
school children. Elementary school children will work with drama
students from several disciplines in a mentoring relationship and
learn that theatre is a collaborative experience. The result will be
joint artistic performances at CMU. The Children’s Heritage
Theatre will present classic text as well as newly scripted plays
based on myths and fairy tales from international cultures.

54-390 Speech and Theatre Community Outreach
Spring: 9 units
Students will develop a process of teaching theatre to middle
school children. Elementary school children will work with drama
students from several disciplines in a mentoring relationship and
learn that theatre is a collaborative experience. The result will be
joint artistic performances at CMU. The Children’s Heritage
Theatre will present classic text as well as newly scripted plays
based on myths and fairy tales from international cultures.

54-393 Speech and Phonetics Instruction and
Outreach I
Fall: 6 units
This course is designed for mentors to teach children at the 5th
grade level to speak in a clear, efficient and pleasing manner with
self-confidence. The children will also be able to understand the
relationship between sound and speech; realize the differences
between American English speech and spelling; relate symbols of IPA
to phonemes we use in speech; improve their articulation of Vowels,
Consonants and Diphthongs; discover the musical patterns their
voices can make; follow directions and drills to learn to discriminate
between correct and incorrect productions of Vowels, Consonants and
Diphthongs; develop the techniques for memorization of challenging
poetry.

54-394 Speech and Phonetics Instruction and
Outreach II
Spring: 9 units
This course is designed for mentors to teach children at the 5th
grade level to speak in a clear, efficient and pleasing manner with
self-confidence. The children will also be able to understand the
relationship between sound and speech; realize the differences
between American English speech and spelling; relate symbols of IPA
to phonemes we use in speech; improve their articulation of Vowels,
Consonants and Diphthongs; discover the musical patterns their
voices can make; follow directions and drills to learn to discriminate
between correct and incorrect productions of Vowels, Consonants and
Diphthongs; develop the techniques for memorization of challenging
poetry and participate in a presentation for family and friends using
the skills they have learned.

54-395 Internship
Fall: 6-36 units

54-396 Internship
Spring: 2-36 units

54-399 Special Topics in Playwriting
Fall: 9 units
Prerequisites: 54189

54-400 Advanced Studies in Playwriting
Spring: 9 units

54-401 Camera Lab
Fall: 6 units
This is a year long course required for senior undergraduate
directing and acting majors and second year graduate directors.
The students are introduced to some fundamental ideas about
story telling with a camera. The students learn and practice both
single and multi-camera techniques. There are a series of
projects for the students to encounter and practice acting,
directing, and designing for the camera.

54-402 Camera Lab
Spring: 6 units
Advanced scene study: selectivity, clarity; the honing of performance techniques. Professional requirements, the practical extension of the training. Audition and T.V. techniques. Preparation for a New York presentation at the end of the Spring semester.

54-403 Voice and Speech IV
Fall: 6 units
(Voice) The senior actors continue to strengthen their voice work with individualized voice classes and tutorials. The voice work often addresses particular issues, which these actors encounter in the mainstage productions. Students also re-visit classical text work and build on their sophomore year preparation with additional Shakespeare material. The pieces are prepared as professional audition selections in "Voice-Over Acting". A commercial aspect of the voice work is introduced, developed and marketed in the Voice-Over Acting class. The course presents information which is then applied to narrating radio and television commercials, industrials, feature-length animations, books on tape, CD-ROM videos, computer software programs, etc. Texts are developed for two demo tapes, which are prepared in class and readied for a professional studio-taping session.

54-404 Voice and Speech IV
Spring: 6 units
(Voice) The senior actors continue to strengthen their voice work with individualized voice classes and tutorials. The voice work often addresses particular issues, which these actors encounter in the mainstage productions. Students also re-visit classical text work and build on their sophomore year preparation with additional Shakespeare material. The pieces are prepared as professional audition selections in this work. (Voice-Over Acting) A commercial aspect of the voice work is introduced, developed and marketed in the Voice-Over Acting class. The course presents information which is then applied to narrating radio and television commercials, industrials, feature-length animations, books on tape, CD-ROM videos, computer software programs, etc. Texts are developed for two demo tapes, which are prepared in class and readied for a professional studio-taping session.

54-405 Graduate Directing
Fall: 6 units
Graduate Directing is a semester long course for first and second year graduate directors and senior actors entitled "Classics in another time and place". It explores the techniques as well as the variety of challenges the director and the actor deal with when they transplant the original setting of a well known classical play into a radically different time frame or place of action.

54-406 Graduate Directing
Spring: 6 units
Graduate Directing is a semester long course for first and second year graduate directors and senior actors entitled "Classics in another time and place". It explores the techniques as well as the variety of challenges the director and the actor deal with when they transplant the original setting of a well known classical play into a radically different time frame or place of action.

54-407 Movement IV
Fall: 3 units
Movement IV is a cross-option course, wherein sophomore Designer builds masks for the Senior Actors to use in the creation of a movement/mask piece based on a classic text. (Examples: HEDDA GABLER, CAT ON A HOT TIN ROOF, DRACULA, CYRANO). The course gives Senior Actors an opportunity to create an original ensemble performance piece, bringing over 30 masks to life, using skills learned in the previous classes in mask work (Neutral Mask, Commedia dell’Arte, character and larval masks). Due to the necessity of working as an ensemble in the creation of this piece, the students must work together in various roles: as actors, of course, but also as directors, writers, dramaturgs and stage managers; this course offers a rare chance for students to experiment with actor-created theatre, as well as, because it is cross-option, an opportunity for actors and designers to work together to create masks which are able to be brought to life through movement, that are comfortable, offer enough visibility, are secure during activity, etc. - a unique learning laboratory for designers and actors to interact involving both artistic and practical issues related to the creation and use of these masks as theatrical metaphor. Prerequisites: 54307 and 54308

54-409 Theatre Lab
Fall: 9 units
This is a two-semester class which teaches the collaborative process of theatre — including the role of the living dramatic writer. New scripts are written by graduate dramatic writers, then developed and realized by senior actors and by graduate and undergraduate directors. This work results in 10-minute play scripts, one acts, monologue dramas, and the texts for the MFA Thesis Productions. This class is co-taught by the Dramatic Writing, Acting and Directing Options.

54-410 Theatre Lab
Spring: 9 units
This is a two-semester class which teaches the collaborative process of theatre — including the role of the living dramatic writer. New scripts are written by graduate dramatic writers, then developed and realized by senior actors and by graduate and undergraduate directors. This work results in 10-minute play scripts, one acts, monologue dramas, and the texts for the MFA Thesis Productions. This class is co-taught by the Dramatic Writing, Acting and Directing Options.

54-411 Rehearsal & Performance
Fall: 12 units
Participation outside of class requirements in departmental productions. Putting into practice the techniques acquired over the years of training and exploring the development of a performance played before the public over two weeks.

54-412 Rehearsal & Performance
Spring: 12 units
Participation outside of class requirements in departmental productions. Putting into practice the techniques acquired over the years of training and exploring the development of a performance played before the public over two weeks.

54-414 Leagues
Spring: 9 units
Senior acting class for actors and Mt’s who are in good standing and in position to graduate in the Spring. Preparation for the New York and Los Angeles Showcase presentations.

54-421 Improvisation
Fall: 2 units
Introduction to single and multicamera studio directing and performance. Encounter major 20th century theatrical and dramatic movements.

54-422 Directing IV
Spring: 4 units
Encounter major 20th century theatrical and dramatic movements. Specific concentration on directorial innovations in the last half of the 20th century

54-423 Dance IV
Fall: 1-3 units
Dance 4 Section A, Ballet - 3 units An advanced ballet class aimed at developing and honing advanced dance vocabulary and artistry. Prerequisite: Dance 3 or permission of the instructor Dance 4 Section B, Broadway Styles - 3 units A practical study of American Musical Theatre dance utilizing choreographic elements of such dance masters as Fosse, Robbins, Bennett, De
Course Descriptions

Mille. The course also examines styles from the 20's, 40's, 60's and current contemporary social dances. Dance 4 Section C, Tap - 1 unit Upper level of tap for Music Theatre majors

Prerequisites: 54323 and 54324

54-424 Dance IV
Spring: 1-3 units
Dance 4 Section A, Ballet - 3 units An advanced ballet class aimed at developing and honing advanced dance vocabulary and artistry. Prerequisite: Dance 3 or permission of the instructor
Dance 4 Section B, Broadway Stylé - 3 units A practical study of American Musical Theatre dance utilizing choreographic elements of such dance masters as Fosse, Robbins, Bennett, De Mille. The course also examines styles from the 20's, 40's, 60's and current contemporary social dances. Dance 4 Section C, Tap - 1 unit Upper level of tap for Music Theatre majors

Prerequisites: 54423

54-431 Scene Design II
Fall: 9 units
A two-semester investigation into the processes, challenges and techniques for the development of scenic environments within the context of theatrical and television production. Assignments of un-produced and produced projects are evaluated through text-based analysis as well as pragmatic solutions. The disciplines of conceptualization, communication and collaboration are fully explored and engaged.

Prerequisites: 54331

54-432 Scene Design II
Spring: 9 units
A two-semester investigation into the processes, challenges and techniques for the development of scenic environments within the context of theatrical and television production. Assignments of un-produced and produced projects are evaluated through text-based analysis as well as pragmatic solutions. The disciplines of conceptualization, communication and collaboration are fully explored and engaged.

54-433 Producing for TV and Film
Fall and Spring: 9 units
The course will examine the responsibilities of a producer in a variety of production situations: working with a client, a staff producer at a television station, an entrepreneur or an independent producer. Students will be required to produce commercials, corporate material, documentaries and dramatic pieces.

54-435 Designer/Director Collaboration
Fall: 6 units
This is a one-semester course in clarifying and enriching the collaborative process of The Creative Team (Designers and Directors) in creating imaginary worlds and making theatre. The hope is to encourage greater understanding, respect and appreciation of the responsibilities of all collaborators in the process, with the goal of fruitful collaborations in the future. An instructor from the Design Option and an instructor from the Directing Option will lead the class. A model will be presented and tested to serve as a guide for future collaborations and how to address working problems. Specific goals of the class are: to determine how to create a base of trust in a creative team and co-ownership of a project; to define responsibilities within a project; to determine an order to the collaborative process; to effectively communicate among theatrical disciplines — working in a professional manner; to collaborate to create a theatrical form expressive of the content of the play; to create a mutually-satisfying project.

54-437 Acting IV
Fall: 6 units
An integration of training and craft approaches related to the rehearsal process featuring a comprehensive approach to text. Students will also examine their propensities and limitations in order to expand their emotional physical vocal and intellectual range.

54-438 Acting IV
Spring: 9 units
An integration of training and craft approaches related to the rehearsal process featuring a comprehensive approach to text. Students will also examine their propensities and limitations in order to expand their emotional physical vocal and intellectual range.

54-441 Costume Design II
Fall: 9 units
FOR: Second year graduate costume majors and upper level undergraduates with declared majors. DESCRIPTION: A two semester course that engages students with Paul Tazewell, Susan Tsu and guest designers. Following the sequence of Fall and Spring Costume Design I, this upper level course exposes students to a range of genres that includes film, television, opera, and dance with a realized Dance/Light/Costume collaboration finishing out the semester.

Prerequisites: 54245 and 54341 and 54347

54-442 Costume Design II
Spring: 9 units
FOR: Second year graduate costume majors and upper level undergraduates with declared majors. DESCRIPTION: The second semester of a two semester course that engages students with Paul Tazewell, Susan Tsu, guest designers and directors. Advanced in-depth design work involves completion of Dance/Light/Costume project, advanced play analysis and design process work including the further refinement of visual skills. Created to augment the experience of students who are already designing School of Drama productions, this course is tailored every year to develop student’s existing design sensibilities and skills, build their portfolios and deepen the exploration of their individual voices as artists. Undergraduates will receive career counseling and mentorship on the preparation of their portfolios, resumes and cover letters for professional interviews.

Prerequisites: 54246 and 54448

54-443 Costume Construction II
Fall: 6 units
Advanced problems in costume building and pattern developing individually assigned to strengthen the skills of the student. Projects may be drawn from actual designs for productions if the challenge is suitable for the student’s development. This course may be taken for 1 or 2 semesters, starting either Fall or Spring

Prerequisites: 54343 and 54344

54-444 Costume Construction II
Spring: 6 units
Advanced problems in costume building and pattern developing individually assigned to strengthen the skills of the student. Projects may be drawn from actual designs for productions if the challenge is suitable for the student’s development. This course may be taken for 1 or 2 semesters, starting either Fall or Spring

Prerequisites: 54343 and 54344

54-446 Business Practices for Designers
Spring: Mini Session - 6 units
An introduction to the issues and conventionally held practices for the development of responsible self-employment by design-oriented professionals. Discussions investigate the challenges of conducting business within the competitive marketplace of performance-based industries.

54-447 Figure Drawing
Fall: 4 units
This year long course explores the realistic and expressive depiction of the human form primarily in two dimensional media. Working primarily from the live model, exercises will be undertaken that address gesture, proportion, movement, anatomy and structure, and composition and expressive form. Students will experience a variety of media and formal approaches to the figure, working from nude, draped, and clothed male and female models. One of the primary goals of the class is to develop the ability to create the human figure from imagination, based on intensive empirical study of the forms and structures of the human body from life. Although most of the work takes place in class, some outside study is required.
course Descriptions

54-448 Figure Drawing
Spring: 4 units
This year long course explores the realistic and expressive depiction of the human form primarily in two dimensional media. Working primarily from the live model, exercises will be undertaken that address gesture, proportion, movement, anatomy and structure, and composition and expressive form. Students will experience a variety of media and formal approaches to the figure, working from nude, draped, and clothed male and female models. One of the primary goals of the class is to develop the ability to create the human figure from imagination, based on intensive empirical study of the forms and structures of the human body from life. Although most of the work takes place in class, some outside study is required.

54-451 Lighting Design II
Fall: 9 units
Students will study lighting design in a variety of genres: dance, opera, television, concert lighting and touring productions. Advanced lighting technology will be integrated into the design process. Projects will include hands-on lab work and theoretical designs that integrate a professional process working with the Pittsburgh Opera, Pittsburgh Ballet and WQED. Focus will be given to developing speed, accuracy and organization in the implementation of designs.
Prerequisites: 54349 and 54350 and 54352

54-452 Lighting Design II
Spring: 9 units
Students will study lighting design in a variety of genres: entertainment design, industrials, architectural lighting, art installations, television and film. Advanced lighting technology will be integrated into the design process. Projects will include hands-on lab work and theoretical designs that integrate a process working with professional companies. Emphasis will also be placed on developing a professional design portfolio.
Prerequisites: 54451

54-453 Production Management Workshop I
Fall: 6 units
Investigates the organization, planning and interpersonal skills required to successfully manage a live theatrical production. Topics covered include: Budgeting, Scheduling, Communication, Job Descriptions, Reporting and Project Management. Permission of instructor required.

54-457 Directing: Production IV
Fall: 10 units
SENIOR DIRECTING PROJECT: This is a 90-minute, public, fully-designed presentation directed by a 4th-Year Directing student with the following goals: to publicly realize a playwright's purpose for a live audience; to tell an entire theatrical story with a beginning, progression & ending; to work as a team with actors & design team to shape a cohesive & coherent theatrical presentation; to extend practical understanding of Theatre as a collaborative process; to synthesize & apply prior studies at Carnegie Mellon

54-458 Directing: Production IV
Spring: 10 units
SENIOR DIRECTING PROJECT: This is a 90-minute, public, fully-designed presentation directed by a 4th-Year Directing student with the following goals: to publicly realize a playwright's purpose for a live audience; to tell an entire theatrical story with a beginning, progression & ending; to work as a team with actors & design team to shape a cohesive & coherent theatrical presentation; to extend practical understanding of Theatre as a collaborative process; to synthesize & apply prior studies at Carnegie Mellon

54-461 Production Preparation IV
Fall: 15 units
Participation in School of Drama productions, usually in supervisory roles in design or production. Pre-requisites/Co-

54-462 Production Preparation IV
Spring: 15 units
Participation in School of Drama productions, usually in supervisory roles in design or production. Pre-requisites/Co-

54-466 Stage Machinery Design II
Spring: 6 units
This is a laboratory experience designed to give practical experience implementing standard stage machinery in a production context. Specific content is dependent on the needs of current productions.
Prerequisites: 54365

54-475 Theatre Management
Fall: 6 units
Survey of management practices and principles as applied to the performing arts. Investigation of selected problems typical of those facing the arts administrator.

54-477 Technical Design II
Fall: 9 units
This weekly seminar focuses on solving technical challenges commonly found in a regional and commercial theatre. Where possible, assignments duplicate actual production specifications. Successful solutions incorporate an awareness of how the particular effect functions within the production as a whole. Students are expected to integrate skills and knowledge from their previous classroom and production experiences. This course will promote appreciation of diverse technical design approaches to the same challenge. Each session will feature a different assignment, to be discussed in the subsequent session. These presentations will provide the basis for roundtable discussion, promoting the appreciation of diverse design strategies. Students must have already successfully completed Technical Design I.
Prerequisites: 54378

54-480 Music Reading for Drama Technicians
Intermittent: 6 units
This course is designed to prepare drama technicians for the basics of musical score reading. The students will work primarily with piano/vocal scores but will also be presented with orchestral scores. Music from the musical theater, opera and ballet repertory will be studied. Interfacing with current projects on campus and in the community will be provided as permitted.

54-483 Speech and Theatre Community Outreach
Fall: 9 units
Students will develop a process of teaching theatre to middle school children. Elementary school children will work with drama students from several disciplines in a mentoring relationship and learn that theatre is a collaborative experience. The result will be joint artistic performances at CMU. The Children's Heritage Theatre will present classic text as well as newly scripted plays based on myths and fairy tales from international cultures.

54-484 Speech and Theatre Community Outreach
Spring: 9 units
Students will develop a process of teaching theatre to middle school children. Elementary school children will work with drama students from several disciplines in a mentoring relationship and learn that theatre is a collaborative experience. The result will be joint artistic performances at CMU. The Children's Heritage Theatre will present classic text as well as newly scripted plays based on myths and fairy tales from international cultures.
Course Descriptions

54-491 Theatre Studies Thesis
Fall: 9 units

54-492 Theatre Studies Thesis
Spring: 6-9 units

54-494 Business of Acting
Fall and Spring: 3 units
The course introduces the (advanced) actor to various aspects of the professional world. Emphasis is placed on the audition and interview process for casting directors, talent agents and personal managers. Each student will present either an individual or small group project chosen from a wide ranging list of topics which include performers unions, various production contracts, New York and regional theater season, professional publications and web sites. Occasional tests are administered on the subject of current Broadway and Off-Broadway seasons. Prerequisites: 54301 and 54302

54-495 Internship
Fall: 9-36 units
Assignment to professional theatre organizations designed to meet the professional needs of advanced-standing students. By permission of the Head of the Department.

54-496 Internship
Spring: 9-36 units
Assignment to professional theatre organizations designed to meet the professional needs of advanced-standing students. By permission of the Head of the Department.

54-500 Voice Lab
Fall and Spring: 5 units
Singing Voice based on speech-level and classical singing techniques, required of all Musical Theatre Majors. Lessons are private, for the duration of one hour per week. Voice Lab combines all students of Musical Theatre in a one-hour performance class, where repertoire is performed for faculty and students alike. Training is progressive, with each semester building on the vocal mastery achieved from the previous semester. Repertoire spans from classical to rock, but with an emphasis on songs extracted from the American Musical Canon.

54-502 Junior Auditioning
Fall and Spring: 2 units
This is a one-semester elective course for Junior Actors & MTs in the fundamentals of the Audition process. Goals include: to learn the givens of the Audition process including determining the parts of the process over which the actor does & does not have control; to learn how to shape an effective Audition; to learn to present oneself in a professional manner; to learn how to choose Audition pieces that work for the specific individual; to learn how to contrast Audition pieces; to learn how to handle cold readings. Important: All showings are to be presented as if for an actual Audition — that is, as if for auditors who do not know you.

54-507 Creating and Producing Independent Video
Fall: 6 units
This is a two semester course. The goal of the course will be to produce a five minute video during the Fall semester and a long form of not more than thirty minutes in duration during the Spring semester. Prerequisites: 54303 and 54304. The foundation developed in the Fall semester will be expanded. Using the script developed in the Falls semester, each student will produce a long form of no more than thirty minutes in duration during the Spring semester. Production teams established in the Fall semester will participate in the collaborative process. In addition to scheduled classroom time, a considerable time commitment will be required. The faculty mentor will meet for one-on-one consultations, supportive discussions and recommendations throughout the production process. Prerequisites: 54301 and 54302

54-508 Creating and Producing Independent Video
Spring: 12 units
All students are required to complete several projects and create a five minute video during the Fall semester and a long form of not more than thirty minutes in duration during the Spring semester. Prerequisites: 54303 and 54304. The foundation developed in the Fall semester will be expanded. Using the script developed in the Falls semester, each student will produce a long form of no more than thirty minutes in duration during the Spring semester. Production teams established in the Fall semester will participate in the collaborative process. In addition to scheduled classroom time, a considerable time commitment will be required. The faculty mentor will meet for one-on-one consultations, supportive discussions and recommendations throughout the production process to review and evaluate project development. Prerequisites: 54507

Music
Undergraduate Courses

57-090 Basic Theory Skills
Fall: Mini Session - 0 units
This course prepares students with little or no theory background to succeed in the sequence of harmony and counterpoint classes (course numbers 151-154). Topics include clefs, scales of all types, intervals, simple chord types, basic notation and terminology, and fundamental concepts of analysis.

57-092 Basic Solfège Skills
Fall: 0 units
This course improves the student’s ability to analyze music aurally and to sing at sight music in traditional meters, major and minor keys, written in treble and bass clefs, and to notate rhythmic and melodic patterns. The “fixed do” system is used. The course begins at a basic level and is designed as a noncredit class to prepare the student for successful participation in future Solfège courses.

57-093 Basic Solfège Skills
Spring: 0 units
Continues 57-092 Basic Solfège Skills. Prerequisites: 57092

57-101 Introduction to Music Technology
Fall and Spring: Mini Session - 6 units
This course gives an overview of music technology through practical information and several hands-on projects. Concepts such as MIDI and digital audio are introduced and specific topics are covered in detail including sequencing, music notation, digital recording, mixing, and production. Throughout the course, students are required to complete several projects and create musical compositions in styles of their own choosing. The student is not graded on the “musicality” of these compositions, but instead on how well they meet the stated project goals by correctly using specific equipment and/or computer programs.
57-102  Finale
Spring: 6 units
This course provides hands-on and in-depth instruction of the Finale music notation program by Coda Music Software. Students will learn how to efficiently use the various notation tools that Finale has to input, edit, and manipulate music. MIDI input, playback, and transcription will also be covered to allow students to quickly notate and hear their music. The goal is to create professional-looking printed scores and parts in a variety of styles from Classical to Contemporary. A basic knowledge of music notation is required.

57-111  Dance I
Fall: 3 units
This course is designed for voice majors. Jazz is a dance technique unique to the United States. The warm-up activities prepare the body for the specific demands of jazz movement. The music, while basically jazz, may range from gospel to punk rock. Levels one and two consist of intensive body stretching, body awareness, body discipline, and understanding the use of technique and conditioning.

57-112  Dance II
Spring: 3 units
Continues 57-111 Dance I.
Prerequisites: 57111

57-151  Principles of Counterpoint
Fall: 6 units
This course explores the development of Western music composed with multiple independent parts. The first half of the course traces the history of part-writing from medieval organum through the late twentieth-century. The second half examines, across several musical styles, specific contrapuntal techniques such as imitation and ground bass forms. Assignments include both writing exercises and analysis projects.
Prerequisites: 57152 or 57155

57-152  Harmony I
Fall: 6 units
This course deals with common-practice harmony. It includes triads and their inversions, tonality and modality, non-harmonic tones, cadences, and the basic concepts of modulation.

57-153  Harmony II
Spring: 6 units
This course is a continuation of the study of common practice harmony, exploring dissonant and chromatic harmony.
Prerequisites: 57152 or 57155

57-154  18th Century Counterpoint
Spring: 6 units
This course deals with all phases of two-part tonal writing and culminates in the study of the Bach Two-part Inventions. The course serves to combine everything the student has learned about counterpoint and harmony.
Prerequisites: 57153 or 57156

57-161  Eurhythmics I
Fall: 3 units
Dalcroze Eurhythmics is a unique approach to music learning based on the recognition that meaningful rhythmic movement experience, associated with ear-training and improvisation, reinforces understanding of music concepts, enhances musicianship, and focuses awareness on the physical demands of artistic performance. All concepts are experienced in a musical context. Rhythm reading, notation, analysis, and improvisation are integral to the course. Eurhythmics I covers basic binary and ternary metric units and rhythm patterns in relation to these metric units within simple and compound meters.

57-162  Eurhythmics II
Spring: 3 units
Continues 57-161 Eurhythmics I. Eurhythmics II introduces combinations of binary and ternary metric units, mixed meters, changing meters, and notation and performance of cross-rhythms.
Prerequisites: 57161

57-163  Eurhythmics III
Fall: 3 units
Continues 57-162 Eurhythmics II. Eurhythmics III focuses on rhythmic transformation, rhythm patterns based on small note values, irregular sub-divisions of metric units, and more complex cross-rhythms.
Prerequisites: 57162

57-164  Eurhythmics IV
Spring: 3 units
Continues 57-163 Eurhythmics III. Eurhythmics IV focuses on changing metric units within a composition, polymeter, and asymmetric rhythmic augmentation and diminution based on Messiaen techniques.
Prerequisites: 57163

57-173  Survey of Western Music History
Fall: 9 units
This course surveys the origins, history, and development of the art music of European civilization from the time of Pope Gregory I to the present. The course is organized around certain recurrent themes, such as the chronic conflict between words and music, classicism and romanticism, and randomness and predictability. Reading assignments and listening to music are equally important for class sessions, but reading and thinking ability are emphasized on tests and exams.

57-181  Solfege I
Fall: 6 units
This course improves the student’s ability to analyze music aurally and to sing at sight in traditional meters and tonalities using the “fixed do” system. Solfege is the integration of the three cognitive skills: reading music, hearing music, and writing what one hears. Section assignment is determined by a placement test given at the time of the audition or prior to the start of classes.

57-182  Solfege II
Spring: 6 units
Continues 57-181 Solfege I.
Prerequisites: 57181

57-183  Solfege III
Fall: 6 units
Continues 57-182 Solfege II. Students are given assignments of classical music written in the treble, bass, soprano, alto, and tenor clefs. Writing consists of two-part contrapuntal dictations.
Prerequisites: 57182

57-184  Solfege IV
Spring: 6 units
Continues 57-183 Solfege III. Students learn to read atonal music and practice three-part contrapuntal dictations as well as harmonic dictations.
Prerequisites: 57183

57-185  Advanced Solfege I
Fall: 6 units
Advanced work for experienced students and those with perfect pitch.

57-186  Advanced Solfege II
Spring: 6 units
Continues 57-185 Advanced Solfege I.
Prerequisites: 57185
57-191 Keyboard Studies I
Fall and Spring: 3 units
All undergraduate music students are required to take four semesters of keyboard studies during their freshman and sophomore years. The emphasis of this course is to develop a practical keyboard facility, which includes keyboard theory and technique, sightreading, solo and ensemble repertoire, transposition, and a variety of creative activities such as harmonization and improvisation.

57-192 Keyboard Studies II
Fall and Spring: 3 units
Continues 57-191 Keyboard Studies I.
Prerequisites: 57191

57-193 Skills of Accompanying I
Fall: 3 units
A required course for first year piano majors. The skills include sightreading, basic keyboard harmony, transposition, and improvised accompaniments for popular or musical theater songs from either a piano reduction or a lead sheet. The students participate in collaborative situations such as juries, recitals, and class presentations. The presentations are critiqued by the instructor and by other students.

57-194 Skills of Accompanying II
Spring: 3 units
Continues 57-193 Skills of Accompanying I.
Prerequisites: 57193

57-202 Opera History
Spring: 9 units
This course surveys the origins, history, and development of opera from the time of the Florentine Camerata to the present. The course is organized around the changing relationships between music and drama from the 16th to the 20th Century, using the stage representation of certain standard operatic character types over the past four hundred years as a point of departure. Reading assignments and listening to music are equally important for class sessions.

57-203 Medieval, Renaissance, and Baroque Music History
Spring: 9 units
This course is organized around developments in music, which resulted in the "classical style," from Gregorian chant to the Rococo idiom of the 18th Century. Major emphases of the course are the persistent conflict of words versus notes, the relation of the artist to the rest of society, and music as a mirror of changing world-views across the centuries. Reading assignments and listening to music are equally important for class sessions.

57-204 18th and 19th Century Music History
Fall: 9 units
This course deals with the flowering and subsequent elaboration of the great quasi-Newtonian musical system known as "functional harmony," "tonality," "common practice," or simply the "classical style." From Joseph Haydn to Richard Wagner, the course examines the increasing importance of literary factors versus musical structure per se. Reading assignments and listening to music are equally important for class sessions.

Prerequisites: 57173

57-205 20th Century Music History
Spring: 9 units
An exploration of 20th Century music arranged by category into three broad groups: concert music, popular music, and world music. In our present era of musical pluralism and technology, styles are exchanged and combined so freely that we owe it to our cultural continuity to look at as many kinds of music as time will permit. Aspects to be discussed are the role of 20th Century music in society, its reception by audiences, its relation to other arts and to political and economic factors, and its theory and pedagogy.

57-207 Secondary Studio
Fall: 3-12 units
Provides the opportunity for students to pursue study in a secondary instrument or area. By special permission only.

57-208 Secondary Studio
Spring: 3-12 units
Provides the opportunity for students to pursue study in a secondary instrument or area. By special permission only.

57-211 Dance III
Fall: 3 units
Continues 57-211 Dance II. Levels three and four emphasize technique.
Prerequisites: 57112

57-212 Dance IV
Spring: 3 units
Continues 57-211 Dance III.
Prerequisites: 57211

57-213 Dance (Tap) I
Fall: 3 units
Prerequisites: 57213

57-214 Dance (Tap) II
Spring: 3 units
Prerequisites: 57213

57-215 Dance (Tap) III
Fall: 3 units
Prerequisites: 57214

57-216 Dance (Tap) IV
Spring: 3 units
Prerequisites: 57215

57-217 Dance (Tap) V
Fall: 3 units
Prerequisites: 57216

57-218 Dance (Tap) VI
Spring: 3 units
Prerequisites: 57217

57-220 English Diction
Fall: 3 units
This one semester course helps singers sing English songs from the Classical and Musical Theater repertoire with clarity, accuracy, ease, uniformity, and expressiveness; to illuminate meaning; and to improve tonal quality through diction.

57-221 Italian Diction
Spring: 3 units
A study of the fundamentals of Italian diction and development of legato vocal style through the analysis of grammatical usage, word construction, vowel colorization, and consonant articulation. Included are in-class performance evaluations, listening assignments, critiques, and private coachings.

57-222 French Diction
Spring: 3 units
This course is designed primarily for singers specializing in French Art Songs of the 19th and 20th centuries. It deals with the use of the International Phonetic Alphabet, its application to singing in French, the use of the liaison and the preparation of the text of a song or aria. One-third of the course is theory and two-thirds of the course is spent on application by performance with piano accompaniment.

57-223 German Diction
Spring: 3 units
In-depth study of German diction - development of legato vocal style in German through the analysis of grammatical usage, word construction, vowel colorization and consonant articulation. Included are in-class German diction evaluations, peer assessment, and emphasis on competency in using the International Phonetic Alphabet.
Course Descriptions

57-225 Contemporary Ensemble
Fall and Spring: 3 units
This ensemble performs the wide range of expressive media that composers have developed in our time. Programs include three categories of works: 1) compositions that can be called Twentieth Century classics because of the historical importance and the aesthetic influence they have had on our musical culture; 2) compositions written by student composers; and 3) compositions written by well-known composers that show new and original artistic points of view. The repertoire ranges from works for chamber ensemble to concert and chamber opera.

57-227 Jazz Ensemble
Fall and Spring: 3 units
These are Jazz Ensembles (Section A and Section B) which incorporate a comprehensive approach to Big Band performance and study. Both ensembles perform four to six times a year as part of the School of Music's regular concert series, as well as at University and off-campus events. The music for both bands is drawn from all eras of Big Band repertoire with occasional projects in a specific genre. The Jazz Ensembles are carefully coordinated with the Jazz Performance Minor program, the Jazz Vocal Ensemble, and the other major ensembles in order to challenge and prepare students for professional music careers. Admission to both jazz ensembles is by competitive audition and placement is determined by the director. Grading is based on attendance, preparation, and consistent progress.

57-228 Chamber Music
Fall and Spring: 3 units
Through rehearsal, coaching, and performance, ensembles solve problems of intonation, balance, and interpretation. A jury exam is required.

57-232 Chamber Music (Guitar)
Fall and Spring: 3 units
Provides an opportunity for students to play in small ensembles, advised by faculty coaches. The performers will develop effective rehearsal techniques, explore chamber music repertoire, deal with issues of intonation and balance, and arrive at interpretative conclusions that are stylistically sound, yet individualistic and creative. A jury exam is required.

57-233 Sonatas
Fall and Spring: 3 units
This course focuses on coaching of performance groups with two members. It parallels Chamber Music, which focuses on coaching of performance groups with three or more members.

57-240 Acting I
Fall: 6 units
The basics of acting will be established throughout the first year following the guideposts described in Audition, by Michael Shurtleff. Structured improvisations, monologues, scene work, songs, and arias will provide a platform for the development of stage presence and effective communication. Each semester will finish with a group project that provides an opportunity for the students to begin to work together as a cast.

57-241 Acting II
Spring: 6 units
Continues 57-240 Acting I. Prerequisites: 57240

57-257 Orchestration I
Fall: 6 units
This is an introductory course for all music majors, and required for sophomore composition majors. The characteristics of each instrument of the orchestra are studied thoroughly. Orchestral textures from the classics to contemporary music are studied and analyzed. Prerequisites: 57152

57-258 20th Century Techniques
Spring: 6 units
This course is open to all music majors and required for sophomore composition majors. The most important techniques from Debussy to the present will be reviewed in terms of melody, harmony, and form. Tonality, serialism, and aleatoric devices will be studied. Compositional techniques of the 20th Century are put into perspective and compared with other developments in the arts. The class is conducted as an open forum in which discussions are encouraged. Prerequisites: 57153

57-265 Fugue
Spring: 6 units
The course is designed to help the students in two directions: the analysis of works written as fugues - or with that concept in mind (fugato) - and the composition of fugues. From the very beginning, it intends to show the difference between Fugue as a form - in particular, a Baroque form - and Fugue as a concept - used as such in many distinctive musical languages (Bach, Mozart, Beethoven, Liszt, Bartok, Ives, and Lutoslawski). The course is useful both for performers, providing them the analytical tools needed to understand this kind of work, and for composers, allowing them to use the concept of Fugue within the framework of their own creative needs. By the end of the semester, each student writes a fugue for string quartet. Prerequisites: 57154

57-271 Orchestration II
Fall: 6 units
This course is designed for junior composition majors; others are admitted by permission. The students will analyze music from the Classical to Avant-garde and use the knowledge acquired to orchestrate piano scores in the appropriate style. Style, practicality, color, and imagination are encouraged. Prerequisites: 57257

57-272 Orchestration III
Spring: 6 units
Continues 57-271 Orchestration II and combines orchestration and composition. Prerequisites: 57271

57-273 Piano Pedagogy I
Fall: 6 units
This course offers an historical overview of piano pedagogy including its significant developments over the past forty years. Topics covered include beginning piano techniques, the sequencing of concepts and materials, common problems among beginning pianists, practicing, motivation, and parental involvement. Current, representative beginning piano methods will be surveyed.

57-274 Piano Pedagogy II
Spring: 6 units
Beyond the beginning years: this course covers piano pedagogy of intermediate and early advanced level students. Topics include "What is style?" and "What is a good piece?" Standard literature and technical development repertoire lists will be studied. The business of piano teaching and the instruction of college keyboard skills for non-piano majors will be discussed. Prerequisites: 57273

57-275 Piano Pedagogy III
Fall: 6 units
Continuation of 57-274. Intermediate literature, analysis, teaching, and performance will be covered. Prerequisites: 57274

57-276 Piano Pedagogy IV
Spring: 6 units
Continuation of 57-275. Early advanced literature, analysis, teaching, and performance will be covered. Prerequisites: 57275

57-291 Keyboard Studies III
Fall and Spring: 3 units
Prerequisites: 57192
### Course Descriptions

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Fall</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>57-292</td>
<td>Keyboard Studies IV</td>
<td>3 units</td>
<td></td>
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<tr>
<td>57-293</td>
<td>Keyboard Studies Test</td>
<td>0 units</td>
<td></td>
<td></td>
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<tr>
<td>57-300</td>
<td>Pipe and Drum Band</td>
<td>3 units</td>
<td></td>
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<tr>
<td>57-301</td>
<td>Bagpipe Composers</td>
<td>3 units</td>
<td>Intermittent</td>
<td></td>
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<tr>
<td>57-302</td>
<td>Bagpipe Construction</td>
<td>3 units</td>
<td>Intermittent</td>
<td></td>
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<tr>
<td>57-303</td>
<td>Bagpipe Literature and Repertoire</td>
<td>3 units</td>
<td>Intermittent</td>
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<tr>
<td>57-304</td>
<td>Bagpipe Maintenance</td>
<td>3 units</td>
<td>Intermittent</td>
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<tr>
<td>57-305</td>
<td>Bagpipe Reedmaking</td>
<td>3 units</td>
<td>Intermittent</td>
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<tr>
<td>57-306</td>
<td>World Music</td>
<td>6 units</td>
<td>Fall</td>
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<tr>
<td>57-307</td>
<td>Bagpipe Theory</td>
<td>3 units</td>
<td>Intermittent</td>
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<tr>
<td>57-308</td>
<td>Bagpipe Advanced History</td>
<td>3 units</td>
<td>Intermittent</td>
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<tr>
<td>57-309</td>
<td>Bagpipe Literature and Repertoire</td>
<td>3 units</td>
<td>Intermittent</td>
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<tr>
<td>57-310</td>
<td>Bagpipe Advanced Literature and Repertoire</td>
<td>3 units</td>
<td>Intermittent</td>
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<tr>
<td>57-311</td>
<td>Dance V</td>
<td>3 units</td>
<td>Fall</td>
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<td>57-312</td>
<td>Dance VI</td>
<td>3 units</td>
<td>Spring</td>
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<tr>
<td>57-316</td>
<td>Dance VI</td>
<td>3 units</td>
<td>Spring</td>
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<tr>
<td>57-328</td>
<td>Jazz Chamber Music</td>
<td>3 units</td>
<td>Fall and Spring</td>
<td></td>
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<tr>
<td>57-331</td>
<td>Principles of Education</td>
<td>9 units</td>
<td>Fall</td>
<td></td>
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<tr>
<td>57-332</td>
<td>Introduction to Conducting</td>
<td>6 units</td>
<td>Fall</td>
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<tr>
<td>57-333</td>
<td>Band and Choral Arranging</td>
<td>6 units</td>
<td>Spring</td>
<td></td>
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<tr>
<td>57-334</td>
<td>Fundamentals of Marching Band</td>
<td>3 units</td>
<td>Fall</td>
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</tbody>
</table>

**Course Descriptions**

- **57-292 Keyboard Studies IV**
  Prerequisites: 57291

- **57-293 Keyboard Studies Test**
  Prerequisites: 57291

- **57-300 Pipe and Drum Band**
  Prerequisites: 57291

- **57-301 Bagpipe Composers**
  Prerequisites: 57291

- **57-302 Bagpipe Construction**
  Prerequisites: 57291

- **57-303 Bagpipe Literature and Repertoire**
  Prerequisites: 57291

- **57-304 Bagpipe Maintenance**
  Prerequisites: 57291

- **57-305 Bagpipe Reedmaking**
  Prerequisites: 57291

- **57-306 World Music**
  Prerequisites: 57291

- **57-307 Bagpipe Theory**
  Prerequisites: 57291

- **57-308 Bagpipe Advanced History**
  Prerequisites: 57291

- **57-311 Dance V**
  Prerequisites: 57291

- **57-316 Dance VI**
  Prerequisites: 57291

- **57-328 Jazz Chamber Music**
  Prerequisites: 57291

- **57-331 Principles of Education**
  Prerequisites: 57291

- **57-332 Introduction to Conducting**
  Prerequisites: 57291

- **57-333 Band and Choral Arranging**
  Prerequisites: 57291

- **57-334 Fundamentals of Marching Band**
  Prerequisites: 57291
primarily for those seeking a career in teaching, will accommodate students with no experience and others who have participated in marching band. Among the many areas of concentration will be: philosophy, show charting, marching fundamentals and commands, logistical awareness, and budget formulation. Observation of and active assistance with Carnegie Mellon Kiltie Band will be part of the course content.

57-335 Analysis Seminar
Intermittent: 6 units
This course is an analytical survey of the music of the 18th, 19th, and 20th Centuries with an emphasis on the music of the 20th Century. Beginning with a demonstration of various analytic techniques, compositions of Beethoven, Strauss, Debussy, Takemitsu, Bartok, Schoenberg, Webern, and Berg will be analyzed and discussed. Participating students should have good knowledge about voice leading and harmonic progression. The course is open to composers, conductors, and performers.
Prerequisites: 57154

57-336 Instrumental/Choral Conducting
Spring: 6 units
This course is a continuation of Introduction to Conducting. The course offers a more detailed conducting technique, adding those subjects related to choral conducting. This is followed by the study and the analysis of interpretation from the point of view of the conductor and ends stressing a set of important practical items, including the psychological attitude and the leadership a conductor must develop as well as the organization and achievement of a fruitful rehearsal technique. The students work periodically with a pianist, a soloist or a chamber ensemble on traditional works and on their own compositions in the case of composition majors.
Prerequisites: 57332

57-337 Sound Recording
Fall and Spring: Mini Session - 6 units
This course centers around the recording studio in the School of Music: how the studio works, and how to record various types of music, including classical music, using the recording studio and the Kresge Recital Hall, which has audio and video links to the recording studio. The method of instruction is to learn by doing, and the goal, from the very first session, is to achieve professional-sounding results. Equipment includes a complete 24-track Pro-Tools system, professionally designed control room that can accommodate up to 24 people, outboard preamps and other gear, and an interesting array of microphones. All recording is direct to hard disc.

57-338 Sound Editing and Production
Fall and Spring: Mini Session - 6 units
Prerequisites: 57337

57-339 Acting III
Fall: 6 units
This course will build upon the foundation laid in the first year, with a more concentrated look at scene work, an audition workshop that focuses on cold readings as well as monologues, and a character-development project that works to identify specific issues that inhibit freedom on stage. More in-depth work on songs and arias will lead into a musical scene project. The year will close with a classical text project in which the students will work with verse.
Prerequisites: 57241

57-340 Acting IV
Spring: 6 units
Continues 57-339 Acting III.
Prerequisites: 57339

57-347 Electronic and Computer Music
Fall: 6 units
This course builds on the concepts learned in Introduction to Music Technology (57-101) and gives added knowledge in the areas of composition using digital and analog devices as well as various computer programs. Building computer models of both analog and digital synthesizers as well as drum machines, loop players and various other sound processing effects will be covered in detail. Students will be required to produce several projects throughout the course demonstrating their understanding of various concepts in electronic music. More emphasis is placed on the overall quality of the end musical product than in 57-101 in order to prepare students for music production in a professional setting.
Prerequisites: 57101

57-349 Supervised Theory Teaching
Fall and Spring: 6 units
This course provides teaching skills in theory for students who have already completed the theory program at Carnegie Mellon University or who have demonstrated theory competence. The students will attend all sessions of the assigned theory class and will assist the professor by correcting homework, delivering a short lecture, developing a class syllabus and tutoring individual students. The work is done under direct supervision and advice from the regular professor who is always present in the class. Enrollment limited to a maximum of two students per class.

57-350 Dalcroze Piano Improvisation
Fall and Spring: 3-6 units
These courses are required for candidates in the Dalcroze Certification program. They provide the keyboard skills necessary for the teaching of Eurhythmics.

57-351 Dalcroze Piano Improvisation
Fall and Spring: 3-6 units
Continues 57-350 Dalcroze Piano Improvisation.
Prerequisites: 57350

57-352 Dalcroze Piano Improvisation
Fall and Spring: 3-6 units
Continues 57-351 Dalcroze Piano Improvisation.
Prerequisites: 57351

57-353 Dalcroze Piano Improvisation
Fall and Spring: 3-6 units
Continues 57-352 Dalcroze Piano Improvisation.
Prerequisites: 57352

57-355 Secondary Guided Teaching
Spring: 3 units
This course develops understanding and application of appropriate and acceptable instructional practices in the secondary school. The student will spend a portion of the course in an assigned public or private secondary school teaching internship. This course is to be taken concurrently with 57-376. It is the last of three field observation experiences required by the Commonwealth of Pennsylvania for certification.
Corequisites: 57-376

57-356 Elementary Guided Teaching
Fall: 3 units
The second level of field experience in the public schools, to be taken concurrently with 57-375. This course provides for observation and closely supervised teaching experiences with elementary age children in a school setting.
Corequisites: 57-375

57-357 Radio Play
Intermittent: Mini Session - 5 units
In this seven-week course, students learn to use a state of the art recording studio in the production of experimental and traditional radio plays. We will explore the power of sound (voice, music, noise) to communicate, provoke, frighten, suggest, amuse, entertain, inform, and inspire. For inspiration we will listen to historical recordings from the days of classic radio, as well as more contemporary productions by artists from diverse backgrounds. Students will have the opportunity to participate in all roles of production: idea generation, writing, performance, sound design, production, and post-production.

57-358 Career Strategies for Musicians I
Spring: Mini Session - 3 units
This second-half mini course is the first of a two-part course designed to help students plan for a career in music. Part I, offered for spring-semester juniors, will provide students with an
overview of post-graduation options: graduate school, fellowships, full-time positions, freelancing, and teaching. Students will learn how to plan for and pursue these options and will develop the skills needed for this level of planning and career development. Students will also learn about a variety of resources that will help them more successfully navigate a career in music. Finally, throughout this mini-course, students will begin to build or refine their professional materials including: resume, bio, headshot, presentation skills, and recording.

57-359 Career Strategies for Musicians II Spring: Mini Session - 3 units This first-half mini course (designed for seniors) will help students continue planning for life after undergraduate music studies. Topics covered include: musician as entrepreneur, contracts, unions, health insurance and otherwise compensating for not getting benefits from a full-time employer. This course will also continue the exploration of options including: teaching, freelancing, and other career possibilities. Students will create a conventional resume, learn how to write a cover letter and learn how to understand and prepare for job interviews. Students will also prepare or refine other professional materials including artistic resume and bio. Part I is not a prerequisite for this course.

57-360 Brass Methods Fall: 3 units This music education course develops basic brass playing and teaching techniques. Special emphasis is placed on instructional techniques appropriate to elementary and middle school instrumental classes, aural and visual diagnosis of playing problems, and methods of accelerating music reading independence in young players.

57-361 Percussion Methods Fall: 3 units This class gives the non-percussion major a background in the fundamentals of teaching percussion. The main focus of the course is snare drum. The students spend most of their time learning the basic concepts of beginning snare drum so they will be prepared to teach beginning students of any grade level. Much time is devoted to proper stance, grip, and stroke in order to insure a good foundation for a beginning student. Also covered are the various mallet instruments, timpani, and all small hand percussion. Students will learn about purchasing proper equipment for the various levels of learning in common school programs.

57-362 Woodwind Methods Spring: 3 units This music education course develops basic woodwind playing and teaching techniques. Special emphasis is placed on instructional techniques appropriate to elementary and middle school instrumental classes, aural and visual diagnosis of playing problems, and methods of accelerating music reading independence in young players.

57-363 String Methods Spring: 3 units String Methods prepares music educators for work in the public schools. A major portion of class time will be applied to violin and cello techniques. Upon completion of the course, the student will be expected to demonstrate the technical skills of a second year beginning string student. Students will also be introduced to various method books, string supplies, and repairs.

57-374 Music in the Urban School Intermittent: 9 units This course will involve workshops with nationally known instructors in eurhythmics, world drumming, contemporary popular music, and classroom management. The course will require attendance at workshops, classroom observations and closely supervised teaching experiences. Schools involved are all inner city schools with a poverty level of 75% or above. This course is offered as the result of a grant received from the Federal Department of Education by the School of Music, the Pittsburgh Public Schools, and the Wilkinsburg School District.

57-375 Music in the Elementary School Fall: 6 units This course is designed to provide a philosophical background for teaching music in the elementary school and to provide a variety of pedagogical techniques, which are essential when teaching music from Preschool through Grade 6. Prerequisites: Corequisites: 57-356

57-376 Music in the Secondary School Spring: 6 units This course covers a variety of topics related to the development of instructional skills and the management of administrative details in the secondary music program. Emphasis is placed on the details of classroom and rehearsal planning, student recruitment and first-year teacher concerns such as yearly planning, relations with parents and student discipline. Prerequisites: 57332 and 57356 and 57360 and 57361 and 57375 and 57607 Corequisites: 57-355

57-381 Accompanying I Fall and Spring: 3-9 units This class is the first in a series of hands-on courses which allow the student to accumulate experience accompanying in a professional venue. Students will be assigned to a vocal and/or instrumental studio and will have the opportunity to coach repertoire with a professional accompanist. Assignments may include playing for instrumental juries.

57-382 Accompanying II Fall and Spring: 3-9 units Continues 57-381 Accompanying I. Prerequisites: 57381

57-383 Accompanying III Fall and Spring: 3-9 units Continues 57-382 Accompanying II. Prerequisites: 57382

57-384 Accompanying IV Fall and Spring: 3-9 units Continues 57-383 Accompanying III. Prerequisites: 57383

57-385 Accompanying V Fall and Spring: 3-9 units Continues 57-384 Accompanying IV. Prerequisites: 57384

57-386 Accompanying VI Fall and Spring: 3-9 units Continues 57-385 Accompanying V. Prerequisites: 57385

57-391 Keyboard Studies Fall and Spring: 3 units This course develops piano skills necessary for work in the elementary and secondary schools. Special emphasis is placed on transposition, score reading, harmonization and sight-reading. This course is required for all music education majors. Prerequisites: 57292

57-392 Keyboard Studies Fall and Spring: 3 units Continues 57-391 Keyboard Studies V. This course is required for all music education majors. Prerequisites: 57391

57-396 Introduction to Interdisciplinary Studies Intermittent: 9 units Instrumentalists, composers, and vocalists, even the most gifted ones, require a stronger humanistic and sociological curriculum to complement their artistic talents effectively. This course deals with the dynamics of culture on a global scale, providing the music student with a forum which answers the increasing need to
The Concerto, one of the most popular forms of music, is also a program analyzes great concerti performed by the world's greatest virtuosi and the concerti that became their "Battle Horses." The "Mandolins" to John Adams's "Grand Pianola Music," and much more, written for all instruments; from Vivaldi's "Concerto for Two players. The goal of this course is to examine the greatest concerti and finally, between the "Solo" virtuoso and the less gifted "Tutti" another (tonal distinction), between the individual and the masses, of sound and another (volume), between one type of sound and another. Emphasis is placed on vocal technique and development, musical testimonial and experience in the choral idiom. Performance requirements are more stringent than those of the Repertory Chorus. Repertory Chorus is an ensemble of predetermined size. Emphasis is placed on vocal technique and development, musical skills in the rehearsal with minimum performance requirements. Audition required.

57-415 Dance VII
Fall: 3 units
Continues 57-316 Dance VI. Levels seven and eight explore advanced jazz and ballet technique.
Prerequisites: 57316

57-416 Dance VIII
Spring: 3 units
Continues 57-415 Dance VII.
Prerequisites: 57415

57-417 Major Choral Ensemble
Fall and Spring: 6 units
There are two choral ensembles. Concert Choir is a select ensemble of approximately 40 voices of superior vocal/musical talent and experience in the choral idiom. Performance requirements are more stringent than those of the Repertory Chorus. Repertory Chorus is an ensemble of predetermined size. Emphasis is placed on vocal technique and development, musical skills in the rehearsal with minimum performance requirements. Audition required.
Prerequisites: Corequisites: 57-500, 57-501, 57-502, 57-509, 57-521, 57-522

57-418 Major Instrumental Ensemble
Fall and Spring: 6 units
There are two instrumental ensembles: Orchestra and Wind Ensemble. Rotating seating plans, within and between ensembles, will prevail at the discretion of the Director of Orchestral Studies and the Director of the Wind Ensemble. The instrumental faculty will be consulted. All music majors who are required to enroll in an instrumental ensemble must audition for placement and enroll in Major Instrumental Ensemble. Audition required.

57-420 Jazz Vocal Ensemble
Fall and Spring: 3 units
A highly selective group of mixed voices who perform contemporary jazz and pop vocal arrangements. Open to all CMU students. Audition required.

57-422 Horn Choir
Fall and Spring: 3 units
This course refines skills pertaining to ensemble playing. Students will work in groups of varying size. Material will include major orchestral works, pieces expressly written for horn ensemble, and transcriptions. The course is open to all horn majors; non-majors may be accepted by audition.

57-408 Form and Analysis
Fall: 6 units
Form and Analysis is an upper level "Music Support" course for Juniors and Seniors who have completed the undergraduate required music theory curriculum in harmony and counterpoint. Prerequisites include: Theory I, II, III and IV or the equivalent courses. This course provides a working understanding of all styles and genres of Western classical and contemporary repertoire. Students will explore various aspects of the compositional process, from basic organizational structures to the details of individual musical phrases. They will learn to see and to hear the most important compositional features of a piece of music and will develop a deeper understanding of the music they perform, conduct, and compose.
Prerequisites: 57154

57-409 Puccini's Operas
Intermittent: 9 units
Standing between the 19th and 20th Centuries, Puccini witnessed extraordinary socio-political and cultural shifts sweeping across Europe. His operas reflect such changes through their gradual stylistic adherence to modernity. From theatrical and literary plots to complex relationships with poets, publishers, impresarios, singers, conductors, and political censors, Puccini's operas offer excellent grounds for interdisciplinary dialogue and cultural analysis.

57-414 Operatic Vocal Literature
Fall: 3 units
Continues 57-315 Operatic Vocal Literature. The course concludes with a final project, either the composition, performance, or critical analysis of a Puccini opera. It is highly recommended for Puccini operas, and for those who plan to pursue a career in the opera field.
Prerequisites: 57-105, 57-106, 57-205, 57-206, 57-305, 57-306

57-413 String Quartet: A Social History
Intermittent: 9 units
This course introduces students to what is loosely known in Great Britain and the United States as Cultural Studies. Cultural Studies broaden the normal range of typical academic subjects by including dynamic topics such as cinema, advertising, popular culture in its various manifestations, political and satirical cartoons, gender relations, mass media, fashion, and popular song. Highlights of this course include discussion of The Beatles, Elvis and Rock 'n Roll, James Bond movies, the Kronos Quartet, World-Wide Rap Music, and much more.

57-398 Global Heartbeat
Intermittent: 9 units
This course will introduce students to what is loosely known in Great Britain and the United States as Cultural Studies. Cultural Studies broaden the normal range of typical academic subjects by including dynamic topics such as cinema, advertising, popular culture in its various manifestations, political and satirical cartoons, gender relations, mass media, fashion, and popular song. Highlights of this course include discussion of The Beatles, Elvis and Rock 'n Roll, James Bond movies, the Kronos Quartet, World-Wide Rap Music, and much more.

57-399 Music, Cinema, Culture
Intermittent: 9 units
The first 100 years of the 20th Century's only original art form, whose advent has brought about tremendous social and cultural changes. Students view selected films, learning first the basics of film theory, cinema's working structures and the function of music. Ultimately, they are able to analyze, in the form of a written essay, the function and value of the music in a particular film and the impact such music has had on society.

57-404 String Quartet: A Social History
Intermittent: 9 units
The string quartet is at once a medium and a genre, even a form which for more than two hundred years has had a special, unparalleled place in Western music. This course examines the development of the string quartet - from its function as an intimate and conversational concert setting for amateurs, to its role as an aesthetic, genre, relationship to community religion, institutions, and patronage. Course goals will be to develop skills useful for broad cross-cultural analyses, and to bring questions about music, art, and politics into the domain of the humanities and social sciences. Special effort will be made to secure the participation of native representatives for each of the cultures under observation.

57-405 Concerto: Virtuosity and Contrast
Intermittent: 9 units
The Concerto, one of the most popular forms of music, is also a dramatic form, a drama of contrast between the strength of one body of sound and another (volume), between one type of sound and another (tonal distinction), between the individual and the masses, and finally, between the “Solo” virtuoso and the less gifted “Tutti” players. The goal of this course is to examine the greatest concerti written for all instruments; from Vivaldi’s “Concerto for Two Mandolins” to John Adams’s “Grand Pianola Music,” and much more, while dealing with the social and personal histories of unforgettable virtuosi and the concerti that became their "Battle Horses." The program analyzes great concerti performed by the world's greatest soloists and orchestras.

Prerequisites include: Theory I, II, III and IV or the equivalent courses. This course provides a working understanding of all styles and genres of Western classical and contemporary repertoire. Students will explore various aspects of the compositional process, from basic organizational structures to the details of individual musical phrases. They will learn to see and to hear the most important compositional features of a piece of music and will develop a deeper understanding of the music they perform, conduct, and compose.
Prerequisites: 57154

Course Descriptions
57-423 Repertoire Orchestra
Fall and Spring: 3 units
This course thoroughly acquaints participants with the standard works one would expect to encounter as part of a career as an orchestral player. Assigned repertoire will be read each class session. All students are eligible to register for this course by special permission. Students who are not placed in the Carnegie Mellon Philharmonic are given priority for registration.

57-424 Percussion Ensemble
Fall and Spring: 3 units
This ensemble is open to all percussion majors; non-majors may be accepted by audition.

57-428 Theatre Orchestra
Intermittent: 6 units
Instrumental ensemble which accompanies vocal productions in the School of Music or the School of Drama.

57-429 Beginning Piano for Children
Fall and Spring: 6 units
This course is the first of two courses in a year-long internship in the piano teaching of young children, combining class and private instruction: a study of the basic teaching/learning process as applied to piano teaching, covering comprehensive step-by-step presentation in reading, rhythm, ear training, sight reading, technique, and musicianship. Under supervision, students will teach the weekly group class and private lessons. Weekly conferences will be held for learning the presentation of materials for class teaching, analyzing pedagogical problems, and developing communication skills with both young pupils and their parents.
Prerequisites: 57273

57-431 Italian Literature and Repertoire
Fall: 3 units
The course provides a bibliography of repertoire in the Italian language. Material will include art songs and cantatas and will be presented via individual student performances in class, listening to recordings and group survey of repertoire. Reading and writing assignments will serve to establish historical perspective as well as programming considerations.

57-432 French Literature and Repertoire
Spring: 3 units
This course examines French songs for solo voice. Representative works from 18th through 20th centuries will be studied in the context of music history, style and programmatic considerations. Classes consist of individual performance, listening to recordings, and group survey of repertoire. Reading and written assignments establish historical perspective as well as programming considerations.

57-433 Musical Theatre Literature and Repertoire
Fall: 3 units
This class covers music theatre repertoire for two semesters, beginning chronologically with the operetta and concluding with current theatre composers. Each student will be assigned songs to prepare from these musicals. These songs can also be used for music theatre auditions. Students are expected to research all assigned songs and perform them in the proper style. Notebooks must be kept which include all lecture notes, class song assignments and music for songs performed individually.

57-434 Musical Theatre Literature and Repertoire
Spring: 3 units
Continues 57-433 Musical Theatre Literature and Repertoire.
Prerequisites: 57433

57-435 German Literature and Repertoire
Fall: 3 units
The course examines German repertoire composed for solo voice. Representative works from the Baroque period through the 20th Century are studied in the context of musical style, vocal demands and programmatic considerations. Repertoire focuses on art songs and cantatas, but also includes certain oratorio excerpts, which are included frequently in recital programs. A bibliography of German repertoire is compiled through individual or group performance of songs, listening to recordings and through research assignments, the latter of which focuses upon the works of specific composers. Reading assignments are included to establish an historical perspective.

57-436 English/Contemporary Literature and Repertoire
Spring: 3 units
The course provides a bibliography of repertoire in the English language. Material will be limited to art songs and will be presented via individual student or group performances in class, and recorded performances. Research assignments will be required for selected anthologies or for works by specific composers. Repertoire will be examined according to vocal requirements, musical style, and programmatic function. The repertoire will consist primarily of works by British and American composers, but works by Russian and Spanish composers will also be included.

57-437 Literature and Repertoire
Fall and Spring: 3 units
This course deals with literature and repertoire for orchestral instruments. There are multiple sections organized by instrument categories or specific instruments, as follows: Woodwind, Flute, Brass, Trumpet, Trombone, Tuba, Violin, Viola, Cello, Double Bass, Percussion, Harp, Euphonium/Baritone, Saxophone.

57-438 Multitrack Recording
Fall and Spring: Mini Session - 9 units
Prerequisites: 57337
This course builds upon the ideas learned in Sound Recording (57-337), but with an emphasis on close microphone techniques and popular music styles. Students will work in small groups and complete at least two recording projects. $10.00 materials fee.

57-439 Acting V
Fall: 6 units
The third and final year is designed to launch the student actor into the business of performing. Great emphasis will be placed on the individual's ability to manage their own performance while developing an awareness of what does and does not "work" in front of a paying audience. Beginning with an "autodrama", the students will discover what is stage worthy and how to mold their work into performance shape. This focus will be maintained throughout further character study and an opera scene project, and will culminate in a public performance that is developed primarily by the students themselves.
Prerequisites: 57340

57-440 Acting VI
Spring: 6 units
Continues 57-439 Acting V.
Prerequisites: 57439

57-442 Analytical Techniques
Spring: 6 units
Analytical Techniques is an upper level music support course for juniors and seniors who have completed the undergraduate required music theory curriculum in harmony and counterpoint. Recommended to be taken after 57-408 Form and Analysis. Studying the principles of Piston, Forte, Schenker and other important music theorists, students will learn to use whatever analytical techniques are best suited to better understand each individual piece. The primary goal of the course is to develop independent skills in analyzing their own repertoire as performers, conductors, composers, and teachers.
Prerequisites: 57154

57-450 Jazz Ear Training
Fall: 3 units
The jazz musician must learn nomenclature found in the many volumes of repertoire in current circulation. To facilitate the interpretation of and improvisation upon jazz pieces of various styles, an examination and explanation of common practice is
necessary. Intervals through the 13th, construction and function of 3, 4, and 5-note chords, common scales and chord sequences, rhythms and song forms will, through dictation exercises, be made a part of the improviser’s language, preparing for the application of these elements in Jazz Improvisation, Jazz Chamber Music, and applied courses offered in the jazz minor curriculum.

57-451 Jazz Arranging  
Intermittent: 6 units  
This course provides the opportunity for qualified participants to learn to write and arrange for various configurations of standard jazz instrumentation. Elements, including scoring 3, 4, and 5-note chords, intro settings, solo backings, and techniques of rhythm section writing will be applied to examples of the standard jazz repertoire. The final project will be writing an arrangement to be performed by one of the jazz ensembles in the School of Music. A strong background in theory and/or jazz performance and repertoire is recommended.  
Prerequisites: 57152

57-452 Jazz Composition  
Intermittent: 6 units  
This course will analyze standard jazz forms such as blues, ternary (A-B-A), and binary (ABAC), with written assignments using riff to through-composed techniques. Use of odd meters, extended harmony, modal harmony, and slash chords will be examined. Students will write examples using these forms and techniques. Techniques in writing for rhythm section will be shown, in preparation for jazz arranging. Contemporary jazz composers and their techniques will be analyzed and used in assignments leading to a final project to be performed with a jazz combo.  
Prerequisites: 57152

57-453 Jazz Improvisation  
Spring: 3 units  
This introductory class explores the many facets of improvised music, with an emphasis on fundamental jazz principles. The course also briefly surveys other improvisational approaches, drawing from a wide variety of sources including twentieth-century classical concepts, blues, Bach, and freely-composed forms. The discipline necessary and essential for this field of study will also be emphasized.

57-454 Jazz Transcription and Analysis  
Intermittent: 6 units  
There are few activities an aspiring jazz musician can engage in that are as beneficial as transcribing the improvisational works and compositions of the jazz masters. Every aspect of the student’s musical ability is challenged and enhanced. Aural ability, rhythmic notation skills, harmonic theory and function, technique, phrasing, and musicianship are all vastly improved when the student embarks on the painstaking but rewarding process of transcription. The course establishes a framework of basic techniques that help break down this process into manageable goals while moving through the distinct eras of the jazz continuum.  
Prerequisites: 57152 and 57181

57-455 Jazz History I  
Fall: 6 units  
This first semester of a two-semester course deals with jazz from its roots through the Bebop Era.

57-456 Jazz History II  
Spring: 6 units  
This continuation of Jazz History I (57-457) covers jazz styles from the Bebop Era to the present. Jazz History I is not a prerequisite.

57-457 Score Reading/Keyboard Harmony  
Fall: 6 units  
This course is for pianists, organists, composers, and other musicians with good keyboard skills. It is a completely practical, hands-on learning experience. Students learn by doing and observing other students. All work is done at the keyboard.  
Prerequisites: 57154

57-465 Eurhythmics Applications for Performance and Teaching  
Fall: 3 units  
Dalcroze Eurhythmics is a unique approach to musicianship through connecting kinesthetic awareness with accurate and sensitive listening and analysis. The study of Eurhythmics reinforces understanding of music concepts, enhances musicianship and focuses awareness on the physical demands of artistic performance. This approach to musical problem solving is applicable for performers, conductors, composers, and studio and classroom teachers. This course applies the principles learned in Eurhythmics I-IV at a more advanced level.  
Prerequisites: 57164

57-466 Eurhythmics Applications for Performance and Teaching  
Spring: 3 units  
Continues 57-465 Eurhythmics Applications for Performance and Teaching.  
Prerequisites: 57164

57-467 Production: Skills  
Intermittent: 3-6 units

57-468 Production: Skills  
Intermittent: 3-6 units

57-469 Production: Workshop  
Intermittent: 3-6 units

57-470 Production: Workshop  
Intermittent: 3-6 units

57-471 Production: Performance  
Fall: 6 units

57-472 Production: Performance  
Spring: 6 units

57-479 Beginning Piano for Children  
Fall and Spring: 6 units  
This is the second of two courses in a year-long internship in the piano teaching of young children, combining class and private instruction: a study of the basic teaching/learning process as applied to piano teaching, covering comprehensive step-by-step presentation in reading, rhythm, ear training, sight reading, technique, and musicianship. Under supervision, students will teach the weekly group class and private lessons. Weekly conferences will be held for learning the presentation of materials for class teaching, analyzing pedagogical problems, and developing communication skills with both young pupils and their parents.  
Prerequisites: 57429

57-485 1920s and 1930s: Perspectives on Arts  
Intermittent: 9 units  
Using the period of the 1920s and 1930s as a case study, this course examines the connections between and the independent developments within the various arts. In contrast to the separate histories of architecture, music, art, and theater traditionally taught, this course takes a multidisciplinary, thematic stance to the histories of the arts in Europe and America. A period embracing both avant-garde and conservative movements, the 1920s-1930s was an era of intense debate. This course explores the competing aesthetic movements of the period, and the ways in which the arts shaped and were influenced by cultural, social, economic, and political forces. Team taught by Musicologist/Cultural Historian Franco Sciannameo and Architectural Historian Diane Shaw, with guest speakers from the College of Fine Arts and the College of Humanities and Social Sciences.

57-487 Advanced Solfege III  
Fall: 6 units  
Covers the same concepts as Solfege IV in more challenging material, from Bach chorales in open score to excerpts by Bartok, Honegger, Stockhausen, or Boulez. Dictations are three-part contrapuntal and difficult harmonic three and four parts.  
Prerequisites: 57186

57-488 Advanced Solfege IV
Course Descriptions

Spring: 6 units
Continues 57-487 Advanced Solfege III.
Prerequisites: 57-487

57-500 Major Studio (Voice)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417, 57-418

57-501 Major Studio (Piano)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417, 57-418

57-502 Major Studio (Organ)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417, 57-418

57-503 Major Studio (Harp)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-504 Major Studio (Hair)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-505 Major Studio (Viola)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-506 Major Studio (Viola)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-507 Major Studio (Cello)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-508 Major Studio (Double Bass)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-509 Studio Major (Guitar)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-510 Major Studio (Flute)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-511 Major Studio (Oboe)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-512 Major Studio (Clarinet)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-513 Major Studio (Bassoon)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-514 Major Studio (Saxophone)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-515 Major Studio (Horn)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-516 Major Studio (Trumpet)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-517 Major Studio (Trombone)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-518 Studio Major (Euphonium/Baritone)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-519 Major Studio (Tuba)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-520 Major Studio (Percussion)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-521 Major Studio (Composition)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-522 Major Studio (Bagpipe)
Fall and Spring: 9-12 units
A one hour private lesson per week for all music majors.
Prerequisites: Corequisites: 57-417-418

57-523 Senior Project
Fall and Spring: 0 units
A composition for orchestra required of all senior composition majors.

57-524 Junior Recital
Fall and Spring: 0 units
A half recital required of all junior performance majors.

57-525 Senior Recital
Fall and Spring: 0 units
A full recital required of all senior performance majors.

57-603 Practice Teaching (Elementary)
Fall and Spring: 6-18 units
Experience in working with elementary students in a public school setting. The teaching is supervised by an experienced public school teacher and members of the CMU music education faculty.

57-604 Practice Teaching (Secondary)
Fall and Spring: 6-18 units
Experience in working with secondary students in a public school setting. The teaching is supervised by an experienced public school teacher and members of the CMU music education faculty. Students may choose a vocal or instrumental emphasis in the secondary placement.

57-607 Vocal Methods
Spring: 3 units
This course enables each student to develop a pleasant, healthy, and musically expressive voice and to develop effective vocal pedagogy.

57-608 Observation
Fall: 3 units
This music education offering is an independent study course intended to introduce students to a variety of seasoned educators and instructional practices through a series of classroom and rehearsal observations. It is strongly suggested that this course be completed ing the sophomore year with concurrent registration in 57-331.

57-610 Internship
Fall and Spring: 3-36 units

57-611 Independent Study in History
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-612 Independent Study in Theory
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-613 Independent Study in Research
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-614 Independent Study in Performance
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-615 Independent Study in Electronic and Computer Music
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-616 Independent Study in Literature and Repertoire
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-617 Independent Study in Sound Recording
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-618 Independent Study in Conducting
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-619 Independent Study in Opera
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-620 Independent Study in Solfege
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-621 Independent Study in Eurhythmics
Fall and Spring: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a full-time faculty member. They choose their topic and contract with the Project Director (faculty sponsor) as to when and how the project will be completed. Open to upperclassmen.

57-641 Dalcroze Research Paper
Fall and Spring: 3 units
Candidates in the Dalcroze Certification Program are required to submit a research paper based on their understanding of Dalcroze principles based on their experience and supported by appropriate literature.

57-691 Dalcroze Pedagogy/Practice Teaching
Fall: 3 units
This first semester of a two semester course provides supervised practice teaching experience in applying Dalcroze principles for young children.

57-692 Dalcroze Pedagogy/Practice Teaching
Spring: 3 units
This second semester of a two semester course provides supervised practice teaching experience in applying Dalcroze principles for older students.

Art
Undergraduate Courses

60-101 Concept Studio I: The Self and the Human Being
Fall: 10 units
The first of a sequence of eight studio courses designed to develop a personal approach to generating art and to learning transferable conceptual skills. The topics of the first three Concept Studios are addressed through a sequence of structured, media-independent projects. Open to freshmen admitted to the School of Art, or by instructor permission.

60-102 Concept Studio II: Space and Time
Spring: 10 units
A continuation of Concept Studio I with a focus on space and time through projects of increasing complexity. Such topics as biological time, historical time, psychological time, celestial time, clock time, and public space, private space, mathematical space, and virtual space are addressed through projects. Open to freshmen in the School of Art, or by instructor permission.

60-104 Contemporary Issues Forum
Fall: 6 units
Introduces students to contemporary issues in the visual arts. Thematic rather than chronological approach. Lecture/discussion format. Requires attendance at the school bi-weekly lecture series. Open to freshmen in the School of Art, or by instructor permission.
Course Descriptions

60-105 Pre-Industrial Visual Cultures to 1789
Spring: 9 units
An exploration of selected examples from the visual arts. Addresses ancient to pre-industrial times, across global cultures. Contextual issues investigated for both distinctive differences and cross-linkages in human experience and expression. Open to freshmen in the School of Art, or by instructor permission.

60-110 Electronic Media Studio I
Fall: 10 units
An introduction to the computer as a multi-purpose, art-making tool that utilizes software application programs. Students use the computer to develop a variety of two-dimensional imagery, animated and interactive artworks. Multiple output media and distribution options are explored. Open to freshmen admitted to the School of Art, or by instructor permission.

60-130 3D Media Studio I
Spring: 10 units
An introduction to three-dimensional form and space. Various materials and methods are explored through projects covering a broad range of sculptural concerns. Students are introduced to welding techniques, wood fabrication and ceramic processes. Students become proficient with a variety of hand and power tools. Materials fee required. Open to freshmen in the School of Art, or by instructor permission.

60-150 2D Media Studio I: Drawing
Fall: 10 units
The first of a two-semester sequence of drawing courses. Focus on the language, materials and concepts of drawing as foundation for all the visual arts. Initial emphasis on the development of perceptual, analytical, and structural drawing skills with increasing attention to idea development. Exposure to methods of creating pictorial and illusionistic space; recording the external world of light and form; and making visible the internal world of the heart, the mind, the soul. Experience with line, texture, tone, shape and mass; in a variety of wet and dry drawing media. Open to freshmen in the School of Art, or by instructor permission.

60-201 Concept Studio III: Systems and Processes
Fall: 10 units
A continuation of Concept Studios I and II with a focus on systems and processes. The utility, discovery, and the generation of systems and processes are addressed through projects. Open to sophomores in the School of Art, or by permission of instructor.

60-203 Sophomore Honors Project
Spring: 10 units
A non-medium-specific studio course which encourages students to develop independently generated projects. Open to sophomores in the School of Art with a minimum QPA of 3.0.

60-205 Modern Visual Culture 1789-1945
Fall: 9 units
Explores the diverse roles of artists in the complexity of modern society from the Industrial Revolution through World War II. Contextual issues include the relationship of artists and art to culture, politics, economics and modern technologies. Attention is paid to the decline of patronage, the diminishing role of the academy and the emergence of an avant-garde and art promotion. Open to sophomores in the School of Art, or by instructor permission.

60-206 Contemporary Visual Culture; from 1945 to the Present
Spring: 9 units
Explores contemporary issues and ideas from the end of World War II to the present. Covers pluralism and the departure of art(s) from traditional environments, with the accompanying technical, theoretical, sociological, economic and political consequences. Topics include art and technology, mass media and communications, and the emergence of new art institutions and their alternatives. Open to sophomores in the School of Art, or by instructor permission.

60-210 Electronic Media Studio II
Fall and Spring: 10 units
Introduction to video production. Explore video art production, post and pre-production. Focus on skills needed to realize intended video projects through discussions and examples of processes, techniques and aesthetic issues. We will look at multi-media, computer effects and digital audio. We will move from traditional narrative to experimental and performative/installation work. Pre-requisite: 60-110, or by instructor permission.

60-230 3D Media Studio II
Fall: 10 units
An introduction to light metalworking techniques, foundry processes and mixed media construction. A broad range of techniques and processes are introduced through demonstrations and placed into practice through assignments. Students gain a basic understanding of the language and processes of sculpture. Materials fee required. Open to School of Art sophomores, or by instructor permission.

60-250 2D Media Studio III: Painting
Fall and Spring: 10 units
A pragmatic introduction to the tools, materials, and techniques of painting, including instruction in the fabrication of sound painting supports and the application of permanent grounds. Students become conversant with the range of visual options unique to the vocabulary of painting. Prerequisite: 60150 and 60151, or by instructor permission.

60-251 2D Media Studio IV: Printmaking
Spring: 10 units
An introduction to the three major areas of printmaking: Intaglio, Lithography, and Serigraphy. Provides students with an overview of printmaking in its historical context. Demonstrates the impact of the print processes on contemporary art. Prerequisites: 60-150 and 60-151. Open to sophomores in the School of Art, or by instructor permission.

60-301 Art in Context
Fall: 10 units
Students affiliate artmaking with a context outside of the university and within the Pittsburgh community. Students develop a relationship with an organization and artmaking is carried out within the context of that organization. Students may take the course for one or two semesters. Open to juniors in the School of Art, or by instructor permission.

60-303 Junior Honors Project
Spring: 10 units
A non-medium-specific studio course which encourages students to develop independently generated projects. Open to juniors in the School of Art with a minimum QPA of 3.0.

60-350 to 60-398 Art History/Theory Special Topics
Fall and Spring: 9 units
Art academic courses that supplement the regularly scheduled cycle of art history/theory courses (60-104, 60-105, 60-205, 60-206). Open to juniors and seniors in the School of Art, or by instructor permission.

Art History/Theory Special Topics courses have included: High and Popular Culture in the Arts; Art, Aesthetics and Literature; New Technologies and Artists’ Tools; Critical Theory; Art &
Religion; Picasso & 20th Century Art; Visual Anthropology; Brancusi & 20th Century Sculpture; Contemporary Culture—Into the Realm of the Public; Cultural Semiotics, Art & Social Engagement; Public Issues in the Arts; Film; Social History of Animation; The Portrait in the USA (1960-2000); The History and Philosophy of Museums.; Museum Curatorship—Collectors Management; Shooting from the Hip—the Independent Director; Writer, Producer, Video Bodies—Sex and Gender in the New Media Debates; Play, Pleasure, Beyond Pleasure; Art Criticism, Social Context and Contemporary Issues; The History of Collaborative Art; Mapping the Terrain: Environmental Thinking and Art Practice; Noise: Toward a Critical Theory of Sound and Hearing; Hip Hop & Contemporary Art; and An Aesthetics of Dysfunction—Film & Video Theory

60-399  Art History/Theory Independent Study
All Semesters: 9 units
A tutorial course in which an Art student works individually on a self-generated project under the supervision of a School of Art faculty member. Prior to enrolling in Independent Study, the student must complete an "Independent Study Proposal" form (available in the bins on the 3rd floor of CFA) which is signed by the faculty member and the Assistant Head of the School of Art. Prerequisite: Art junior or senior status, or permission of instructor.

60-401  Senior Project
Fall: 10 units
Students initiate a comprehensive two-semester project in the first semester to be completed in the second semester of their senior year (60-402). Open to seniors in the School of Art, or by instructor permission.

60-415  Advanced ETB: 3D Animation
Fall and Spring: 10 units
Introduces the students to the techniques of 3D computer modeling and animation including techniques for lighting, mapping and rendering. Explores the history of animation emphasizing 3D object animation done with and without the computer. The students will have the opportunity to use techniques of 3D animation as a means of self expression. Prerequisites: 60-110 and 60-210, or by instructor permission.

60-416  Advanced ETB: Interactive Multimedia
Intermittent: 10 units
Within this class students engage in a personally directed exploration of the creative, conceptual and tactical possibilities of interactive scenarios and their art practice. The term "Interactive" will be used and discussed in its broadest possible context, and students will be given space to explore a wide range of digital and non-digital approaches to user oriented strategies within the art making process. We will also examine and discuss a range of historical and contemporary strategies employed by art makers who have used forums from on-line and virtual spaces to physical and site specific venues to expand and explore the relationship between the art object and the audience. Prerequisites: 60-110, 60-210, or by instructor permission.

60-417  Advanced ETB: Video
Intermittent: 10 units
This course offers an in depth exploration of video as a tool for creative expression. Topics for investigation and discussion will include: histories of experimental video, contemporary trends in the field, technological developments, performativity, perception and manipulation of time, and theories of representation. Additionally this course will provide instruction in advanced production and post-production techniques, including lighting, editing, compositing, 2D animation, graphics and sound design. Prerequisite: 60-210, or by instructor permission.

60-421  Advanced ETB: Gizmology
Intermittent: 10 units
Gizmology introduces artists to the fascinating, real world of three-dimensional time-based/kinetic media. Students will be given intensive instruction in digital electronics as well as an introduction to mechanics and machine/sculpture fabrication. Students will complete assignments as well as pursue their own self-directed kinetic project. Prerequisites: 60-110 and 60-210, or by instructor permission.

60-422  Advanced ETB: Robotic Art Studio
Intermittent: 10 units
This course is intended to provide students with an intense introduction to a diverse range of locomotion systems. Students will be encouraged to experiment with different designs associated with machine movement and will work on an individual project that represents their unique research and approach to the subject. Topics covered in the class include electronics, motor control, microcontrollers, sensors and mechanics. A course material fee is required. The student can expect to purchase some individual items outside of those provided if they are unique to their project design. Prerequisites: 60-110 and 60-210, or by instructor permission.

60-418 to 60-429  Advanced Electronic Time-based (ETB) Special Topics Studies
Fall and Spring: 10 units
Each semester the electronic and time-based media faculty offer special topics courses to supplement the regularly scheduled cycle of courses associated with electronic and time-based media. Prerequisites: 60-110 and/or 60-210, or by instructor permission.

Advanced ETB: Special Topics courses have included: Sound and Image; Media Performance; Interactive Narrative in Physical Environments; Programming for Artists; Sound as Art; Sound, Installation and Video Performance; Mediated Performance; Interactive Strategies; Sound Art; Audio/Installation (with SIS); Motion Graphics; and Telepresence Art and Applications; Interactive Programming; Animation Art & Technology; Radio Play; AudioVision; Physical Computing; Interactive Installations and Tangible Interfaces; Digital Video—Advanced Techniques; Human Algorithms; Fundamentals of Computational Visual Form; Experimental Web Animation; Responsive Urban Spaces; Data Visualization as a Mode of Art Practice; Introduction to Interactive Graphics; and Live Video—Systems and Performance.

60-430  Advanced SIS: Sculpture
Intermittent: 10 units
Sculpture is perhaps the broadest field among the contemporary visual arts. Through its privileged relationship to the physical world and the viewer’s body, sculpture is the glue that connects the intermedia practices of object, installation, interactive art and performance. In this class we build on skills and concepts learned in 3D media 1 and 2 to develop students’ individual approach. Students define independent responses to topics proposed through discussion of contemporary sculptors. Emphasis is placed on individual development. Students are encouraged to explore inter-disciplinary approaches. Prerequisites: 60-130 (3D Media 1) and 60-230 (3D Media 2), or by instructor permission.

60-431  Advanced SIS: Installation
Intermittent: 10 units
Studio focus on relatively large scale works which often involve an ensemble of objects or phenomena in a particular space. Both temporary and permanent works are addressed. Prerequisites: 60-130 and 60-230, or by instructor permission.

60-432  Advanced SIS: Site-Work
Intermittent: 10 units
Studio focus on work designed for a specific site. Object work, installations, and environmental work are included. Site analysis, environmental work, and social dimensions are addressed. Prerequisite: 60-130 and 60-230, or by instructor permission.

60-433  Advanced SIS: Clay
Intermittent: 10 units
Studio focus on ceramic materials and processes as applied to sculptural issues. Fabrication, glazing, and kiln-firing are addressed. Material fee required. Prerequisite 60130, or by instructor permission.
Advanced SIS: Foundry
Intermittent: 10 units
Studio focus on metal casting processes. Objects are created in clay, wax, wood and plaster and cast into bronze or aluminum. Fabrication and welding techniques are presented. Materials fee required. Prerequisites: 60-130 and 60-230, or by instructor permission.

Advanced SIS: Metals
Intermittent: 10 units
Studio focus on fabrication using light metalworking techniques including forming, joining, and finishing. Metal stretching, forging, brazing, texturing and patination are also presented. There will be a materials fee. Prerequisites: 60-130 and 60-230, or by instructor permission.

Advanced SIS: Environmental Sculpture
Intermittent: 10 units
Studio focus on sculpting within the environment. Includes object making, installations and site work with an emphasis on ecological materials, environmental impact and related issues. Students required to explore and develop proposal-making skills in order to implement projects in public places. Both individual and collaborative projects are assigned. Prerequisites: 60-130 and 60-230, or by instructor permission.

Advanced SIS: Intimate Objects
Intermittent: 10 units
Explores the issues of small scale sculpture. This class will deal with the creation of objects that require a one-on-one interaction with the viewer. Unlike much heroically scaled sculpture, there is a distinctly personal and intimate connection that these objects engender. The class will look at historical examples, as well as 20th century works starting with the dada and surrealists. Problems of small scale sculpture will include topics such as the miniature versus actual size, the nature of materials, the issues of craftsmanship, the problem of preciousness. Sophomore status. Priority to Art majors. Prerequisites: 60-130 and 60-230, or by instructor permission.

Advanced PDP: Drawing
Intermittent: 10 units
Drawing will include a large variety of media, methodologies and practices. Subjects will include observable sources as well as conceptual frames. Students will be encouraged to identify resources, research and develop a sustained body of work. Prerequisites: Drawing I (60150) and Drawing II (60151), or by instructor permission.

Advanced PDP: Anatomy/Drawing
Intermittent: 10 units
For thousands of years artists have seen the human body as an object of beauty, and as a powerful metaphor for documenting the passion and the pathos of human experience. This course will focus on that complex and compelling subject. In class, students will work from the model, studying the figure as a means to heighten sensitivity, expand visual perception, and refine drawing skills. An introduction to the landmarks of anatomical bone and muscle structure will be included. Outside class, students will be encouraged to seek meaning in the humanity of the figure as a vessel for expression, be it personal, social, political, spiritual, narrative or emotional. Prerequisites: 60-150 and 60-151, or by instructor permission.

Advanced PDP: Painting
Fall and Spring: 10 units
In this course students will be encouraged to expand their skills and develop a personal vision, while maintaining a spirit of investigation into the developmental process, the magic, the illusion and the physical reality of painting. The professor will act as critic and advisor as students work independently developing self-generated ideas and setting personal examples. The class will meet as a class for group critiques, discussions, presentations on the practical aspects of the profession, and slide lectures on contemporary artists. Prerequisite 60-250 (2DIII), or by instructor permission.

Advanced PDP: Intaglio
Intermittent: 10 units
Advanced intaglio studio focuses on the development of additional techniques such as lift and soft grounds, photographic processes, color and multiple plate printing, and viscosity printing. Emphasis will be placed on artistic/image development in relationship to the print as a democratic multiple. In addition cross disciplinary work will be encouraged within other printmaking studios to expand the visual vocabulary and image development. Prerequisite: 60-251, or by instructor permission.

Advanced PDP: Lithography
Intermittent: 10 units
Studio focus on the processes and issues of lithographic printmaking. Includes both traditional stone and aluminum plate processes along with photographic techniques. Prerequisite: 60-251, or by instructor permission.

Advanced PDP: Idea Generation
Intermittent: 10 units
This course will support rapid development within each student’s self-directed body of work. The course will facilitate the development of that body of work by challenging it through a series of exercises designed to alter habits, provoke material and procedural experimentation, multiply avenues of approach, and expand on the conceptual issues inherent in the work. Materials and content will be determined by each student individually (primarily 2-D media but trans-media and crossover experiments will be encouraged). Sophomore status. Priority to Art students.

Advanced PDP: Serigraphy
Intermittent: 10 units
Studio focus on processes and artmaking issues related to water-based/ acrylic serigraphy. Emphasis on individual conceptual/ artistic development. Prerequisite: 60-251, or by instructor permission.

Advanced Painting/Drawing/Printmaking (PDP) Special Topics
Fall and Spring: 10 units
Each semester the painting, drawing and printmaking faculty offer special topics courses to supplement the regularly scheduled cycle of courses associated with painting, drawing and printmaking. Prerequisites: 60-250 and/or 60-251, or by instructor permission.

Advanced PDP: Special Topics courses have included: Draw/Paint; Paint/Print; Photogravure; Materials & Techniques; Paint/Drawing/Opera; 2D/Installation Environments; 2D Mixed Media; Conventional & Experimental Figuration; Structures of Vision; Artists’ Books; Print/ Draw; Hot Off the Press...Printing, Multiplying, Marking and the Construction of Image; and The Figure in Space.

Color Studio
Intermittent: 10 Units
This course is a general studio/lab introduction to the phenomena of color. “Color” is perhaps the most complex and relative of all mental and cultural phenomena. This studio examines the life of color in art and consciousness. It is intended to search out the origins of color, to understand its various forms, and to explore and reveal color through the physics of light and color and the biological systems that register the phenomena of color. It will also address the psychological nature of color perception and the historical/ cultural context that is intrinsic to any experience of color. The course uses studio projects, technologies, demonstrations, readings, and lectures.

Studio Independent Study
Semesters: 10 units
A tutorial studio in which an Art student works individually on a self-generated project under the supervision of a School of Art faculty member. Prior to enrolling in Independent Study, the student must complete an “Independent Study Proposal” form (available in the bins on the 3rd floor of CFA) which is signed by the faculty member and the Assistant Head of the School of Art. Prerequisite: Art Junior/Senior status and permission of instructor.
CFA Interdisciplinary Undergraduate Courses

62-190 BHA/BSA Integrative Seminar
Fall: 9 units
This course is designed to create an environment for interdisciplinary learning and collaboration for students in the Bachelor of Humanities and Arts (BHA) and Bachelor of Science and Arts (BSA) degree programs. It provides a forum for BHA and BSA freshmen and sophomores to discuss their own projects and begin collaboration with other students. The course includes guest presentations, discussions, slide/video presentations and reading assignments. Instr. Maurides

62-218 Sparta, Greece: Inquiry and Vision
Intermittent: Mini Session - 6 units
Sparta, Greece: Inquiry and Vision is an introduction to Greek language and culture. This course will include a series of guest presentations, discussions, reading assignments and a field trip to St. Nicholas Greek Orthodox Cathedral in Pittsburgh. This course will provide a forum for students to interact with each other in preparation for two-week summer study course in Sparta, Greece. This course is open to all students - participation in summer study is not a requirement. Instr. Maurides

62-241 Black and White Photography II
Intermittent: 9 units
A continuation of topics explored in Black and White Photography 1 with an emphasis on aesthetic development and image evaluation. Alternate individual tutorial/classroom demonstration and group critique structure. Students will gain experience with a variety of formats; experimental methods and media will be encouraged. Photo or equivalent required by end of the semester. Prerequisites: Black and White Photography I 62-141 or consent of instructor. Special Permission only. Contact Jennifer Morris at jmdr@andrew.cmu.edu
Prerequisites: 62-241

62-337 Studio Lighting
Intermittent: 9 units
This course provides a working knowledge of studio based lighting techniques. Students will create photographs using artificial light - both 'hot' lights and electronic flash units. Assignments will include table-top/still life and portraiture. Students can use all format cameras to complete assignments, but class instruction will emphasize the use of 4X5 cameras that are available to all studio lighting students. To successfully complete assignments students will be required to purchase paper, film, and 4X5 polaroid. The class may visit off-campus galleries and museums, and will invite photographers for special presentations. Grading is based on attendance, assignment critiques, and the final portfolio. Special Permission only. Prerequisites: Corequisites: 62-241, 62-141

62-358 Art and Biology
Intermittent: 9 units
The goal of this studio laboratory course is to examine similarities, differences and interactions between art and biology. It is an opportunity for students interested in interdisciplinary concepts to work both in a studio art environment and biological laboratory. This course explores the relationship between the working processes of visual artists and experimental scientists. Both artists and scientists seek to discover fragments of reality in the process of working either in the studio or the laboratory. Both disciplines seek to increase levels of observation, awareness, and perception. In addition to art science projects, this course includes lectures, discussion, slide/video and media presentations, and reading assignments. Students will be introduced both to the work of artists whose art is based in science as well as to the work of scientists who use visual data to inform their scientific work. Students will have an opportunity to experiment creatively with scientific media such as electron and video probe microscopy. Instr. Maurides

62-381 Color Photography I
Intermittent: 9 units
Color photography is not better, easier, or harder than black and white photography. It is just different. This course has two basic goals. First, students will technically understand color negative film. How it "sees" in comparison to B&W film. Second, students will complete a body of work based on their own concept. Other class topics include a history of color photography, presentations of artists' works, and class discussions of students' work. A great deal of out-of-class darkroom work and shooting expected, some library research. Lab fee and 35mm manual camera required. Prerequisite: 2 darkroom courses, or by instructor permission. Contact Jennifer Morris at jmdr@andrew.cmu.edu
Prerequisites: Corequisites: 62-241, 62-141

62-390 BHA/BSA Undergraduate Research Project
All Semesters: 3,6,9 units
The BHA/BSA Undergraduate Research Project is for Bachelor of Humanities and Arts (BHA) and Bachelor of Science and Arts (BSA) students who want to work on a self-designed project with the one-to-one guidance of a faculty advisor. The project should be interdisciplinary in nature, and can be a scholarly and/or creative endeavor. The project may take the form of a written thesis, a compilation of creative works, an outreach project, etc. The project topic must be pre-approved by the faculty member who agrees to supervise the project and assign a letter grade for the course. Projects are to be completed in one semester, and may be worth 3, 6, or 9 units of academic credit. To register, students must submit an "Undergraduate Research Project Proposal Form" signed by both the student and the faculty advisor, along with a proposal, to the Associate Director of BHA and BSA Programs.

62-400 BHA/BSA Semester Senior Project
All Semesters: 9 units
The BHA/BSA Senior Project allows Bachelor of Humanities and Arts (BHA) and Bachelor of Science and Arts (BSA) students the opportunity to weave together the interdisciplinary elements of their curricula into an integrated project. The Senior Project should reflect the student's interdisciplinary ?vision? in the arts and humanities or arts and sciences. The creation and completion of such a project can be an important integrative and fulfilling capstone for BHA and BSA students. Senior Projects are semester-long or year-long (9 units for one semester; 18 units for two semesters), and are structured as independent studies under the supervision of a single faculty member or a small committee of faculty from the areas relevant to the project. To register, the student must submit a "Senior Project Proposal Form" signed by the student and faculty advisor, along with a proposal, to the Director of BHA and BSA Programs for final approval.

62-590 BHA/BSA Internship
All Semesters: 3,6,9,12 units
An internship is a supervised professional work experience with clear links to a student's academic goals. BHA and BSA students may choose to complete a BHA/BSA internship for elective credit with appropriate individuals or organizations within or outside of Carnegie Mellon University. Junior and senior BHA and BSA students in good academic standing are eligible to receive academic credit for one internship. Graduating is pass/fail only. Prior to enrolling in an internship, the student must have a "BHA/BSA Internship Proposal Form" signed by their site supervisor and approved by the Associate Director of the BHA and BSA Programs.
H&SS Interdisciplinary
Undergraduate Courses

66-198 H&SS Interdisciplinary Research Training
Fall and Spring: 9 units
This course is part of a set of 100-level courses offered by H&SS departments as independent studies for second-semester freshmen and first- or second-semester sophomores, in the College. In general, these courses are designed to give students some real research experience through work on a faculty project or lab in ways that might stimulate and nurture subsequent interest in research participation. Faculty and students devise a personal and regularized meeting and task schedule. Each Research Training course is worth 9 units, which generally means a minimum for students of about 9 work-hours per week. These courses are offered only as electives; i.e., they cannot be applied toward a college or major requirement, although the units do count toward graduation as elective units. Additional details (including a roster and descriptions of Research Training Courses available in any given semester) are available in the H&SS Academic Advisory Center. For H&SS students only; only for second-semester freshmen, or first- or second-semester sophomores; minimum cumulative QPA of 3.0 (at the time of registration) required for approved entry; additional prerequisites (e.g., language proficiency) may arise out of the particular demands of the research project in question.

66-210 Science, Technology and the Environment
All Semesters: 9 units
This course begins with the premise that it is essential to understand a few scientific principles and the basic premise and practice of technology for two important objectives: (1) to understand how the environment works, and how science and technology affect it; (2) to insure that science and technology work for (and not against) the natural environment. The aim of this course is to explore the use of science and technology in the context of the earth’s natural environment. Specifically, students will learn the basic principles of science and technology that can enable them to understand environmental phenomena, and the effects of human activity on these. These principles are learned through their use in the context of environmental issues. Students also examine the values, assumptions and actions that have guided our actions towards the environment, and the resulting impacts. Most class meetings demand active participation by students in the form of discussions, group projects and some field observations.

66-250 Introduction to Religion
Fall: 9 units
The objective of this course is to introduce students to the variety of intellectual disciplines by which the religions of mankind can be studied and some of the typical foci of such study. Topics to be covered in the course include: What is religion? Religious studies vis-à-vis theology; literary, historical, anthropological, sociological, psychological, philosophical, phenomenological approaches to religion; the sacred/holy; myth, symbol, doctrine; ritual; society and the sacred; deity; cosmogony, religious anthropology, theodicy; ethics, soteriology, eschatology; secularism and pluralism.

66-301 Science and Christianity: A Multidisciplinary Approach
Spring: 9 units
Christianity and Science is a multidisciplinary lecture/discussion course that is part of the interdepartmental program in religious studies at Carnegie Mellon University. The nature and history of Christianity are considered in light of the cultural, political, philosophical and theological background of the patristic period (0-600 CE). The nature and history of science is developed using the classic “The Structure of Scientific Revolutions” by Kuhn. The history of the interaction of Christianity and Science is examined using the book, “God and Nature”, which is a collection of current scholarship in this area. Modern text exegesis is explored using the book, “In The Beginning” by Blocher. A current treatise on the topic of this course, “Quarks, Chaos and Christianity” by Polkinghorne is also studied in detail.

66-307 Independent Study
All Semesters: 6-18 units
This course is intended for students with a special interest in an interdisciplinary area in the humanities and/or social sciences not covered by a normal course. Readings and other works are developed by the student and an individual faculty member. The number of units will be assigned at the time of registration based on the number of hours to be completed (decided in advance with the sponsoring faculty member).

66-320 Internship
All Semesters: 3-18 units
Internships-for-credit allow students to apply course-based knowledge in a non-classroom setting, under joint supervision and evaluation by an on-site supervisor and a faculty sponsor. Approved internships must conform to college guidelines for internships-for-credit, and are available by permission only arranged through the Associate Dean’s Office in Baker Hall A57.

66-400 H&SS College Honors Colloquium
Fall: Mini Session - 3 units
The purpose of this course is to provide students admitted to the H&SS Senior Honors Program with a shared course experience that orients and prepares them for a successful senior honors thesis experience. The course will consist of seven weekly meetings. Each will be organized around a theme and related topics that are either relevant to the senior honors thesis experience, or that take advantage of both the high caliber and interdisciplinary diversity of the course members to provide a shared set of intellectual as well as practical experiences. All students will participate in critiques of fellow-students’ presentations and plans. The course will be led by the H&SS Senior Honors Program Director with assistance from guest speakers (including faculty thesis advisors, and current and former senior honors program students).

66-501 H&SS Senior Honors Thesis I
All Semesters: 9 units
This sequence is open only to those seniors who have been admitted to the H&SS Senior Honors Program. This is the first semester of a two-semester sequence that is designed as a readings course, and the second semester course as the culmination of an original, year-long independent research project. Research topics are selected by faculty and students.

66-502 H&SS Senior Honors Thesis II
All Semesters: 9 units
This sequence is open only to those seniors who have been admitted to the H&SS Senior Honors Program. This second semester course is the culmination of an original, year-long independent research project. Research topics are selected by faculty and students. Prerequisites: 66501

67-101 Colloquium: Perspectives in Information Systems
Spring: Mini Session - 3 units
This course is an introduction to the Information Systems major and its potential career directions. Topics covered include overviews of systems development, project management, the logic of the IS curriculum, industry trends, and the professional workplace. It includes presentations by IS faculty, students (demonstrating systems projects), and by professionals from Pittsburgh-area firms. As a colloquium, it is a mini course and will meet once a week for three units and a letter grade. It is for IS freshman students only. This is an elective course and is not required in the IS curriculum.

67-211 Introduction to Business Systems Programming
Fall and Spring: 6 units
This course is an introduction to the COBOL programming language. In addition to the basic syntax of the language, the course presents several information systems applications and
discusses their solution in COBOL. COBOL is the most widely used language in the business community. New versions of COBOL for Unix and PCs have enhanced its status in the programming world. This class is a combination of lecture, readings, and programming. Students leave the course with an understanding of the COBOL syntax and the data file usage. The instruction emphasizes the importance of design and maintenance as well as coding in developing business applications. Expected class size is 25-30.

67-250 The Information Systems Milieux Spring: 9 units
This course is an introduction to information systems from a humanities and social science perspective. Students will investigate the cultural, historical, economic, political, design, and other social aspects of the role that information and information systems play in our lives and in our world. Students will develop foundational technical skills necessary for subsequent course in the IS program. This course is for second-year Information Systems students only.

67-271 Fundamentals of System Development I Fall: 9 units
This is an introductory course in software systems analysis and design and project management. The course will cover contemporary themes and issues involved in developing high quality software systems that meet users' expectations. Students will learn the basic theory, techniques and skills that systems analysts need to develop and document requirements and project plans for complex information systems projects. Since software system development practice is a rapidly evolving area, a cross-section of current, as well as time tested best practices methods will be presented. The course consists of these main components: overview of systems analysis and design, lifecycle and process issues, requirements articulation with use cases, object models and diagramming and documentation tools and techniques, and project management, including issues of software quality and metrics. Concepts will be mastered through a combination of assigned readings, class attendance, homework assignments and mini-projects. Grades will be assigned by weighting assignments together with midterm and final examinations. Expected section size is 60. Prerequisites: 15-111 or 15-121 or 15-200 or 15-211 and Junior class standing.

67-272 Application Design and Development Fall: 9 units
This course provides students with the concepts and techniques to design and develop software applications, and to understand the design process. Students will learn the importance of user-centered design and will develop prototype applications. Students will develop competency with several key technologies used in web development and e-commerce and will learn the principles needed to make effective use of these technologies. To that end, lectures each week will focus on conceptual issues and principles for using and applying IS technologies. Topics include user centered design and development, database design concepts, Structured Query Language, and various supporting web technologies. Lab sections are conducted each week to give students hands-on experience with these technologies. Learning will be accomplished through assigned readings, lectures, homework assignments and projects. Grades will be assigned by weighting assignments together with midterm and final examinations. Expected section size is 60. Prerequisites: 15111 or 15121 or 15200 or 15211.

67-301 Networks and Telecommunications Spring: 9 units
This course will introduce students to the basics of telecommunications, including voice, data and video, with an emphasis on data. The course will cover both technical and business aspects of networking, and it will consider regulatory and industry factors affecting telecommunication networks. Students will be introduced to the concepts and terminology of networks, including layered network models, and to practical issues involved in designing, managing, and using networks and network applications. Learning will take place through assigned readings, class participation, and homework assignments. Grades will be based on examinations, homework assignments and contributions to classroom discussions. Junior or senior class standing required. Prerequisites: one computer programming course.

67-303 Systems Delivery in Complex Organizations Intermittent: Mini Session: 6 units
This mini-course provides students for leading software application projects in the broader context of a large-scale business environment. Technical and analytical skills are necessary but insufficient for successfully executing on IT projects in a complex organization. This course covers critical success factors in software delivery including project governance, scope management, justification, and intergroup coordination. Case studies of major software failures will be reviewed for lessons learned. Special focus will be placed on understanding and servicing the growing trend of offshore IT outsourcing. Upon completion, you will have a better perspective on what it takes to address the political and organizational components of both on-site and remote project success. Reading: Software Runaways (Robert J. Glass) and various industry websites and articles. Prerequisites: one programming course and junior or senior class standing.

67-304 Database Design and Implementation Intermittent: Mini Session: 6 units
This course provides an introduction to database design and implementation with a primary focus on the relational model. By the completion of this course the student will be able to appropriately use database design and implementation tools (the relational model, E-R models, normalization, and SQL) and apply knowledge of both technical and business issues related to database design and implementation to generate and evaluate alternate solutions to business situations. The course will also cover database dependability, reliability, availability, recovery, architectures, and distributed databases. Current topics in databases such as object-oriented and object-relational database models as well as data warehousing and data mining will also be presented. Projects will be completed using a "significant" relational database management system such as Oracle, DB2 or Microsoft SQL Server. Prerequisites: 67-271 and 67-272.

67-344 Organizational Intelligence in the Information Age Intermittent: 9 units
Across all organizations people find that the actions they take affect, and are affected by, the technology, norms, procedures, culture, and members of the organization. In order to navigate through this organizational world, agents need a better understanding of social and organizational intelligence. How do organizations (and the people who populate them) acquire and then process information? In what ways have new technologies affected the norms, procedures, and culture of organizations? How do leaders successfully guide their organizations through a world where new information and new technologies are constantly being produced? This course is about information assessment and analysis in organizations, and the ways organizations are transformed by technology.

67-373 Software Development Project Spring: 12 units
This is a lab course providing experience working with a small project group to design and analyze a computer-based information system. To illustrate and provide practice utilizing the tools of structured analysis and design, the class is divided into groups which are assigned to analyze, design and build an information system. Prerequisites: 67-271 and 67-272.

67-390 Independent Study in Information Systems All Semesters: 3-18 units
Independent studies are opportunities to engage in research with a faculty member to advance your learning in certain areas of interest. Information Systems students may enroll in independent study for 3, 6, 9 or 12 units of academic credit by obtaining a faculty sponsor who will oversee the academic component of this coursework, monitor progress and assign a final grade.
Course Descriptions

67-475  Information Systems Applications
Fall:  12 units
In this course, students design and implement a usable information system for a client. The client may be affiliated with the university, government, business, or non-profit agency. Students will be assigned to teams to work on these projects, and will produce operational, fully documented and tested, computer-based information systems. The projects will be supervised by CMU faculty and, when possible, by project clients. Prerequisite: 67-373.

67-480  Advanced Projects in Information Systems
All Semesters:  3-18 units
This course is for senior year Information Systems students who wish to work on systems projects in addition to the required senior project course. Permission of the instructor is required.

Physical Education
Undergraduate Courses

69-101  Racquetball
Fall and Spring:  Mini Session - 3 units
This course is designed to aid in developing the fundamental skills involved in racquetball. Techniques, rules and strategy are stressed. It is hoped that the student will develop a reasonable level of proficiency to enable participation on a leisure-time basis.

69-102  Weight Training
Fall and Spring:  Mini Session - 3 units
This course is designed to provide the opportunity for the in-experienced student to learn the effectiveness of a carefully planned weight-training program as a method of body development and the contributing benefit to performance in many sports.

69-108  Jogging for Fitness
Fall and Spring:  Mini Session - 3 units
This course will be a jogging course prescribed partially by the individual with assistance from the instructor to insure that the desired results will be achieved or at least pursued correctly. Guidelines will be enforced, but individual goals will be the main concern. Stretching, health and nutrition will be discussed.

69-109  Karate
Fall and Spring:  6 units
The student begins the study of application of the basic techniques in combinations (continuous execution of techniques in succession). Basic sparring is also introduced, along with additional formal exercises (Katas).

69-110  Personal Fitness
Fall and Spring:  Mini Session - 3 units
This course will be a conditioning course prescribed partially by the individual with assistance from the instructor to insure that the desired results will be achieved or at least pursued correctly. Individual goals will be the main concern. Stretching, aerobics, weight training and nutrition will be discussed.

69-112  Fitness Fusion
Fall and Spring:  Mini Session - 3 units
A fun power-packed workout designed to introduce all aspects of fitness. This class combines simple exercises including cardio endurance with dynamic balance and stabilization. The class will fuse fitness while maximizing the benefits offered by training with concise, innovative, and effective exercises for the whole body. Every few weeks another aerobic activity will be added. We will start slowly so you can experience progressions and advance your training. During the fusion of strength, core, and flexibility, we will use a variety of "toys" to enhance your fun and fitness while fusing the total package of mind, body, and spirit.

69-128  Shaolin (Kung Fu) Temple Boxing
Fall and Spring:  Mini Session - 3 units
Shaolin Temple Boxing trains the external aspects of Chinese Kung Fu which helps beginning students attain firm balance, flexibility, agility, good posture and stance work, proper mechanical and structural alignment, coordination, stability while moving, and a physically strong body. A well-rounded physical regimen will warm up the muscles and elongate the tendons for the Stationary Basic exercises, Walking Basics, and Kicking Basics, leading into Empty Hand Forms Practice and Sparring. Emphasis will be placed on knowledge fundamental techniques and power-issuing methods. These basic skills are practiced in the context of developing all aspects of the fighting arts such as foot and leg work, striking with all parts of the body; seizing and locking (qin na); and throwing (shuai jiao). The instructor is Marc P. Black.

69-130  Tennis
Fall and Spring:  Mini Session - 3 units
This course is designed to familiarize the student with the rules of tennis and to develop the skills needed to become proficient for recreational play.

69-131  Volleyball
Fall and Spring:  Mini Session - 3 units
This course is designed to familiarize the student with the rules of volleyball and to develop the skills needed to become proficient for recreational play.

69-134  Beginning Golf
Fall and Spring:  Mini Session - 3 units
This course is designed to give the student all the skills necessary to play a satisfactory game of golf. The long game, the short game and putting are covered. It is a leisure time sport that is challenging and can be used by the student for the rest of his/her life.

69-135  Soccer Skills
Fall and Spring:  Mini Session - 3 units
This course is designed to familiarize the student with the rules of soccer and to develop the skills needed to become proficient for recreational play.

69-136  Basketball Skills
Fall and Spring:  Mini Session - 3 units
This course is designed to familiarize the student with the rules of basketball and to develop the skills needed to become proficient for recreational play.

69-140  Squash
Fall and Spring:  Mini Session - 3 units
This course is designed to aid in developing the fundamental skills involved in squash. Techniques, rules and strategy are stressed.

69-142  Beginning Fencing
Fall and Spring:  6 units
This course will cover the basic skills needed for fencing with the foil. Footwork, attacks, and defenses will be practiced. Competition rules and strategies will be discussed. Students will fence each other and the instructor in almost every class.

69-150  Beginning Swimming
Fall:  6 units
This basic course is designed to equip the non-swimmer with fundamental skills and knowledge to assure reasonable safety in, on or about the water. Areas covered include the basic swimming strokes, basic diving, safe and efficient entry into the water, and some elementary forms of rescue.

69-151  Advanced Beginner's Swimming
Spring:  Mini Session - 3 units
This course is designed for individuals who are comfortable in shallow water and who can swim in any form from one side of the pool to the other. Areas covered include refinement of basic swimming strokes, basic diving, safe water entry and some elementary forms of rescue.
69-153 Lifeguard Training
Spring: 6 units
The American Red Cross Lifeguard Training course material will be taught. Students who complete certification will be eligible to be employed as lifeguards. Attendance required.

69-155 Aerobic Fitness
Fall and Spring: Mini Session - 3 units
A total body fitness class for men and women that incorporates stretching for flexibility, exercises for strength and movement to increase cardiovascular improvement.

69-156 First Aid/CPR
Fall and Spring: Mini Session - 3 units
A basic course in treatment and care of injuries in emergency situations. Topics will include legal liability, prevention of injuries, nutrition and cardiovascular conditioning. The course will conclude with theoretical and practical application of cardiopulmonary resuscitation. Upon completion of the course students will receive Red Cross Certification.

69-157 Swimming Stroke Improvement
Fall and Spring: Mini Session - 6 units
This course is designed to provide the student with the opportunity to learn the elements of good swimming. A wide range of strokes, basic diving, safety, endurance, and versatility in the water will be covered for all students. Experienced swimmers will have the opportunity to perfect their strokes.

69-158 Beginning/Intermediate Yoga
Fall and Spring: Mini Session - 3 units
A user-friendly style of yoga for the general population. In this course, you will discover new ways to move, breathe, stretch, and relax using traditional yoga poses. Participants will breathe better, move easier, and become more comfortable in everyday activities.

69-159 Aqua @ Both Ends
Fall and Spring: Mini Session - 3 units
Discover a great way to effectively train and smoothly blend excitement and fun with directional changes and multi-dimensional movement while working your heart, toning your muscles, and strengthening your core. Repeated bouts of exercise with intermittent rest periods challenging even the deepest muscle layers in your body. Participants are in either shallow or deep water. NO SWIMMING SKILLS REQUIRED! Buoyancy and resistance equipment supplied.

69-160 Swim-Fit
Fall: Mini Session - 3 units
You must know how to swim to take this class; this is not a learn-to-swim class. Pre and post timed swims, deep water treading, lap swimming interval training.

69-175 Dance for Non-Majors (Fusion of Dance Styles)
Fall and Spring: Mini Session - 3 units
Students will learn basic concepts and techniques that focus on body awareness set to progressive and alternative music. The overall objective will be focus on releasing muscle tension, developing a stronger core, and attending to proper skeletal alignment all while having a good time and moving, moving, moving. Open to non-drama and drama majors. Instructor - New York Professional Gia Caciliano

69-190 Alternative Health
Fall: Mini Session - 3 units
This course is designed to expose students to various complementary and alternative health practices. The field of "integrative medicine" will be seen as providing novel insights and tools for human health. A broad range of healing philosophies (schools of thought), approaches, therapies, and mainstream Western (conventional) medicine will be discussed. Classes will be a series of guest lectures and experienced professionals from the community. Please come prepared to experience some alternative practices. Dress comfortably.

Spring: Mini Session - 3 units
This course is designed to be a do-it-yourself guide to whole person well-being (body, mind, and spirit). Students will learn that wellness is the right and privilege of everyone. No matter what the student's current state of health, they will learn how to appreciate themselves as growing, changing, developing people. This class will allow students to move toward a happier life and positive health by integrating practices and philosophies that promote well living. Concepts include the classic work of John Travis and Regina Ryan (The Wellness Workbook).

69-193 Healthy Eating, Healthy You
Spring: Mini Session - 3 units
The college setting can present a challenging environment for healthy eating. Away from home for the first time, students are often exposed to a variety of food choices available at all times of the day and night. Regulating eating habits and making healthy food choices can become an overwhelming task. This course will provide students with practical, up-to-date information, ranging from nutrition basics to discussions of topical issues in contemporary nutrition. Upon completion of this course, students will be able to evaluate their own dietary behaviors and devise a plan for healthy eating that fits their lifestyle and academic schedule. This course is open to all students. The Registered Dietitian from Student Health Services will teach the course, Healthy Eating, Healthy You.

69-195 Emergency Medical Technician
Spring: 0 units
This course is designed to instruct a student to the level of Emergency Medical Technician-Basic. This includes all skills necessary for the individual to provide emergency medical service at a basic life support level with an ambulance service or other emergency service. Students who pass the state exam will receive Pennsylvania Accreditation as EMT-Basic.

69-191 Wellness
Course Descriptions

Business Administration
Undergraduate Courses

70-100 Introduction to Business
Fall: 9 units
This course provides an overview of the functional areas of business and how they contribute to the management of a firm. It places business within the broader context of business history, business ethics, and the role of business in various world cultures. For first-year business majors only. Students may not receive credit for both 70-100 and 70-101.

70-101 Introduction to Business Management
Fall and Spring: 9 units
Through case studies and analyses of documents such as annual reports, students gain an understanding of the business functions and of how business decisions are made. Functional areas examined include finance, marketing, accounting, organizational behavior and business strategy. BA majors may not take this course without special permission. Students may not receive credit for both 70-100 and 70-101.

70-122 Introduction to Accounting
All Semesters: 9 units
This course provides the knowledge and skills necessary for the student to understand financial statements and make use of the information for management and investment decisions. Topics include an overview of financial statements and business decisions; the balance sheet, the income statement, and the cash flow statement; sales revenue, receivables, and cash; cost of goods sold and inventory; long-lived assets and depreciation, and amortization; current and long-term liabilities; owners’ equity; investments in other corporations; an introduction to financial statement analysis; and international issues dealing with financial statements.

70-160 Graphic Media Processes
Fall: 9 units
This course provides a foundation for the study of graphic media by investigating the processes and materials used in the production of graphic media. Topics of investigation include: graphic media options, typography, photography, color reproduction, papermaking, ink systems, finishing techniques, document security, digital printing, and electronic publishing.

70-161 Graphic Media Technologies
Spring: 9 units
This course provides an in-depth review of the various technologies used in the production of graphic media. Beginning with a historical review of printing technologies, the course examines the processes used for various graphic products. In addition to the traditional printing technologies, emerging graphic technologies are examined. The course also examines the origins of photography, cinema, video, and the Internet and their applications in multi-media graphics today. (Prerequisite 70-160)
Prerequisites: 70160

70-194 Publishing Management in the Information Age
Spring: 9 units
The digital era is transforming the publishing industry. This course addresses the opportunities brought about by digital technologies on both print and electronic publishing. The course focuses on the management of intellectual property, publishing process, career opportunities, and publishing e-commerce. Lectures, guest speakers, field trips, and student business simulations help to integrate learning. Although the book publishing model is the focal point, this course presents management principles that are applicable to all graphic media.

70-201 Professional and Service Projects
All Semesters: 9 units
This course consists of career-related and community service activities in which the student participates over a period as long as four semesters. The student chooses activities posted on the BA web site, each of which is assigned a certain number of points. A minimum number of points must be accumulated in order to pass the course, and the course grade depends on the number of points accumulated above the minimum. Students may propose projects or activities that are not posted. Students should not register for the course until the semester during which they expect to complete their activities. The course is open to all students.

70-207 Probability and Statistics for Business Applications
Fall: 9 units
Elementary ideas in probability, statistics and data analysis presented in the context of their importance to modern business management. Prerequisites: 21121

70-208 Regression Analysis
Spring: 9 units
The theory and applications of multivariate regression and time series analysis, with particular emphasis on business applications. Prerequisites: (21121 or 21116 or 21112) and (36202 or 70207 or 36310 or 36220 or 36247) and (73100 or 73110)

70-311 Organizational Behavior
Fall and Spring: 9 units
This course examines the factors, which influence individual, group, and firm behavior in the context of the work place. Topics covered include perception, group behavior, decision-making, motivation, leadership, and organizational design and change.

70-332 Business, Society and Ethics
Fall and Spring: 9 units
The course examines the political, social and legal environment of the firm, within and outside the United States. Topics include restrictive trade practices, laws and directors’ responsibilities and liabilities, manufacturers’ responsibilities and liabilities, securities regulation, environmental protection, intellectual property, labor unions, trade associations, employee rights and duties, the attorney-client relationship, advertising and the media, the role of regulatory agencies, multinational operations, dealing with bribery and corruption, values in a business society, societal implications of business policies and corporate social responsibility.

70-340 Business Communications
Fall and Spring: 9 units
Business Communications develops and sharpens your written, oral, and interpersonal communication, introducing you to common forms of professional writing and speaking in specific business situations. The course explores crucial rhetorical issues that impact your ability to communicate and achieve your objectives as a business leader. Prerequisites: 76100 or 76101 or 76104 or 82085

70-341 Organizational Communication
Fall: 9 units
Much of the work in groups and organizations consists of communication. You communicate to get information that will be the basis of decisions, to provide a vision for the people who work for you, and with you, to coordinate activity, and to sell yourself and your work. The goal of this course is to identify sources of communication problems within an organization and ways to overcome them. To do this requires that we know how communication normally works, what parts are difficult, and how to fix it when it goes wrong. The focus of this course is on providing you with a broad understanding of the way communication operates within dyads, work groups, and organizations. This course is not a practicum in public speaking or writing, although you will get some experience writing, speaking and managing impressions. Rather the intent is to give you theoretical and empirical underpinnings for the communication you will undoubtedly do when you return to work. Readings come from both the research and the managerial literatures. Among the topics considered are managerial communication, persuasion and conformity, self presentation and person perception, social networks. Cases and group
projects give you an opportunity to apply what you’ve learned. Prerequisites: 36201 or 36207 or 36217 or 36220 or 36225 or 36247 or 70207

70-342 Managing Across Cultures
Spring: 9 units
This course is designed for students who expect to do business in other countries or work with people from other cultures. It provides an intellectual framework for understanding other cultures (and eventually one’s own), as well as detailed studies of particular countries. It discusses how culture defines organizations, contracts, personal relationships, attitudes toward authority, time and space, ethics, wealth, and subcultures, and how these affect business. Student teams study a culture of their choice and make presentations, based on interviews and literature research. The written student reports are collected into a Cultural Handbook that is distributed to all students in the course.

70-343 Interpersonal Communication
Spring: 9 units
This course examines various types of interpersonal communication usually found in business situations. Topics covered will vary each semester, but can include business etiquette, ethics in business, interviewing skills, leadership skills, listening skills, how to run a successful meeting, intercultural communications, motivating employees, negotiating, networking in business, non-verbal communications, performance appraisals, power communication, telephone skills, and team/small group communication. Co-curricular events will be required and may include conducting mock interviews, role playing business luncheons, and navigating business social events.
Prerequisites: (70340) and (76100 or 76101 or 76104)

70-345 Oral Communications
Fall and Spring: 9 units
In this course, students prepare, present, discuss, and critique the different oral presentations currently practiced in business. Topics include developing verbal and physical presence; planning presentations based on audience needs and expectations; projecting personal credibility, professionalism, and appropriate emotional responses; and using various multi-media technology. Assignments and cases will cover informative and persuasive presentations, which will vary from term to term and may include the following business talks: such as formal public introductions, explanation of policy and/or procedures; employee training sessions; state-of-the-company addresses; sales proposals; team-driven strategic plans; unfavorable annual reports; public interviews with a hostile press; budget proposals.
Prerequisites: 70340

70-346 Written Communications
Spring: 9 units
A course in the style and mechanics of composition. Written Communications aims to increase your confidence and facility as a professional writer. The course develops and sharpens your knowledge of writing standards and techniques, patterns of organization and development, strategies of structure and definition, principles of classical rhetoric and processes of revision. Through close reading, detailed language analysis, and repeated, guided practice in composition, Written Communications prepares you for the writing you will do in your professional career; the identification, construction and exploration of issues and ideas, crafted with the best possible means of support and expression and the most effective means of persuasion, given your purpose and audience.
Prerequisites: 70340 and (76100 or 76101 or 76104)

70-364 Business Law
Fall and Spring: 9 units
The course is a survey of the major legal principles and processes affecting business managers in the United States, with some reference as well to the laws of other countries. The topics include contract law, product liability, intellectual property, employment, corporation law, environmental law, consumer protection, issuance of securities, secured transactions, commercial paper, bankruptcy, corporate crimes, business torts, antitrust regulation, international trade, business ethics and corporate social responsibility. The course draws examples from decided cases and from current business activities.

70-365 International Trade and International Law
Fall: 9 units
The course discusses the international legal system and laws that affect international trade. It covers the Foreign Corrupt Practices Act, treaties and concessions, shipping and customs, appointment of foreign sales agents, resolution of trade disputes, international mergers and joint ventures, international competition law, UN sales convention, international trade organizations (IMF, WTO, World Bank, etc.) , risk insurance, cultural factors, international E-Commerce and intellectual property.
Prerequisites: 73100 or 73110

70-366 Intellectual Property and E-Commerce
Spring: Mini Session - 6 units
This course covers the basics of doing business on the internet with emphasis on E-Commerce issues such as intellectual property, cybersquatting and commercial transactions.

70-371 Production I
Fall and Spring: 9 units
An introduction to production and operations management that covers both manufacturing and services. It deals with design and planning issues (capacity and location planning, facility layout) as well as operational issues (inventory management, material requirements planning, scheduling, project management). It also discusses recent developments as computer integrated manufacturing, flexible manufacturing systems, and just-in-time inventory systems. The linkage between strategy and tactics and the role of integrated systems will be emphasized. The students will learn concepts and tools that shall help them to manage from the “boardroom” to the “toolroom”.
Prerequisites: (21257 or 21292) and (70207 or 36202 or 36310 or 36220 or 36247)

70-381 Marketing I
Fall and Spring: 9 units
An introduction to the nature and fundamentals of marketing. Topics include an analysis of the factors influencing buyer behavior, marketing research, market segmentation, development of marketing strategies (new product, price, advertising and distribution decisions), and international marketing.

70-391 Finance I
Fall and Spring: 9 units
The course examines the role of the financial manager in the overall management and control of a firm. Stress is placed on the use of analytical models for improving the decision-making process. Both the short-term management of working capital and the long-term planning of capital structure and investment strategy are covered.
Prerequisites: (21257 and 70122 and 70207) or (21292 and 70122 and 70207)

70-392 Financial Economics
Spring: 9 units
A rigorous quantitative course covering the economic fundamentals of financial markets. The course covers individual decision making about saving and investment under uncertainty, and the equilibrium determination of asset prices for both complete- and incomplete-market settings. In addition, the course will cover topics in corporate financial decision making and the micro-structure of financial markets.
Prerequisites: 73250 and 73300

70-393 Financial Analysis and Securities Trading
Fall: 9 units
The Financial Analysis and Securities Trading (FAST) system is an educational technology that teaches applied principles of financial economics using a sophisticated network of personal
Prerequisites: (70121 and 70371 and 70381 and 70391) or are graded based on metrics similar to real executives: 1.) ability approve future plans and provide shareholder oversight. Students years. At the end of each year, the management students report to a operating a computer synthesized company for 3 simulated environment in which to experiment, 2.) to teach strategic management framework. The course has 3 main educational implementation of a strategy using a simulation as a framework. This is an applied strategy class that focuses on the business plan in a subsequent course entitled New Venture Creation created by teams from the class that can be developed into a entrepreneurship, innovation and leadership. The output of the course is a "mini-business plan" or venture opportunity screening document created by teams from the class that can be developed into a business plan in a subsequent course entitled New Venture Creation or through independent study.

70-397 Venture Capital Investing Fall: 9 units
Angel investors and venture capitalists have become the most visible sources of investment in new businesses in the United States. This course examines the investment process from the viewpoint of the angel and venture investor, and provides the students with a framework of their investment process. The course comprises four sections: investment criteria and selection, due diligence, deal structure and valuation, and post investment management. Students will be expected, in a team setting, to move a potential investment through its diligence, deal structure and valuation stages, and present investment recommendations. Guest speakers will supplement the course.

70-401 Management Game Spring: 12 units
This is an applied strategy class that focuses on the implementation of a strategy using a simulation as a framework. The course is designed to integrate the concepts and techniques studied earlier in the curriculum, into a unified, general management framework. The course has 3 main educational objectives: 1.) to give the student a dynamic competitive environment in which to experiment, 2.) to teach strategic planning as a process with an implementation focus, 3.) to learn to cooperate within a high performance team. Students are divided into teams of 5 or 6 managers and given the task of operating a computer synthesized company for 3 simulated years. At the end of each year, the management students report to a board of directors who review performance, set compensation, approve future plans and provide shareholder oversight. Students are graded based on metrics similar to real executives: 1.) ability to achieve objectives, 2.) value creation for shareholders, 3.) creation of competitive advantage, 4.) accumulation of personal wealth.
Prerequisites: (70121 and 70371 and 70381 and 70391) or (70122 and 70371 and 70381 and 70391)

70-414 Technology-Based Entrepreneurship Fall: 9 units
This course is an Introduction to Entrepreneurship designed to develop skills related to entrepreneurship and innovation for non-business undergraduate and graduate students. The course assumes no background courses in business and is appropriate for those who are interested in bringing innovations to market either through new companies or existing companies. The course provides an overview of entrepreneurship and innovation, develops an entrepreneurial frame of mind, and provides a framework for learning the rudiments of how to generate and evaluate ideas and opportunities. Students come up with or are presented with potential ideas and learn how to develop these ideas into opportunities, and to explore their potential for becoming viable businesses. They learn how to do market research, to develop go-to-market strategies, value propositions, and to differentiate their products or services from potential competitors. The focus is on understanding and developing strategies for approaching the key elements of the entrepreneurial process – opportunity, resources and team. The course consists of a balance of lectures, case studies and encounters with entrepreneurs, investors and business professionals. The students are exposed to financial and intellectual property issues, and encounter a real world perspective on entrepreneurship, innovation and leadership. The output of the course is a "mini-business plan" or venture opportunity screening document created by teams from the class that can be developed into a business plan in a subsequent course entitled New Venture Creation or through independent study.

70-416 New Venture Creation Fall: 9 units
This course is designed to be a follow on to Introduction to Entrepreneurship. Students working in teams develop and advance business plans that serve as roadmaps for building and their businesses. The business plans include strategies for commercializing and marketing their products and/or services, for building their management teams, and for financing their ventures and projects. The end objective is for the student teams to develop compelling plans that will enable them to convince the outside world that their ventures and projects represent opportunities that are viable with a substantial potential for success and with well understood and manageable risks. Students are encouraged to participate in business plan competitions and to seek financing for their projects. The course exposes students to the nuances of financing new ventures and getting them started legally.
Prerequisite courses are 70-415 or 70-414 (or the equivalent in MCS, CIT, or SCS)
Prerequisites: 70414 or 70415

70-417 Topics in Entrepreneurship Fall and Spring: 9 units
This is an independent study course where students work on "actual" real-life entrepreneurial businesses. "Entrepreneurial Entrepreneurship" is a concept which was founded at CMU – and has shown that students can have real insight and input into the day to day issues surrounding local entrepreneurial ventures. Students work in very small groups (or one-on-one with the instructor) to study in depth particular entrepreneurial topics in which they are interested. The 'experiential' side can include family business, intrapreneurial activities, CMU related businesses that are attempting to get 'launched' on campus, or the development of their mini-business plan into a full-blown business plan.
Prerequisites: 70415 or 70416

70-418 Financing Entrepreneurship Ventures Spring: 9 units
This course follows the entrepreneur throughout the money-raising process from idea generation through receiving and analyzing a term sheet. The course is focused on four segments: determining how much capital to raise, identifying sources of capital, convincing an investor to write a check, and determining whether a deal is good or not. Guest entrepreneurs, venture capitalists, and other professionals are invited to class to discuss their perspectives on each stage of fundraising. This course emphasizes the financial component of the business plan and provides the student with the skills and tools required to build an effective financial operating model.
Prerequisites 70-414 or 70-415 (or equivalent in MCS, CIT, SCS, or CIT)
Prerequisites: 70414 or 70415

70-424 Corporate Financial Reporting Spring: 9 units
This course is designed to strengthen your ability to correctly interpret financial statements and their accompanying disclosures. The course is aimed at anyone whose career might involve working with accounting data, and should be especially useful for those interested in computers and workstations. Students learn finance using both real time data feeds as well as a simulated trading environment.
Prerequisites: 70391

70-397 Venture Capital Investing Fall: 9 units
70-401 Management Game Spring: 12 units
70-414 Technology-Based Entrepreneurship Fall: 9 units
70-416 New Venture Creation Fall: 9 units
70-417 Topics in Entrepreneurship Fall and Spring: 9 units
70-418 Financing Entrepreneurship Ventures Spring: 9 units
70-424 Corporate Financial Reporting Spring: 9 units

Course Descriptions

- **Prerequisites:**
  - 70391

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**Course Descriptions**

**70-418 Financing Entrepreneurship Ventures**

**Spring: 9 units**

This course follows the entrepreneur throughout the money-raising process from idea generation through receiving and analyzing a term sheet. The course is focused on four segments: determining how much capital to raise, identifying sources of capital, convincing an investor to write a check, and determining whether a deal is good or not. Guest entrepreneurs, venture capitalists, and other professionals are invited to class to discuss their perspectives on each stage of fundraising. This course emphasizes the financial component of the business plan and provides the student with the skills and tools required to build an effective financial operating model.

Prerequisites: 70-414 or 70-415 (or equivalent in MCS, CIT, SCS, or CIT)

Prerequisites: 70414 or 70415
consulting and financial analysis. Throughout the semester we will discuss the key disclosure rules in the United States, the communication methods available to managers, managers' incentives and ability to exert discretion over reported earnings, and the interplay between a company's corporate strategy and its financial reporting policies and practices. The course revolves around a number of topics of recent interest to the business community including the quality of earnings, mergers and acquisitions, purchased R&D, post employment benefits, executive compensation, and intangible assets.

Prerequisites: 70122

70-430 International Management
Spring: 9 units
This course is designed to familiarize the student with the problems and opportunities involved in operating a business that spans national borders. It addresses recent developments in world trade, traditional approaches such as top-down or structured, the world financial environment, business policy and strategy for firms competing in the global marketplace, and theory behind international business. Issues in managing cross-cultural differences, global marketing, multinational finance, accounting, and taxation are also covered.

Prerequisites: 73100 or 73110

70-440 Corporate Strategy
Fall: 12 units
This course is designed to provide the student with a general management perspective and an understanding of the total business enterprise. It builds upon previous course work in functional areas and provides insights and analytical tools which a general manager should have in order to plan and implement successful business strategy. The student will analyze complex business problems and formulate realistic strategic solutions. Emphasis is placed on the practical application of business theory by the student in his/her business career.

Prerequisites: 70122 and 70371 and 70381 and 70391

70-451 Management Information Systems
Fall: 9 units
The objectives of this course are to provide students with basic knowledge of the technology used in computer-based information systems and to enable them to acquire the skills for analyzing how to manage this technology in business. There is a strong emphasis on how to become both an intelligent user of information systems and also an effective participant in the design process of these systems. Credit will not be allowed for both 70-451 and Information Systems, 88-200.

Prerequisites: 15100 or 15111 or 15112 or 15120 or 15125 or 15127

70-453 Systems analysis and Design
Spring: 9 units
This course is designed to provide students with a basic understanding of how to develop and implement computer-based management information systems. Students will be introduced to a variety of system development concepts and techniques. These can include traditional approaches such as top-down or structured, problem definition, feasibility analysis, enterprise analysis, and data flow diagrams, as well as interactive and iterative development approaches such as prototyping and object-oriented concepts and techniques. The course also explores topics related to successful implementation of systems such as testing strategies, project management, user oriented design and software maintenance. Students will work in teams to analyze, design, and build a small information system.

Prerequisites: 70451

70-455 Information Resource Management
Spring: 9 units
The objective of this course is to explore information resources management issues from a managerial perspective. In this course students learn how information resources can influence and define corporate strategy, how to discover opportunities to gain competitive advantages with information resources, and how managers control the development and use of such information resources (covering topics such as end-user computing expert systems and privacy). Students also learn how to model and analyze corporate information needs, how database management systems serve to support those needs, and how managers address significant issues concerning that support.

Prerequisites: (15100 and 70451) or (15100 and 67271) or (15100 and 67272)

70-456 Telecommunication and Network Management
Fall: 9 units
This course introduces students to telecommunication and computer network technologies. We discuss computer telecommunications, local area networks and wide area networks. Topics include the ISO reference model; network architecture; data communications; local area networks; and ISDN. Students will develop a project to demonstrate impacts of telecommunication technology in business.

Prerequisites: 70451

70-459 Web Business Engineering
Spring: 9 units
In this course students will learn how to set up a business on the Internet by using World Wide Web technologies. The students will examine telecommunications technologies to tie businesses together to form a virtual business?

Prerequisites: (15100 and 70451) OR (15100 and 67271) OR (15100 and 67272)

70-460 Mathematical Models for Consulting
Fall: 9 units
This course introduces students to a wide variety of models and techniques used by consultants and decision-support software. It covers applications of linear and integer programming, fuzzy logic and fuzzy control, neural networks, constraint programming, Bayesian networks, influence diagrams, analytical hierarchy process, and data envelopment analysis. Such heuristic methods as tabu search, simulated annealing, genetic algorithms, learning based methods, asynchronous teams, and ant colonies are briefly discussed.

Prerequisites: 21257 or 21292

70-465 Information Technology Strategy
Spring: 9 units
This course explores how firms use Information Technology (IT) strategically while focusing on the use of the technology rather than its details. The goal is to understand how IT enables new strategies and how existing strategies adapt to innovations in IT. The course focuses on approaches to value creation using IT and their application to a variety of business settings. It will examine such issues as: how different functional areas employ IT; electronic commerce - applications and pitfalls; the impact of IT on traditional supply chains, logistics and payment systems; and the impact of electronic business on established industries and companies. The course will examine these issues in a variety of industries and business settings, e.g. business-to-business, business-to-consumer and consumer-to-consumer contexts.

Prerequisites: 70371

70-471 Logistics and Supply Chain Management
Spring: 9 units
This course shall highlight the architecture, processes and drivers of performance of modern supply chains in various industries. We will link the material and information flows and discuss key business processes related to bridging the demand and supply side. There is an extensive use of cases, computer models and emphasis on recent developments in the supply chains of Fortune 500 firms. Industry experts will also share their experiences and challenges.

Prerequisites: 70371

70-481 Marketing Research I
Spring: 9 units
Marketing research is the process of acquiring, analyzing and presenting information used to make marketing decisions. The beginning of the course describes the general process of conducting marketing research. A significant portion of the course focuses on methods of acquiring marketing data through surveys, experimentation, panels and secondary data sources. The remainder
Course Descriptions

70-483 Marketing Communications
Spring: 9 units
A brand’s first contact with the consumer is by Marketing Communications. Whether by traditional advertising and sales promotion or by new media and approaches, the proliferation of marketing communications is impacting culture and business performance and must be managed by marketers. Integrated marketing communications campaigns are the best way to effectively build brands. This course covers the role and execution of marketing communications within the context of overall marketing strategy and in conjunction with other elements of the marketing mix. Students acquire an understanding of marketing communications tools and apply them to a real-world situation through the development and team presentation of an integrated marketing communications campaign.
Prerequisites: 70381

70-484 Direct and Interactive Marketing
Fall: 9 units
Direct and Interactive Marketing is a fast growing discipline with special competencies that are impacting and advancing the field of marketing in general. This consumer marketing course develops direct marketing planning skills, explores the future of the field including how interactive marketing is evolving with the internet, and offers students further insight into marketing as a career field of choice. The course incorporates cases, lectures and a team project to provide a comprehensive understanding of the meaning, uses, and contribution of direct marketing to the firm and consumer.
Prerequisites: 70381

70-485 Product Management
Spring: 9 units
This course focuses on problems and strategies specific to managing products and services. Emphasis primarily on the design and marketing of new products and services. The objectives of the course are to acquaint students with the new product development process; to introduce students to the concepts and techniques useful for making new product decisions; and to give students an opportunity to apply course concepts to the actual development of a new product or service by working on a comprehensive group project.
Prerequisites: 70381

70-486 Pricing
Spring: 9 units
The purpose of this course is to present a framework for assessing pricing decisions, the central element of marketing. The course is structured around marketing’s three C’s: Costs; Customers; and Competitors. In the first part of the course we discuss how costs should, and should not, enter the pricing decision. We move on to show how a marketing focus on the customer provides insight into the pricing decision. Then we discuss how competitors impact the pricing decision. The course concludes with pricing strategies, tactics, and their applications: dynamic pricing over the product life cycle, product line pricing through the marketing channel, price bundling and legal aspects of pricing.
Prerequisites: (70381) and (73100 or 73110)

70-487 Investment Analysis
Spring: 9 units
Students gain an understanding of financial theories through learning the theory and development of basic computer programs that can be applied in a real world environment. Typical projects include obtaining the efficient frontier of a given set of securities; deciding on the optimal investment strategy for a given set of securities; calculating option prices using Black-Scholes and Binomial option pricing models.
Prerequisites: 70391

70-497 Options
Fall: 9 units
This course is designed to provide students with (a) the skills and intuitive insights needed to identify and manage opportunities to appropriately employ derivative securities in the conduct of their business either for gain or risk management, (b) a working knowledge of the mechanics of the futures, options and swap markets and (c) a fundamental understanding of how derivative securities are priced.
Prerequisites: 70391

70-499 Internship
All Semesters: 1-18 units
BA students are strongly encouraged to undertake internships. Students doing an internship of an academic nature do so under the supervision of a faculty member and receive a letter grade. Non-academic internships are possible for pass-fail credit with the approval of the Department Director. Enrollment by permission of the BA Program.

70-500 Honors Thesis I
Fall and Spring: 3-18 units
Business students with outstanding academic records may undertake an Honors Thesis. The topic is of the student’s choice but must have some original aspect in the question being explored, the data set, or in the methods that are used. It must also be of sufficient academic rigor to meet the approval of a faculty advisor with expertise in the project’s area. Students enroll each semester in a 9-unit independent study course with their faculty advisor for the project (70-500 in the fall and 70-501 in the spring). Students and their faculty advisor develop a course description for the project and submit it for approval as two 9-unit courses to the BA Director. Enrollment by permission of the BA Program.

70-501 Honor Thesis II
Spring: 3-18 units
Business students with outstanding academic records may undertake an Honors Thesis. The topic is of the student’s choice but must have some original aspect in the question being explored, the data set, or in the methods that are used. It must also be of sufficient academic rigor to meet the approval of a faculty advisor with expertise in the project’s area. Students enroll each semester in a 9-unit independent study course with their faculty advisor for the project (70-500 in the fall and 70-501 in the spring). Students and their faculty advisor develop a course description for the project and submit it for approval as two 9-unit courses to the BA Director. Enrollment by permission of the BA Program.

70-502 Independent Study in Management
All Semesters: 3-18 units
Students with a special interest in Management/Production not covered by a formal Business course may develop an Independent Study Course in that area. Readings and work to be completed are by agreement between the student and an individual faculty member. Enrollment by permission of the BA Program.

70-503 Independent Study in Marketing
All Semesters: 3-18 units
Students with a special interest in Marketing not covered by a formal Business course may develop an Independent Study Course in that area. Readings and work to be completed are by agreement between the student and an individual faculty member. Enrollment by permission of the BA Program.

70-504 Independent Study in Organizational Behavior
All Semesters: 3-18 units
Students with a special interest in Organizational Behavior not covered by a formal Business course may develop an Independent Study Course in that area. Readings and work to be completed are by agreement between the student and an individual faculty member. Enrollment by permission of the BA Program.

70-505 Independent Study in Finance
All Semesters: 3-18 units
Students with a special interest in Finance not covered by a formal Business course may develop an Independent Study Course in that area. Readings and work to be completed are by agreement between the student and an individual faculty member. Enrollment by permission of the BA Program.
Course Descriptions

70-506 Independent Study Management Information Systems
All Semesters: 3-18 units
Students with a special interest in Management Information Systems not covered by a formal Business course may develop an Independent Study Course in that area. Readings and work to be completed are by agreement between the student and an individual faculty member. Enrollment by permission of the BA Program.

70-507 Independent Study in Business Communications
All Semesters: 3-18 units
Students with a special interest in Business Communications not covered by a formal Business course may develop an Independent Study Course in that area. Readings and work to be completed are by agreement between the student and an individual faculty member. Enrollment by permission of the BA Program.

70-520 Publicity and Public Relations
Fall: 9 units
The course examines the concepts, principles, and ethics essential to the practice of public relations as a profession. It discusses the diverse areas of public relations, from publicity and special events management to lobbying and fund raising. Through case studies, students learn how to solve problems using time-tested public relations strategies. The course also examines the elements of successful publicity. Students learn the tools of publicity, including pitch letters, news releases, and tip sheets. They also learn the basics of news writing, how to identify a news angle and how to write about it. Writing is an essential part of this course and students are evaluated, in part, on their written work.

70-635 Desktop Publishing
Spring: 9 units
Starting in the mid 1980's, desktop publishing has transformed the way that graphic media is produced. It enabled non-professionals with modest desktop equipment to produce files for high quality graphic output. This course examines the methods and applications of desktop publishing from two perspectives: from a project management perspective, and from a hands-on production perspective. The topics covered include: the new digital workflow, typography, file formats, trapping, software applications, imposition, preflighing, output issues.
Prerequisites:

70-637 Interactive Media Management
Fall: 9 units
Interactive media offers a powerful communication method by providing an immersive, self-guided multi-media environment. This lab-based course uses exercises in Macromedia Flash to build animations that demonstrate the capabilities of interactive media. The course provides an introduction to project management methods for interactive media. Students learn how to conceptualize, manage, and execute an interactive media project that combines text, illustrations, photographs, animations, sound, and video.
Prerequisites:

70-639 Advanced Interactive Media Management
Spring: 9 units
This course extends the knowledge of Macromedia Flash learned in 70-637. This project-based course relies heavily on Action Scripting to make advanced interactive projects. (Prerequisite 70-637)
Prerequisites: 70637

70-640 Emerging Graphics Technologies
Fall: 9 units
Recent developments impacting the graphic communications industry are examined in this seminar course. Computer-to-plate technology, database publishing, on-demand printing, digital printing, www publishing, e-paper and multi-media production are among the topics under discussion.

70-641 Color Reproduction and Management
Spring: 9 units
In today's business world, the accurate reproduction of color in various media is both a challenge and a necessity. This course examines the issues related to color reproduction and the methods by which consistent color appearance can be maintained across a variety of traditional and electronic media. Topics include: the perception and measurement of color; the capture, separation, and manipulation of color images, and color management techniques for a variety of media including print, the WWW, and television.
Prerequisites: 70160

70-643 Publishing on the World Wide Web
Fall and Spring: 9 units
In just over a decade, the World Wide Web has become an essential venue for businesses. This course examines a variety of topics related to web publishing including: the design and usability of web sites, the appropriate use of file formats, business practices across the web, the integration of other media, the increased use of mobile devices, strategies for search engines, and others. Classroom instruction is supported by laboratory exercises where students make and publish functional and effective web pages.

70-650 Independent Study: Graphic Communications Management
All Semesters: 6-12 units
Students with a special interest in Graphic Media not covered by a formal Business course may develop an Independent Study Course in that area. Readings and work to be completed are by agreement between the student and an individual faculty member. Enrollment by permission of the BA Program.
Prerequisites:

Economics

Undergraduate Courses

73-099 Introductory Economics
AP Credit: 9 units
Credit for AP coursework satisfying the H&SS General Education Requirement.

73-100 Principles of Economics
Fall and Spring: 9 units
An introductory course in the development and use of economic tools for analysis of public policy issues. The course begins with an introduction to the central problem of organizing an economy and allocating resources, emphasizing an overview of the market system in a private enterprise economy. Demand and supply analysis and the elements of long-run competitive equilibrium are developed. This is followed by an analysis of the foundations of consumer behavior which determine market supply and demand. The course concludes with an examination of cases in which the competitive paradigm does not hold (monopoly, oligopoly), and a consideration of the problem of multi-market equilibrium in a private enterprise economy. In addition to serving as an introduction to economic analysis, the course is also intended to provide the necessary methodological basis for students who go on to take courses in intermediate economic analysis.

73-101 Freshman Seminar
Fall and Spring: 9 units
A topics-based course for first year students who intend to major in economics. The subjects discussed vary from year-to-year and from instructor-to-instructor. Check with the Undergraduate Economics Program or their website for descriptions of recent and current offerings.

73-148 Environmental Economics
Intermittent: 9 units
The course develops and uses economic concepts to explain why environmental problems occur, to determine economically efficient allocations of environmental resources, and to evaluate the consequences of public policies that are intended to improve the use of environmental resources. Uncertainties that limit knowledge about
environmental resources and the consequences of their use are examined, and the effects of such uncertainties on the practical feasibility of implementing theoretically efficient principles and policies are analyzed. Alternative public policies that might achieve superior allocations of environmental resources in practice are investigated. Prerequisites: 73-100 or 88-220

73-200 Macroeconomics Fall and Spring: 9 units A calculus-based introduction to modern macroeconomics. Building macroeconomic models from microeconomic principles, insights are developed into economic growth processes and business cycles. Topics include aggregation and measurement, national income, business cycle measurement, economic welfare theorems and social inefficiencies, the effect of government fiscal policy upon employment and productivity, and the relationship between investment, interest rates and economic growth. Ideas of multivariate calculus (such as partial derivatives) are introduced as needed and taught in the context of economic theory. Prerequisites: (73-100 or 88-220) and (21-112 or 21-120 or 21-121)

73-226 Quantitative Economic Analysis Spring: 9 units Using and extending upon students' introductory knowledge of probability and economic models, this course introduces students to the tools of economic analysis. Taking the perspective of active economic participants (rather than outside observers), students gain experience with a diversity of analytical techniques—such as regression analysis and simulation—in the context of real world data driven problems. Classes consist of a combination of cases, lectures, and interactive discussions. Prerequisites: (21-122 or 21-123) and (36-217 or 36-225) and (73-200 or 73-251)

73-251 Economic Theory Fall and Spring: 9 units This course prepares students for advanced coursework in economics by providing a mathematically intensive overview of economic theory. Students take advantage of their knowledge of multi-dimensional calculus and constrained optimization techniques in order to understand the development and logical consistency of the most commonly employed economic models. Topics include consumer preferences and utility function representations, consumer choice under a budget constraint, substitution and income effects, compensated and uncompensated demands, expected utility theory, risk and insurance, technology and production functions, cost minimization, profit maximizing firms, perfect competition, single-firm markets, game theoretic analysis of markets with few firms, introduction to general equilibrium models and the welfare laws. Prerequisites: (21-256 or 21-259) and (73-100 or 88-220)

73-261 Econometrics Fall: 9 units After reviewing elements of linear algebra, including the use of vector and matrix notation, students use it to analyze least squares estimation in the multivariate linear model. This is followed by a discussion of several of the assumptions on which least squares estimation is based, and what corrective actions should be taken if they are violated. Particular attention is paid to specification errors, multicollinearity, measurement errors, heteroskedasticity and serial correlation, and the estimation of simultaneous equations models (such as supply and demand). Prerequisites: (21-122 or 21-123) and (21-256 or 21-259) and (73-226)

73-270 Professional Writing for Economists Fall and Spring: 9 units A writing course specifically designed for third-year Economics majors. Students gain experience with technical writing techniques and skills needed for both their senior thesis and their eventual professional careers. The course emphasizes both individual and group projects.

73-325 Experimental Foundations of Equilibrium Fall or Spring: 9 units Combining non-cooperative game theory and its applications with experimental methods, this course teaches students how to develop and test models of social and business interactions (for the purposes of explanation and prediction). Both extensive and normal form games are treated in depth, including the concept of Nash equilibrium and it refinements. These concepts are applied to topics in industrial organization, labor theory, finance, auctions, and markets. Students learn to design, run and analyze their own experiments. Prerequisites: 73-200 or 73-251

73-340 Labor Economics Fall or Spring: 9 units This course uses economic theory and data to analyze topics such as: (1) individuals decisions about hours of work, wages and earnings; (2) firms decisions about hiring, training workers, and setting wage rates; and (3) the resulting wage and employment outcomes as influenced by union contracts and implicit employment contracts. Also considered are public policy recommendations concerning minimum wages, job and market flexibility, job training programs, hazards on the job, race and sex discrimination, and income inequality. Prerequisite: 73-251

73-347 Game Theory for Economists Intermittent: 9 units An introduction to the theory of non-cooperative games with an emphasis on economic applications. After an initial examination of two-person, zero-sum games, the notion of a Nash equilibrium in an n-person, non-cooperative game is considered. Existence of and refinements to the equilibrium concept are discussed in the context of both normal and extensive form games. Economic applications may include various topics, including Cournot and Bertrand oligopoly models, general competitive exchange equilibria, and free rider problems. Prerequisites: (21-122 or 21-123) and (73-251)

73-351 Public Finance Intermittent: 9 units This course examines problems created by market failure and analyzes the incentives and institutions, which can be used to alleviate these problems. We will consider applications such as education, environmental, defense, crime, and common resources. The common thread in these situations is that individual optimizing behavior does not necessary lead to an outcome, which is optimal for the society. We will evaluate possible solutions involving private, informal mechanisms as well as those requiring public sector intervention. Prerequisites: 73-251

73-352 Public Economics Intermittent: 9 units In this class we will analyze the role that government plays in a market economy and the lives of its citizens. We will consider some reasons for government intervention in markets and study the impact of government programs on the behavior and welfare of its citizens. We will analyze some of the main economic challenges faced by modern societies in an increasingly globalized economy. The course will cover a wide range of controversial topics including taxation and expenditure policies, externalities and market failure, social security, public assistance programs and redistribution. We will also cover the role of local and state governments in the economy covering issues such as crime, urban development and education. Prerequisites: 73-200 and 73-251

73-354 Law and Economics Intermittent: 9 units In recent years, the use of economics to analyze legal issues and decide legal controversies has been extended far beyond its original domain of antitrust and public utility regulation. Now not only scholars but also courts and regulatory bodies routinely apply economic principles to issues as diverse as the control of crime, accident law, contract damages, judicial administration, financial regulation,
and pollution. This course reviews the major findings of the scholarly literature on law and economics, and emphasizes the application of economics to specific problems. No knowledge of law is presumed or required.
Prerequisites: (73-200 or 73-251) and (73-226 or 70-208)

73-356 Political Economy of Public Institutions
Intermittent: 9 units
This course provides the student with an introduction to formal political theory and the modeling of political processes in a rigorous scientific way. Several substantive issues and areas are examined, including: 1) the causes of public sector growth; 2) the politics of regulation; 3) the logic of legislative action; 4) simple majority rule elections; and 5) interest group decision-making. The perspective adopted here is that of extending contemporary economic theory to collective (e.g., governmental) choice institutions. Specifically, we consider, first, how economic theory can be applied to these issues and, second, how that theory can be modified usefully to model political, non-market phenomena. A brief introduction to game theory is included.
Prerequisite: 73-251

73-357 Regulation: Theory and Policy
Fall or Spring: 9 units
There is hardly an aspect of our lives – our food, health care, work environment, the air we breathe, the places where we live – that is not subject to some government regulation. This course explores the origins, goals, and implementation of many major regulations. We use an analytical framework that considers the economic, political, and bureaucratic forces that create and shape regulation. This framework is developed and applied with reference to specific cases, including air pollution, auto safety (air bags), food additives, technological risk (nuclear reactors), occupational safety (asbestos, cotton dust), hospitals, airlines and trucking, and consumer protection (truth in advertising).
Prerequisite: 73-251

73-358 Economics of the Environment and Natural Resources
Spring: 9 units
The economic theory of environmental degradation and public policies designed to deal with it; the theory of renewable and nonrenewable resources including their pricing and allocation over time. Implications for the intermediate term future (25 to 50 years hence) are modeled.
Prerequisites: 73-251

73-359 Benefit-Cost Analysis
Fall or Spring: 9 units
The evaluation of public private sector projects. The theory of benefit-cost analysis and related techniques, such as cost-effectiveness analysis. Attention is given to such issues as valuing goods and services that are not normally traded in the marketplace (e.g., the value of an individuals life) and the social rate of discount. Applications are considered in detail.
Prerequisites: 73-251

73-365 Industrial Organization
Fall or Spring: 9 units
This course is concerned with the economic analysis of industrial markets that are not perfectly competitive. The effects of imperfect competition on firms' decisions (pricing, location, advertising, research and development, among others) are reviewed. Implications of these effects in terms of public policy are also discussed from a variety of perspectives. Finally, applications to actual markets are considered.
Prerequisites: 73-251

73-371 International Trade and Economic Development
Intermittent: 9 units
This course examines the economic rationale for trade among nations and its consequences for the citizens of the nations involved. Topics to be considered include comparative advantage, gains from trade, possible gains from tax-subsidy programs, traditional and recent arguments for protection, and the effects of special trade arrangements such as regional trade zones. In addition, the course considers the effects of trade and other policies on economic growth and development. Emphasis is given to the principle analytical concepts and results relevant to the special problems of developing nations.
Prerequisites: 73-251 and 73-200

73-372 International Money and Finance
Fall or Spring: 9 units
This course is devoted to economic analysis of exchange rate behavior, balance of payments adjustments, the financing of payments imbalances, and related topics in the areas of international monetary, macro, and financial economics. A simple but flexible model of exchange rate determination will be formulated and tested empirically. Considerable emphasis will be given to issues concerning alternative monetary arrangements such as fixed vs. flexible exchange rates, currency unions, and commodity-money standards. Some historical consideration of the pre-1914 gold standard and the 1945-1971 Bretton Woods system will be included, as well as institutional discussion of the present (and prospective) European Monetary System.
Prerequisites: 73-251 and 73-200

73-385 Incomplete Information and Economics
Intermittent: 9 units
Economic analysis of market situations where at least some of the agents are imperfectly informed. This analysis includes the impact of incomplete information upon the actions of sellers and buyers, as well as upon the resultant market equilibria and their properties. Topics include: the effect of consumers being poorly informed as to a products quality or price; auctions with imperfect information as to participants' valuations; market equilibria which reveal privately held ability (or lack thereof) to police undesirable (but not directly observable) actions such as collusion between firms and predatory pricing.
Prerequisites: 73-251 and 73-226

73-392 Financial Economics
Fall or Spring: 9 units
A rigorous quantitative course covering the economic fundamentals of financial markets. The course covers individual decision making about saving and investment under uncertainty, and the equilibrium determination of asset prices for both complete- and incomplete-market settings. In addition, the course will cover topics in corporate financial decision making and the micro-structure of financial markets.
Prerequisites: 73-251 and 73-200 and (73-226 or 70-208)

73-410 The Economics of Business Cycles
Fall or Spring: 9 units
The purpose of this course is to educate the student in modern business cycle theory. The first part of the course surveys the empirical regularities, which comprise fluctuations in aggregate economic activity, which economists have labeled business cycles. The second part of the course discusses the existing macroeconomic models, which students have learned in intermediate macroeconomics, while the third part of the course examines the policy implications of these models and the inadequacies of the models as economic explanations of cycles. The final part of the course discusses rational expectations models of the business cycle in considerable detail. The empirical implications of these new models are examined, and their policy implications are assessed.
Prerequisites: 73-251 and 73-200 and (70-208 or 73-226)

73-420 Monetary Theory and Policy
Intermittent: 9 units
This course is concerned with various topics in monetary and macroeconomics including anticipated inflation, hyperinflation, output effects of monetary policies, alternative techniques of monetary policy implementation, and the interaction of monetary and fiscal policy strategies. Analysis of these issues is conducted by means of simple by explicit dynamic models incorporating rational expectations. In addition, attention is devoted to alternative
types of monetary systems – commodity vs. paper money, for example. This segment of the course includes some consideration of issues relating to a technologically advanced society in which transactions are carried out by means of a computerized economy-wide bookkeeping system, rather than by money.
Prerequisites: 73-251 and 73-200

73-430  Topics In The Economics Of Uncertainty
Intermittent:  9 units
The course is designed to investigate both the behavior of economic agents and the characteristics of markets in the face of uncertainty. The first third of the course deals with the behavior of individual agents and optimal choices under uncertainty. The second third of the course examines various notions of equilibrium in the face of uncertainty. We then consider various models, which attempt to explain phenomena such as price dispersion and unemployment as arising from uncertainty.
Prerequisites: 73-251 and 73-200

73-435  Economics of Negotiations
Fall:  9 units
The objective of this course is to understand the influence of economic factors upon both the conduct of involved parties and upon their anticipated outcomes. Insights gained from economic analysis are used to help find profitable negotiation strategies and to help evaluate opportunities which depend upon a negotiated outcome. Topics include: the creation and allocation of economic value; the negotiator’s fundamental decision problem; the tension between creating and claiming value; strategies for better agreements; the role of coalitions in multi-party negotiations; negotiations within and between organizations. Considerable emphasis will be placed on negotiation exercises, role playing, and the student discussion and analysis of actual current and past negotiation situations.
Prerequisites: 73-251 and (70-208 or 73-226)

73-458  Money and Banking
Fall or Spring:  9 units
This course addresses several issues concerning money in our economic system. These include the definition of money and its role, an investigation of banks and their behavior, and the relationship of knowledge of the monetary system to controlling the economy.
Prerequisites: 73-200

73-469  Economics of E-Commerce
Fall or Spring:  9 units
The information revolution brought about by the Internet is having a dramatic impact on the organization of economic activity. Long-term contractual relationships that once governed corporate procurement are being dismantled as manufacturers use the Internet to market directly to the public. New transportation networks that used to simply move goods from point A to point B are evolving into dynamic inventory pipelines that allow manufacturers to track and even reroute shipments in real time. At the same time, individuals are making use of sophisticated search engines to comparison shop at a scale that would have been physically exhausting even five years ago. In the Economics of E-commerce, we will use the basic tools of economic analysis to understand how and why the changes in information technology are reshaping the economic landscape.
Prerequisite: 73-251

73-476  American Economic History
Intermittent:  9 units
The study of economic history provides important perspective on current economic institutions and policies. A failure to understand the historical evolution of economic institutions or the variety of past economic experience is perhaps the worst shortcoming of many economists. The study of economic history provides an opportunity to test currently fashionable theories against data different from those used in their construction. In fact, this is a course in applying economics. The theories developed in the intermediate courses will be applied to episodes from the past in ways that increase understanding both of the specific historical episodes considered and the economic theories employed.
Prerequisites: 73-251 and 73-200 and (70-208 or 73-226)

73-495  Advanced Independent Study in Economics
All Semesters:  1-18 units
The Independent Study course in economics allows the student to pursue his or her own research interests in any of a variety of topics in economics. A typical independent study course involves a semester long research project under the supervision of an appropriate faculty advisor. The nature and scope of the project are determined by the student and faculty advisor and may range from an in-depth survey of the literature to a detailed theoretical or empirical analysis of the topic in question.
Prerequisites: (73-250 or 73-251) and (73-200 and 73-300) and (70-208 or 73-226 or 73-300)

73-497  Senior Project
Fall:  9 units
A fourth-year project course, open only to Economics primary and additional majors with Senior standing. Prerequisites: 73-200 and 73-251 and 73-226

73-500/501  Honors Thesis
Fall/Spring:  9 units
Economics majors with outstanding academic records and intellectual promise will be given the opportunity to undertake original research under the direction of individual faculty members. Research topics are selected by students and approved by faculty. Prerequisites: Senior standing in the Economics Program and permission of the Economics faculty.

English

Undergraduate Courses

Each semester the English Department provides detailed and current descriptions of courses to be offered the following term. These descriptions are available from the Department office, Baker Hall 259, in advance of registration. The following brief descriptions constitute a sample of courses the Department teaches; however, every course is not offered every term, new courses are added from time to time, and variations on the basic courses can change the focus of these courses from term to term. For the most up-to-date information, be sure to check current information available from the Department each semester.

Numbering System:
Courses offered by the Department are numbered roughly according to level of difficulty. Consult with your advisor for more information. The following is a scheme for relating course numbers to the classes of students for whom the courses are primarily targeted:

76-100-199  Freshman
76-200-299  Sophomore and Introductory level courses
76-300-399  Sophomores, Juniors and Seniors and above *
76-400-499  Juniors and Seniors and above *

* Selected 300- and 400-level English courses are open to graduate students in the Department and may include a mix of upper level undergraduate and graduate students. Graduate students in these courses may have different prerequisites and requirements. Check the Department course descriptions available each semester and information from your advisor for details.

Courses listed as “Fall or Spring” may be offered either fall or spring semester but frequently not both semesters in a given year. Some courses in this category may be offered only every other year.
76-101 Interpretation and Argument
Fall & Spring: 9 units
Interpretation and Argument is structured to introduce students to fundamental practices of critical reading and writing. In the course, students are exposed to a variety of different texts, both fiction and nonfiction, so that they can explore and critically evaluate a single issue from multiple perspectives. They are taught to summarize and analyze arguments within that issue so that they may contribute an argument of their own. The course is also geared toward helping students understand the requirements of college-level argumentation and composition. Becoming a competent writer in this way requires that students be reflective and strategic with their composing processes, particularly with planning, writing, reading, detecting and diagnosing problems within their own work, and finally with revising their own texts. Ultimately, the course provides opportunities for students to develop critical thinking skills for analyzing and producing texts within the context of an academic community.

76-206 Introduction to Creative Writing
Fall or Spring: 9 units
This course gives students practice in reading and writing various types of creative writing. In a workshop setting, students gain critical and analytical skills through discussing published work and work written by class members. The course is intended primarily for freshmen or students fulfilling their Integrated Liberal Studies requirements and cannot be counted for credit toward any requirements for degrees in English. Additionally, students who are registered for or have already taken one of the Survey of Forms courses 76-260, 76-265, or 76-269 ¾ are not eligible to enroll in 76-206 because of the substantial overlap involved.

76-221 Books You Should have Read by Now
Fall or Spring: 9 units
It may seem more and more difficult to get a good classical, liberal education these days. The demands of professional training force many of us to skim on our understanding of major artistic achievements. This course is for those people who should have read some of the best books around, but haven't managed to yet—books you should have read by now. Kurt Vonnegut's character Kilgore Trout sings the praises of Dostoevski's *The Brothers Karamazov*, pointing out that it contains everything you need to know about life. He then ruefully adds that unfortunately that's not enough any more. It may not be enough, but it might be a place to start. Each book will be considered in itself for whatever it might offer by way of understanding the world, then and now. Each one can be seen as a useful foundation point for understanding an important period of history (Machiavelli and the Renaissance, for example). Finally, we shall use the idea that literature is equipment for living as a way of understanding and evaluating our experiences.

76-227 Comedy
Fall or Spring: 9 units
This class deals with some of the most famous comic texts from the time of the Greeks (Aristophanes) up to current times. The “texts” to be considered include classic literary works (plays, novels, short stories) and more contemporary examples of film and TV sitcoms. Students will become familiar with the main theoretical approaches to comedy, and will find that comic theory offers a wide range of interesting approaches to thinking about the life of the individual in society.

76-230 19th Century American Literature and Culture
Fall or Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: Nineteenth Century American Literature and Cultural Conversations
Throughout the Nineteenth Century, the United States was engaged in the often difficult process of defining itself culturally. This process took the form of conversations, sometimes fiercely contested, around certain issues. When Walt Whitman, in 1855, declared that “the United States themselves are essentially the greatest poem,” he established a link between these cultural conversations and the literature of the new nation which “our fathers brought forth on this continent.” This course will explore the interrelationship between the literature of Nineteenth Century America and the conversations surrounding such cultural issues as growing urbanization, sexuality, gender roles, religion, race, slavery and war. We will read essays, poems, short stories and novels by authors such as Emerson, Thoreau, Fuller, Hawthorne, Melville, Whitman, Dickinson, Stowe and Twain to see how these literary works reflect and shape the cultural conversations surrounding the issues.

76-231 20th Century American Literature and Culture
Fall or Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Over the course of the semester, we'll be looking at some of the most famous hard-boiled crime novels written, as well as the more marginal books of this genre, including a few selections that fall outside its classic parameters, but can't be understood without them. As a means of getting under the skin of these books, not to mention the time period and its problems, we'll be incorporating into our discussions reviews of the books, films made from them, and interviews with the writers (when possible). Our focus will be on discovering what makes this genre such a powerful and resonant mode in which writers write and readers read, with an eye towards its political undercurrents both radical and reactionary. Some of the authors we'll be reading are Dashiell Hammett, James M. Cain, Horace McCoy, Meridel LeSueur, Chester Himes, Mickey Spillane and Budd Schulberg.

76-232 African-American Studies
Fall or Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: African American Folklore and the Folk
This is a survey course that focuses on expressive culture (i.e. stories, art, songs, performances) of African Americans through U.S. history. We will examine the forces that produced folk culture and the very idea of the folk. Who are the folk? When are they popular and why? What expressive materials did communities create? African American folklore is oral, aural, and visual as well as literary. We will bring these aspects of Black folk culture to bear on our close readings of folklore in texts, music, and artwork. Materials and subjects include Charles Chesnutt, Zora Neale Hurston, Leadbelly, *Beloved*.

76-233 Postcolonial Literature
Fall or Spring: 9 units
Topics vary by semester, with the common theme of how national, cultural, and racial differences inform a variety of writing and other artistic practices and their reception.

Example: World Literatures
During the past few decades a new body of literature written in English has emerged from nations formerly colonized by the British. These writers have provided vibrant portrayals of the fraught issues of cultural identity facing people from these countries. In this course we will focus on literature by African, Indian, and Caribbean writers creating “postcolonial” literature and the literature of migration. We will supplement this with some readings on the history of world colonization and migration. During the semester, we will explore some of the central concepts of postcoloniality, including cultural hybridity, notions of “self and other,” definitions of modernity, and modes of resistance. We will also examine, and engage in, some of the debates over the term “postcolonial.” This course will include novels, short stories, poetry, drama and criticism organized around categories of narrative style. Rather than contain these works into narrow meanings, these groupings will be a way to spark a dialogue about the relationship between the political and aesthetic.
often delightfully irrational) historical period, the English tradition of "enlightenment" conjures up images of stalid, bewiged gentlemen that rarely admit racial difference, despite the fact that eighteenth-century London was populated by thousands of Africans who lived, died, worked, played—and occasionally wrote—against the historical background of British colonial expansion and the thriving institution of chattel slavery. What did it mean to be a black Londoner in the age of enlightenment—and slavery? We will explore the history of black London during the "age of reason" in textual and visual representations of Africans contemporary to the period and, most importantly, in writings by Africans—such as Ignatius Sancho, Olaudah Equiano, and Mary Prince—who lived and wrote of their lives in London. This course offers students an introduction to the cultural study of race as well as the period of eighteenth-century literary studies.

76-236 19th Century British Literature and Culture 
Fall or Spring: 9 units

Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: Science and Culture in the 19th Century

For most of the 19th century, the humanities and the sciences were not clearly distinct. The intellectual and professional terrain was not neatly divided between "scientists" on the one hand and "humanists" and "social scientists" on the other. Rather, participants took part in ongoing collaborations and debates that included science, literature, the arts, education, and politics. Some historians have considered the first three quarters of the 19th century remarkable for its "common intellectual or cultural context" or public sphere. This course will explore the early to late 19th century, noting the convergences and eventual divergences of science and culture across several distinct yet overlapping public spheres. Beginning with Mary Shelley's Frankenstein (1818), and filmic renderings thereof, other objects of study include Richard Carlisle, An Address to Men of Science (1821); [Robert Chambers], Vestiges of the History of Natural Creation (1845); Charles Darwin, Origin of Species (1859); and George Eliot, Middlemarch (1871). We finally arrive at the heated science and culture debates between Matthew Arnold and Thomas Huxley and end with C.P. Snow's notion of the "two cultures" (1959). We will read the novels and shorter works in their entirety, and excerpts of the major science works. The course includes a few secondary readings and several films. Assignments include one short paper, one longer paper, and an oral presentation.

76-238 Introduction to Media Studies 
Fall or Spring: 9 units

This course varies in content from semester to semester but always focuses on questions, issues, and concepts related to mass media and its social, cultural, and historical contexts. Consult the course descriptions provided by the Department each semester for current offerings. For fall 2004, for example, the course begins with a focus on understanding the words "media" and "culture" then move to a close study of advertising as a window into the range of media in which it appears. One goal is to develop a conceptual framework for analyzing the media that surround us and for understanding media's historical development. The course looks specifically at the historical development of mass media, beginning with the origins of mass advertising in popular magazines and print ads, through radio and television programs and commercials, and finally considers representations of advertising from film and literature. We examine a variety of historians and specific and often conflicting theories of the meaning and influence of mass culture.

76-239 Introduction to Film Studies 
Fall or Spring: 9 units

Core course for H&SS Film and Media Studies Minor

This course provides an introduction to the technology, history, semiotics, and ideology of film. Its focus is the Hollywood film, with special concentration on the "studio era" of that form, 1920-1950. The course is organized more or less historically, beginning with early films by Melies, Porter, and the brothers Lumiere, moving through the development of different styles in European and American silent features, and then into the sound era. It will also consider recent alternatives to Hollywood such as the French "New Wave" directors and feminist independent filmmakers. In addition to this general historical plan, the course is also designed to survey the various techniques by which films are made, and the signs of which films are constructed. Throughout the course, we will be concerned with the ideologies present in the films we see, especially those concerning gender and class. At several points, we will focus specifically on a theory of film criticism, including feminism and auteurism. In general, the approach is to draw connections between the films and the larger culture.

76-241 Introduction to Gender Studies 
Fall or Spring: 9 units

Core Course for H&SS Gender Studies Minor

This course will be devoted to introducing the predominant methodologies in gender studies-while touching on as many disciplines as possible. The course pursues questions arising from the study of the social construction of gender. A second focus will be on questions of cultural transformation.

76-245 Shakespeare – Tragedies & Histories 
Fall or Spring: 9 units

We will read both histories from early in Shakespeare’s career and tragedies from his later work and consider films of some of both. The course approaches these plays from two angles. First, we will try to see them in relation to the culture for which they were written and which they helped shape – the newly established public theater in London, prevailing notions about social class and gender, Puritan attacks on playing and the like. To help situate the plays in this way, we will read brief essays from time to time. In addition, we want to see these plays in terms of “what’s in it for us?” or how current audiences and readers can enjoy and interpret these plays. We will be considering how complicit the plays are with the authoritative institutions and discourses of their time, and how well or poorly they speak to us now that those institutions and discourses have been replaced by others.

76-247 Shakespeare – Comedies & Romances 
Fall or Spring: 9 units

In this class we examine two genres of Shakespearean drama – comedy and romance – and think about how his work in these two dramatic “kinds” helps us understand his place in the larger context of Renaissance drama, in particular the religiously fraught, thriving mercantile culture of London, which supported the institution of theater in the English Renaissance. On the one hand, we will be considering Shakespeare’s ambitions as a writer, in particular the ways in which he adopted these two forms in order to advance his artistic (and financial) interests as a professional playwright for the public theater. On the other, we will be considering how the issues he dealt with in these plays – the nature of romantic love, the duties of children to parents, the correction of vices in the theater, the “coded” aspects of romantic communication – in order to understand how these issues translate into contemporary performances (in film) of these plays.

76-246 British and American Literature and Culture 
Fall or Spring: 9 units

Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: The British and American Novel: Much has been made of the differences between English and American novelists in their handling of narrative but is it true? In this course we will consider eight influential novels from the two sides of the Atlantic, four from England and four from the US. We’ll look at adventure stories like Frankenstein and Huck Finn, at novels about working conditions from Dickens, Hawthorne, and Stowe, and at courtship novels from Austen, Charlotte Bronte and James. Students are required to attend regularly, participate in discussions, prepare brief commentaries to deliver in class, write two papers, and take a final exam.
76-260 Survey of Forms: Fiction
Fall & Spring: 9 units
Prerequisite: Credit for 76-101 or a designated writing course.
This course gives students practice in reading and writing short fiction. In a workshop setting, students gain critical and analytical skills through discussing published fiction and fiction written by class members. H&SS students have priority. 76-260 with a grade of A or B is a pre-requisite for 76-460: Beginning Fiction Workshop.

76-265 Survey of Forms: Poetry
Fall & Spring: 9 units
Prerequisite: Credit for 76-101 or a designated writing course.
This course gives students practice in reading and writing poetry. In a workshop setting, students gain critical and analytical skills through discussing published poems and poems written by class members. H&SS students have priority. 76-265 with a grade of A or B is a pre-requisite for 76-365: Beginning Poetry Workshop.

76-269 Survey of Forms: Screenwriting
Fall: 9 units
Prerequisite: Credit for 76-101 or a designated writing course.
This course gives students practice in filmic and televisual reading and writing. In a workshop setting, students gain critical and analytical skills through discussing produced films and videos and short scripts written by class members. H&SS students have priority. 76-269 with a grade of A or B is a pre-requisite for 76-469: Screenwriting Workshop.

76-270 Writing in the Professions
Fall & Spring: 9 units
Note: Intended for students not majoring in English. Required course for the H&SS Multimedia Minor and the Communication Design Concentration for the Information Systems degree.
Writing in the Professions is specifically designed for students in all majors other than English and from all Carnegie Mellon colleges. The basic idea is to give you experience in developing the writing and communication skills you will be expected to use as you make the transition from student to professional. The main work of the course is a series of situational writing assignments through which you'll learn to analyze and solve a range of communications problems that professionals in the workplace typically face. For each project, you will plan and produce effective, professional-quality examples of the communication genres common in all professional fields — proposals, correspondence, reports, instructions, and publications intended for clients and general audiences.

76-271 Introduction to Professional and Technical Writing
Fall & Spring: 9 units
Non-majors: Please see listing for 76-270, a closely related course designed specifically for students not majoring in one of the degrees in English.
Introduction to Professional and Technical Writing is designed specifically for English majors who wish to prepare for careers involving one of the many areas of Professional or Technical Writing. The main work of the course is a series of situation-based writing assignments spread over three broad and often overlapping areas — business/professional writing, media writing, and technical writing — through which you will learn to analyze and solve a range of communications problems that professional writers typically face. Typical projects include resumes, correspondence, feature articles, consumer/user instructions, proposals, and adaptations of specialized information for non-expert audiences. As a final project, you will create a portfolio of polished writing samples that you can use in applying for internships and employment. The course gives you experience with a variety of writing situations and also reflects options for specialization that you can pursue in future coursework and in your career as a professional writer. The course is a core requirement for majors in both Professional and Technical Writing, who have preference in registration.

76-272 Talking Across Difference
Fall or Spring: 9 Units
What happens at the borders of racial, ethnic, class and cultural difference when people try to "read" each other or "read" the world? We know that these cultural differences help shape the discourses we use, that is, our ways of talking and writing, of building what we see as "reasonable" interpretations or "good" arguments. So how do we take the next step? How do we enter into an intercultural dialogue and inquiry with others and actually talk across differences? In this course we explore how culturally charged issues that face college students — such as identity, individualism, authority and education — are represented within different cultural communities and discourses. This is a course about reading, writing, thinking and doing where you get to put ideas into practice. You will be learning a variety of strategies not only for "reading the world" but also for engaging in intercultural dialogue and collaborative interpretation with others on issues Carnegie Mellon students face.

76-294 Interpretive Practices
Fall & Spring: 9 units
This class will introduce students of English to the theory and practice of interpretation. Students will become familiar with fundamental texts of literary and cultural theory and learn how to put theory into practice in reading a range of literary and cultural texts with close attention to both language and social contexts. The goal is for students to learn to produce their own analytic, interpretive essays. Specific course content will vary from semester to semester.

76-300 Professional Seminar
Fall: 3 units
This once-a-week seminar is designed to give students majoring in the various English degrees an overview of career options available to them. Invited professionals from fields as diverse as journalism, public relations, medical communications, science writing, writing for the Internet, technical writing, and consulting and freelance writing meet with students for an hour over lunch, talk about their own and related careers, and answer students' questions. Additional meetings involve sessions on working with the Career Center, applying and interviewing for positions, and portfolio development.

76-301 Internship
Fall & Spring: 3-12 units
Prerequisites: Open to junior and senior English majors with a 3.0 or above GPA in their major. One prior 200-level or above writing-intensive course (including Survey of Forms) and permission of the English Department Internship Coordinator are also required. Registration is by permission only.
Internships combine workplace experience as an entry-level professional with academic credit and an opportunity to reflect on your experience. Many types of internships, both on and off campus, are options. Depending on your interests and available sites, you might intern with a local newspaper or magazine, write software documentation for a local high tech firm, design web sites, work for a political campaign, or do research and promotions for a non-profit agency associated with a cause you feel strongly about. A 9-unit internship involves a minimum of 120 hours per semester (8 to 10 hours per week) at the internship site plus a reflective journal and a series of short reading and writing assignments linked to the topic of the internship.

76-306 Editing and Publishing
Fall & Spring: 3-18 units
Prerequisites: Registration is by permission of the instructor only.
In this course, students work closely with the editors of Carnegie Mellon University Press to learn many of the facets of producing books. These range from business management to the elements of editing and book-production.

76-318 Communicating in the Global Marketplace
Fall or Spring: 9 units
In this day and age, some of the most exciting employment opportunities are with multinational and international corporations. But are you prepared for the challenge of working with professionals from all over the world? Even as more people around the globe learn English, specific cultural values, beliefs, and assumptions continue to influence the way in which they communicate. Often times there is a whole different worldview behind a foreign accent. The same word or phrase in English might actually carry very distinct connotations for
someone whose native language is French, German, Russian, or Japanese. This course is designed as an introduction to international professional communication. We will talk about the way in which culture influences communication, about the job of translators and interpreters, and about specific communicative norms for the global marketplace. We will look at many concrete examples of communication in the international arena and we will have a chance to meet some experienced professionals in this field.

76-320 The Cultural History of Print in Britain and America
Fall or Spring: 9 units.
The “age of the book” is far from over—and we are only now realizing how culturally and materially complex the history of print has been, and continues to be in the age of information. This course focuses on key episodes in the British and American history of books, magazines, and readers. Students will have hands-on access to rare and unusual books or book-forms (such as the graphic novel, periodical, or other adaptations of the book) from Houghton Library’s Special Collections and elsewhere. Topics will include how authors and publishers have tried to control the reading of books, how readers have resisted or appropriated the forms of print and ideas they read for their own purposes, and the social and cultural struggle for the control of printing and its products in the 17th and 18th centuries—from licensing and censorship to copyright controversy, the problem of intellectual property, and how key literary genres—the novel, the modern poem—were shaped by their interaction with printed formats, from books to serialization. Readings in Walter Ong, Roger Chartier, Michel Foucault, Richard Ohmann, Roland Barthes, Janice Radway, Adrian Johns, Marshall McLuhan, Jane Austen, William Morris, Thomas Pynchon, and others.

76-330 Medieval Literary and Cultural Studies
Fall or Spring: 9 units.
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: Medieval Literature.
Some contemporary critics argue that fictions about individual agency began with Shakespeare (the invention of the human, as Harold Bloom puts it); are they right? This course will consider records from as early as the 700s and as late as the 1400s. We will explore the distinctive ways medieval men and women represented their lives (including their fantasy lives) in texts and well-known fictions such as Beowulf, The Song of Roland, Inferno, and various Arthurian tales, as well as some texts by women writers. Did these people imagine themselves primarily as filling roles in a social or religious scheme or as self-fashioning persons? How did gender differences figure in these representations?

76-331 Renaissance Literary and Cultural Studies
Fall or Spring: 9 units.
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: “X-Files” of the Seventeenth Century
During the 17th century, ghosts, monsters, prodigies, demons, and other strange phenomena ¾ many of so-called “prenatural” occurrences ¾ were becoming the object of overlapping (and sometimes conflicting) forms of explanation. Whereas some of these phenomena could be explained philosophically ¾ with reference to Natural causes ¾ others belonged to religious debate or seemed exclusively to exist in the imagination. Using a broad range of texts, we will examine the widespread interest in the preternatural in seventeenth century culture, exploring the political, religious, and ideological consequences of this fascination. Texts will include images of natural “marvels” and “monstrosities,” collections of “curiosities,” plays by William Shakespeare and Ben Jonson, utopian fiction by Margaret Cavendish, selections from Edmund Spenser’s Faerie Queene, seventeenth century crime pamphlets, philosophical texts by Francis Bacon, Robert Hooke’s images from the microscope, readings in Renaissance and classical poetics, and various religious texts. Students can expect the reading for this class to be demanding but interesting.

76-332 African American Studies
Fall or Spring: 9 units.
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: Introduction to Race and Representation
This class examines the way in which race makes meaning in American culture through images and narrative. The class focuses most clearly on racial identities, such as blackness and whiteness, as important symbols that have tangible social and cultural consequences. We will also address issues of identity more generally in our theoretical readings and discussions. How do we know, understand, and live racial identities? We will examine literature and films as a means to approach the question of how race comes to be understood and conveyed in culture. In what ways do such texts use race to make meaning? Texts include Toni Morrison’s short-story Recitatif, Nella Larsen’s Passing, Octavia Butler’s Dawn, Omi and Winant’s Social Construction of Race, Corell West’s Race Matters, excerpts from Morrison’s Playing in the Dark, and several films.

17-334 19th Century Literary and Cultural Studies
Fall or Spring: 9 units.
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: Narratives of Profession
Who wants to be a professional? The professions as we know them only came into existence in the nineteenth century. The nineteenth century was also a kind of golden age of the British novel, with Dickens, Trollope, Eliot, and many others delivering a steady stream of substantial novels. Reflecting and refracting their time, many of the novels dealt with the rise of professions, with characters who aspired to be professionals, from clergy to lawyers to writers, and with good and bad professionals. In this course we will look at a number of novels through the century that foreground this topic of professionalism. Some of the novels we’ll read will include Hardy’s Jude the Obscure, Trollope’s The Warden or Dr. Thorne, Gissing’s New Grub Street, and Conrad’s Heart of Darkness. In addition, we will read selections from the history and theory of professionalism.

76-335 20th Century Literary and Cultural Studies
Fall or Spring: 9 units.
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: American Fiction of the 20s and 30s
The 1920s and 1930s are important decades in twentieth-century America. Popular wisdom has it that they are decidedly different from one another and from contemporary America. We will read four novels from each decade not only to see how they compare with each other, but also to see how they compare with the America you are experiencing. We will also examine how various racial, ethnic, and religious groups are dealt with in the novels of the two decades.

76-338 The American Cinema
Fall or Spring: 9 units.
This course will look at major works of sound-era American Cinema in the context of the history of the film industry and the larger society. The course will focus on the changes that follow major transitions in the industry: the production code of 1934; the consent decree of 1948; the end of the production code in 1968. We will look at the work of major directors, such as Hawks, Hitchcock, Coppola, and Polanski, major genres, such as screwball comedy, women’s pictures, and Westerns, and major stars, such as film noir. Requirements are likely to include, in addition to readings and film viewing, three papers and a final exam.

76-339 Advanced Studies In Media
Fall or Spring: 9 units.
Studies in the history, theory, and analytical reading of print and electronic media, using the techniques of structural, contextual, and ideological analysis. Offerings will vary by semester. Consult detailed course descriptions available from the Department each semester for details.
Course Descriptions

76-343 South Asian Literature and Film
Fall or Spring: 9 units
This reading- and writing-intensive course focuses on contemporary work in English from India, Pakistan and other parts of South Asia, as well as by people of South Asian origin. As we explore this body of literature and visual culture, we will examine some of the following themes: independence, partition, cosmopolitanism, diaspora, identity, immigration and globalization. Possible texts include work by J.S. Naipaul, Rohinton Mistry, Romesh Gunesekera, Amitav Ghosh, M.G. Vassanji, Bapsi Sidhwa, Arundhati Roy, Salman Rushdie, Samrat Upadhyay, Hanif Kureishi, Mira Nair, Gurinder Chadha, and Meera Syal.

76-347 & 76-348 American Literary and Cultural Studies
Fall or Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.

Example: Reading the Civil War
The Civil War was the bloodiest war in United States History, killing more Americans than World War I, World War II, Vietnam and the Gulf War combined. But how many times have we heard the statistic more Americans than World War I, World War II, Vietnam and the Gulf War combined? But how many times have we heard the statistic that most high school students do not know when it began or who was president or who was emancipated as a result? In this course we will master some historical "facts" about the Civil War, but, more importantly we will think about how the texts and images about the Civil War circulated in the emerging nation-state. This is an English course dedicated to the investigation of historical memory – how it is established, and how it has worked for over 100 years. We will look at Alexander Gardner's Civil War Sketchbook (an album of Civil War landscape photographs), Louise May Alcott's novel about a Civil War nurse, and Walt Whitman's poetry composed in honor of Abraham Lincoln. We will read Frederick Douglas' Civil War and Emily Dickinson poetry written on the eve of the Civil War. We will read diaries, letters, novels, and shorts histories. We will read Karl Marx's journalistic writings about the Civil War. We will take a field trip to Gettysburg, Pennsylvania and other Civil War memorials in PA. We will "read" the Civil War – as a text, as a historical moment, and as one of the most important stories of our national and racial formation.

76-349 The Lost Generation: The Great War and Modern Fall or Spring: 9 units
Before the Beat Generation there was the Lost Generation. Both moments of literary history have an important relevance for our time, and both produced many major literary works. The 20's, like the 50's and 60's, were marked by the effects of World War, Gertrude Stein, and 20th century and 60's, were marked by the effects of World War, Gertrude Stein, and 20th century and 60's, were marked by the effects of World War, Gertrude Stein, and 20th century and 60's, were marked by the effects of World War, Gertrude Stein, and 20th century. The assumption will be that feminist discourses operate variously and diversely; across a wide range of social, cultural, and historical issues and experiences. They are guided not necessarily by "feminist theory" as such, but just as importantly by the demands of very specific cultural and political circumstances. Thus the course's emphasis will be on feminist responses to them. We'll also be asking about the possible productive tensions between feminism diversity and the general political and cultural aims of feminisms.

76-355 The Rhetoric of Making a Difference Fall or Spring: 9 units
The rhetoric of making a difference is about speaking up for your commitments and speaking wisely and persuasively for change in everyday settings. This class combines the study of such rhetoric with real world experience making a change in which students organize and document the discoveries of an intercultural Carnegie Mellon Community Think Tank. See www.cm.edu.thinktank. The writers we read (coming out of the American Pragmatist tradition from Emerson and King to bell hooks and Cornel West) all wrestle with the tensions between critique and commitment, between non-conformity and building connection, and they model distinctive approaches to posing problems, negotiating conflict, and creating change. In the second half of the term, we will put these ideas and strategies to use in a Think Tank on a problem in urban education, when teenagers, teachers, administrators and employers come to the table as collaborative problem solvers. This project will also teach you research tools for discovering and dramatizing a shared problem, conducting an intercultural inquiry, and documenting and publishing your findings.

76-360 Literary Journalism Workshop
Fall or Spring: 9 units
Prerequisites: 76-265, 76-270, 76-271, 76-372 or 76-472
While culture becomes increasingly obsessed with celebrities, contemporary literary journalism is writing that usually focuses on so called "ordinary" people in various social contexts. The emphasis is to use the journalistic essay to reveal character rooted in and influenced by a particular time and place. Students will be required to do a series of short essays, and one long essay, on subjects of their own choosing. These essays will almost always involve field research; one goal of the course will be to acquaint students with research techniques and methods. This is both a reading and writing intensive course, and will be run usually as a workshop. The class is designed for both professional writing and creative writing students.

76-363 Reading Contemporary Poetry
Fall or Spring: 9 units
This course will focus on reading and analyzing late 20th century and contemporary poetry. Specific works and topics will vary by semester. The goal of the course is to help students develop a deeper understanding and awareness of recent poetry.

76-366 Reading Contemporary Fiction
Fall or Spring: 9 units
This course will focus on reading and analyzing late 20th century and contemporary fiction. Specific works and topics will vary by semester. The goal of the course is to help students develop a deeper understanding and awareness of recent fiction.

76-365 Beginning Poetry Workshop
Fall & Spring: 9 units
Prerequisite: 76-265 with a grade of A or B.
Poetry workshops are a series of courses involving discussion of poems produced by members of the class. Emphasis is on basic techniques of prosody, structure, and imagery. This course may be taken more than once for credit.

76-371 Language in Design
Fall: 9 units
Cross-listed with the School of Design
Language in Design focuses on improving communication skills in
situations where writers, visual designers, and their clients commonly work together as collaborators. These skills impact not only the quality of the project, but also the client’s acceptance of the proposed solution. In this class, we will consider the communication stumbling blocks that prevent optimal solutions by looking first at a case study in which the expert/client relationship does not develop optimally. Based on what we learn from that case study, we consider – through reading, discussion, and related papers and projects – how to avoid those mistakes and others. The quality of the work can be optimized when the collaborators can also optimize their interactions, and we’ll work to achieve these ends through projects including interactions on paper, in face-to-face communication, in electronic communication, and in designed artifacts.

76-372 Contemporary Journalism
Fall: 9 units
Contemporary Journalism explores how newspaper and magazine reporters think, and how they approach writing stories for newspapers, magazines and/or electronic media. The course focuses on developing necessary skills in journalism. Class time is devoted to such topics as interviewing, sourcing of stories, accuracy, fairness, tone, fairness, ethics and libel law, as well as the acquisition of skills to write news and feature stories. Case studies examine professional ethics and the role of the journalist in framing public discourse. The writing assignments — four stories and several exercises — enable experienced and inexperienced writers to extend their ability to cover events, identify and document trends, and write profiles and interpretative stories. Weekly readings are assigned from coverage of historic events and the writers who covered them. The course also explores online publishing, the effect it has on journalism and the reliability of information the public receives via the Internet.

76-373 Topics in Rhetoric: Argument
Fall & Spring: 9 units
This course is an exploration of the theory and practice of argument: what an argument is, what makes an argument good or bad, and how arguments are best constructed, analyzed and evaluated. The course will explore these questions by drawing upon rhetorical, philosophical, and psychological theories; empirical research; and examples of arguments. An important focus of the course is on developing the abilities necessary for arguing effectively in various contexts. The course is required for majors in Professional Writing and designed for all students interested in developing a more thorough critical apparatus of argumentation as well as those interested, for professional or scholarly reasons, in developing more effective arguments.

76-375 Magazine Writing
Fall or Spring: 9 units
Prerequisites: 76-260, 76-270, 76-271, 76-372, or 76-472
This course gives writers experience in various forms of magazine journalism including interviews and profiles, investigative research stories, how-to and service pieces, and human-interest articles. Emphasis is on the varied world of professional magazine journalism, including copy editing, revision, query letters, meeting deadlines, working with designers, and adapting texts to the different communications environments that interact with magazine journalism including online journalism.

76-377 Rhetoric of Fiction
Fall or Spring: 9 units
This class deals with a number of classic and modern/contemporary works of fiction, taking as a guide the central issues raised in the influential critical book by Wayne Booth, The Rhetoric of Fiction. The class offers an introduction to a rhetorical theory of the arts, drawing on Kenneth Burke and Mikhail Bakhtin. Students will get a brief history of the emergence and development of the novel, and some aspects of narrative theory will be covered. Readings will vary by semester but would typically include works such as Jane Austen, Persuasion; Henry James, The Turn of the Screw; James Joyce, Portrait of the Artist as a Young Man; Fedor Dostoevsky, Notes From Underground, Gustave Flaubert, Madame Bovary; Italo Calvino, If on A Winter Night a Traveler.

76-378 Community Literacy and Intercultural Interpretation
Fall or Project: 9 units
This course is an introduction to the interdisciplinary study of literacy: its history, theory, and problems. These include the tensions between academic and workplace literacy, the power struggle between elite and community literacies, and the competing theories of how people learn to read, write, and control and operate within new literate practices. It is also an opportunity to turn your ideas into action in a hands-on, community literacy project. Projects vary by semester. In spring 04, for example, the focus will be on ways community literacy allows everyday people in urban school and inner city neighborhoods to take literate action for themselves.

76-379 Technical Communication for Engineers
Fall & Spring: 9 units
Prerequisites: Open to CIT Engineering students only, with priority to seniors.
This course is designed for junior and senior engineering students seeking to improve their abilities in practical, professional communications (both written and oral). The course aims to help students compose clear, concise technical writings and oral presentations for multi-level audiences. Assignments include technical definitions, descriptions, instructions, process explanations, abstracts, memos, and research reports. Assignments may incorporate recent engineering research at CMU, projects in related technical courses, and professional case studies.

76-381 Contemporary Rhetorical Theory
Fall or Spring: 9 units
This course examines prevalent theories of what constitutes effective communication and how perceptions of effectiveness are shaped by social and historical influences. The course emphasizes the reading of theory in primary sources. Topics for discussion include the relationship of ethics to language, argument theory, speech-act philosophy, and the process of symbolization. The objectives of this course are to provide knowledge of theory and model construction that have direct relevance to the teaching and practice of effective communication.

76-382 Multimedia Authoring I
Fall & Spring: 9 units
Required course for H&SS Multimedia Minor and for IS/CD majors
This course provides an introduction to the technical skills needed for designing In-Line content and Interactive Multimedia. Current multimedia tools for use in creating web-based products will be taught alongside ample opportunity for practice. Students learn authoring tools and multimedia techniques while covering topics including non-text-based communication, integration of visuals, the animation of text and graphics, and digital video web-deployment. Principles of design will be discussed and stressed throughout the course. Group design processes and project management issues will also be addressed. This course makes extensive use of web-oriented applications such as Dreamweaver and Flash. Preference is given to majors in the English department, Multimedia Production minors and IS Majors in the Design and Communication Track for whom the course is a requirement.

76-383 Multimedia Authoring II
Fall & Spring: 9 units
Required course for H&SS Multimedia Minor
Prerequisite: 15-100 or higher or instructor permission
Multimedia authoring involves the combination of graphics, sound, text and movies to create products such as sales presentations, kiosks, software prototypes, games, CD-ROMs, and computer-based training materials. You will be using Macromedia Director, the most often used program today for multimedia development and authoring. Its proprietary Lingo programming language allows the designer a great deal of control over the content, flow and interactivity of a presentation (or movie). In this class, you will get a thorough grounding of the basics of multimedia authoring, animation, and Lingo scripting. You will work on several smaller projects in preparation for a final class project, due at the end of the semester.
Discourse analysts ask and answer many questions about why people do the things they do with language. They study the structure of written texts — the semi-conscious rules people use to organize paragraphs, for example — as well as the unconscious rules that organize oral discourse such as spontaneous stories and arguments. They look at how grammar is influenced by what people need to do with language, and how discourse changes grammar over time. They ask how children learn how to make things happen with talk and writing. They analyze the choices that speakers and writers make and what these choices reveal about how they see themselves and how they relate to others. They study how people define disease, aging, and disability as they talk about them, and how language is used to mirror and establish social relations in institutional settings like law courts and schools as well as more personal relationships within families and among friends. This course focuses on the theory and practice of writing clear, effective prose. It should interest and benefit any student who wants to improve the clarity, precision and coherence of his or her writing, whether the student intends to be a professional writer (creative, professional or technical) or a professional who writes (lawyers, engineers, scientists, business managers) — in other words, just about anybody.

76-385 Introduction to Discourse Analysis  
**Fall & Spring:** 9 units  
*“Discourse” is language in use: people talking or signing or writing. Discourse analysts ask and answer many questions about why people do the things they do with language. They study the structure of written texts — the semi-conscious rules people use to organize paragraphs, for example — as well as the unconscious rules that organize oral discourse such as spontaneous stories and arguments. They look at how grammar is influenced by what people need to do with language, and how discourse changes grammar over time. They ask how children learn how to make things happen with talk and writing. They analyze the choices that speakers and writers make and what these choices reveal about how they see themselves and how they relate to others. They study how people define disease, aging, and disability as they talk about them, and how language is used to mirror and establish social relations in institutional settings like law courts and schools as well as more personal relationships within families and among friends. This course focuses on the theory and practice of writing clear, effective prose. It should interest and benefit any student who wants to improve the clarity, precision and coherence of his or her writing, whether the student intends to be a professional writer (creative, professional or technical) or a professional who writes (lawyers, engineers, scientists, business managers) — in other words, just about anybody.*

76-386 Language and Culture  
**Fall & Spring:** 9 units  
The subject of this course is the life-world of language, the inseparable link between a language and the culture of its speakers. We will investigate this relationship through a range of questions including the following: Do the words and conventions of our own language trap us inside a conceptual prison? What are the social consequences of differences in speech? What happens when languages compete for political exclusivity? Can language be legislated? What role does language play in areas of ethnic difference? Along what dimensions do the roles of language vary in different societies, and among their own speakers? By what methods do linguists and anthropologists research language in its cultural setting?

76-387 Introduction to Sociolinguistics  
**Fall & Spring:** 9 units  
This course provides an overview of the field of sociolinguistics, or the study of language in its social and cultural contexts. Among the questions posed in the course are these: How and why do speakers select among the range of linguistic varieties in their repertoire of standard and vernacular, regional-sounding or not, more writerly or more oral, gendered in one way or another, and so on? How can such variation be accounted for in a theory of language? What kind of “grammar” is involved in knowing how to participate in conversations, and how do conversational styles differ from group to group? What causes misunderstanding and what enables understanding interaction among people who are different? What are the effects of multilingualism and language contact, for speakers and for languages? How and why do standard varieties of languages come to be, and how are they perpetuated? What are the relationships between language, society, and the individual speaker?

76-389 Grammar of Standard Written English  
**Spring:** 9 units  
You have all “done grammar” at some point in your schooling. A college-level course in the structure of English is something quite different. It demands the control of challenging new concepts and techniques. The pay-off is incalculable — a rigorous understanding of how the sentences of the written language are put together, a recognition of the sources of grammatical mistakes and how not to make them, an awareness of the principles of style, work usage, and punctuation for which a thorough knowledge of grammar is indispensable. If you want to learn to be a better writer from the ground up, this is the course for you. I’ll expect you to work hard and think deeply, but I’ll steer you through the mysteries and frustrations of real grammar, and you’ll come through it with a tangible achievement — a secure understanding of how your language works. The course will involve linguistic analysis and practice in the parsing (diagramming) of sentences, recognition of types of constituents in the sentence, and control of the standard grammatical terminology that goes with these types.

76-390  Style  
**Fall & Spring:** 9 units  
*Style is a term used to describe the manner of expression in written language. To achieve the mastery of style that enables writers to express themselves in a way that is fresh, original, and appropriate across audiences and situations, they need to be able to choose the right words, arrange them appropriately, and punctuate them in a way that controls pacing and emphasis. This course is intended to help students (1) derive a common vocabulary for discussing writing, (2) examine the effect of particular stylistic choices, and (3) become better editors of both their own writing and that of others. The course focuses on the theory and practice of writing clear, effective prose. It should interest and benefit any student who wants to improve the clarity, precision and coherence of his or her writing, whether the student intends to be a professional writer (creative, professional or technical) or a professional who writes (lawyers, engineers, scientists, business managers) — in other words, just about anybody.*

76-392 Rhetoric and Public Policy  
**Fall & Spring:** 9 units  
In this course, students read classical and modern theorists in order to understand the role of rhetoric in public decision-making, public argument, and the construction of public knowledge and to rethink rhetoric as a theory of public discourse. Rhetoric in this sense is not merely words, but an art, a technique, a process, a mode of invention for the production of public knowledge, public argument, public problem-solving, public action, public response, and public critique. Topical focus may vary by semester.

76-393 Rhetorical Traditions  
**Fall or Spring:** 9 units  
Rhetoric is the study of the relationship between discourse and action, with persuasion as its central concern. As one of the oldest academic disciplines in the West, rhetoric has provided concepts, models and systems for understanding how we use words to do things. Rhetorical Traditions introduces students to the texts, figures, conventions, and assumptions that define rhetoric as a discipline, and to the generative issues and relations that have shaped its development since its inception in classical antiquity. By understanding the functions of rhetoric within their social contexts, students will acquire a foundational knowledge of rhetoric as a discipline central to the Humanities.

76-394 Research in English Studies  
**Fall:** 9 units  
This course offers training in gathering information systematically and building arguments based on that information. Students will hone their skills in reading texts, using critical commentary, assessing material available electronically, and conducting interviews and surveys. They will learn how to test their hypotheses against alternatives and present their research to audiences within the discipline of English. The historical or thematic content of this course will vary by semester. Consult detailed course descriptions available from the Department each semester for details. For students in the EBA degree, this course is a pre-requisite or co-requisite for 400-level EBA seminar courses.

76-395 Science Writing  
**Spring:** 9 units  
*Prerequisites: 76-270, 76-271, 76-372, 76-379, or 76-472  
A central goal of this course is to learn how to engagingly communicate science and technology to lay readers without sacrificing the integrity and complexity of the subjects at hand. The course will also investigate the unique challenges of science writing (as opposed to other forms of journalism), the need to recognize emerging trends that can be transformed into interesting topics as well as the skills that keep readers’ attention. Assignments may include doing a radio show, a critique for an article, an essay on a local scientist or physician and their work, and a feature-length article for a newspaper or magazine about a subject of your choice. Students will be expected to hone their abilities in research (primary, secondary
76-396 Writing in the Public Interest
Spring: 9 units
Prerequisite: 76-270, 76-271, 76-372, 76-373, or 76-472.
Writing in the Public Interest focuses on persuasive writing designed to successfully debate, write about, and promote public and social policy issues. This course allows you to identify and acquire a working knowledge of a current, but also an issue of special importance to you. Issues chosen in the past include re-introduction of the gray wolf into Yellowstone Park, legalizing needle exchanges for intravenous drug-users, press ethics and censorship, and Medicare reform. This kind of persuasion is central to the work of public affairs writers and communications consultants, volunteers and professionals working for advocacy organizations, and managers in the private sector who need to understand public issues and influence public policy. Knowledge you develop on your issue throughout the term becomes the basis for a series of assignments, including a position statement supported by simple statistics, a "best-practice" case study, and a media kit and press conference you will create with team members.

76-397 Instructional Development & Design
Fall or Spring: 9 units
Prerequisites: 76-270, 76-271, or 76-379.
Instructional Development and Design provides an introduction to the major theories and procedures of instructional design (ID) and explores these theories and procedures across a range of instructional situations. The types of instruction studied range from textbooks, on-line help and user instructions to seminar and workshop presentations and employee training. The course is particularly appropriate for professional and technical writers and instructors who design training courses, present seminars, or conduct hands-on assignments, including a final project, in which they design, write, and evaluate instruction.

76-430 Modernist Poetry, Poetics, and Politics
Fall or Spring: 9 units
In this course we will read the poetry and prose of what critic Hugh Kenner has dubbed the "Pound Era." Ezra Pound, who edited T.S. Eliot's "The Waste Land," advised other famous writers, and wrote both difficult poetry and bizarre political tracts about money, usury, and banking. Charged with treason against the United States for his propaganda radio broadcasts during World War II, Pound escaped a possible death sentence by hopping an insanity plea. His career raises issues that are relevant to other modernists. Why were so many canonical modernists politically reactionary, and how does this tendency jive with their radical aesthetics? We will contemplate this question in relation to the work of Yeats, Rilke, and Stevens. We will also consider whether women poets in this same period -- H.D., Edna St. Vincent Millay, and Amy Lowell -- support or dispute the politics and poetics of their male counterparts.

76-431 Advanced Seminar in British Literary and Cultural Study
Fall or Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.
Example: Constructing the "Long" 18th Century
This period in British history, 1660-1790, plays an important role in what we call "the modern." "Reason," "enlightenment," "the public sphere," "the rights-bearing individual," indeed, modern imperialism and the nation-state, while not originating during this time, took on characteristc forms that are recognizable as "modern" from our historical perspective. This course focuses on how present-day historians and literary scholars construct the years between 1660 and 1790: what cultural events punctuate historical narratives of this time period? What writers and texts are important to those events? The heart of this course is a wide sampling of imaginative literary texts—prose fiction, poetry, and drama—from the beginning to the end of the long eighteenth century. This sampling includes novels by Aphra Behn, Daniel Defoe, Henry Fielding, Samuel Richardson, Frances Burney, and Tobias Smollett; poetry by Alexander Pope, Thomas Gray, and Oliver Goldsmith; the satire of John Gay and Jonathan Swift; and the drama of John Dryden, George Lillo, and Richard Brinley Sheridan. Obviously, this reading list will have to be highly selective. To keep us aware of what ways American selectiveness, we will also study histories of the period that have been highly influential in the field of literary and cultural studies. These texts should help us consider how the stories we tell about the past and the texts we chose to study from that past mutually determine each other.

76-432 Advanced Seminar in African American Studies
Fall or Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.
Example: Diaspora and Transnationalism in African American (Expressive) Culture
Since the 18th century African Americans have found travel, artistic, and intellectual activity outside of the United States to be rewarding and politically fruitful. This course examines episodes of these movements with an eye towards their manifestation and negotiation through expressive culture. We deal with artistic, historical, biographical, and theoretical texts to examine the development and textuality of African American engagements with other cultures and identities. These excursions were accomplished against a context of African American national identities and values reflecting both national and sub-cultural movement. How did these interactions define African-American racial and national identity, internationalism, and the meanings of diaspora? In what ways was American national identity also forged and formed through these expressions and activities? How did African Americans negotiate the deal with the various and overlapping cultural baggage that accompanied multiplying and competing identities into an increasingly global world? How did African American transnationalism begin to set and change the terms of international relations and extra-national identity both culturally and politically? This class makes fairly broad leaps through the 19th century examining one or two key figures, focuses on the first half of the 20th century, and ends roughly at the civil rights era.

76-433 Advanced Seminar in Postcolonial Literature and Theory
Fall or Spring: 9 units
In recent decades postcolonial studies has emerged as an interdisciplinary field that highlights, in the words of critic Bart Moore-Gilbert, "the interconnection of issues of race, nation, empire, migration and ethnicity with cultural production." Authors such as Kenyan Ngugi wa Thiong'o and Indian Arundhati Roy provide vibrant portrayals of individual and community life in formerly colonized countries; postcolonial theorists, meanwhile, offer ways to situate these literary works in their diverse historical and cultural contexts. In this course we will interweave a study of literature with that of theory as we focus on works by African, Indian, and Caribbean writers and critics. Readings will include fiction, drama, poetry and film by such authors as Ama Ata Aidoo, Salmon Rushdie, Ngugi wa Thiong'o, Arundhati Roy, M.G. Vassanji, Bessie Head, Ben Okri, and Derek Walcott. Theoretical works will include writings by Frantz Fanon and Patrice Charniere on nationalism; Chandra Mohanty and Anuradha Nandy on gender; Homi Bhabha and R. Radhakrishnan on hybridity; and Gayatri Spivak and Edward Said on the postcolonial critic.

76-434 James Joyce
Spring: 9 units
Many people know that James Joyce is considered a major novelist—perhaps even the most influential novelist of the twentieth century. If they have only read a short story or two of his, however, or his A Portrait of the Artist as a Young Man, they may not understand why. In this seminar, we will read and discuss Dubliners, A Portrait, and
76-435 Gay and Lesbian Theory
Fall or Spring: 9 units
This course provides a theoretical overview of gay and lesbian studies and explores the work of key writers on theory and politics, with a focus on "queer theory." It also provides an overview of the gay and lesbian cultural and political movements of the 20th century through various gender, sexual identity, and cultural representations.

76-439 Advanced Seminar in American Literary and Cultural Studies
Fall or Spring: 9 units
This seminar explores issues in American literary and cultural studies, with a focus on contemporary debates and theoretical frameworks.

76-441 Chaucer
Fall or Spring: 9 units
This course examines the work of Geoffrey Chaucer, focusing on his use of language and his depiction of medieval society, with an emphasis on the social and political contexts of his work.

76-444 Enlightenment Sexualities
Fall or Spring: 9 units
This course investigates the intersections of Enlightenment thought and sexuality, exploring the ways in which eighteenth-century ideas about sex and gender were formulated and expressed through literature and other cultural forms.

76-450 Senior Seminar
Spring: 9 units
This seminar focuses on a topic in American literary and cultural studies, with a focus on student research and critical thinking.

76-468 Advanced Seminar in Film Studies
Fall or Spring: 9 units
This seminar explores advanced topics in film studies, with a focus on a particular period or genre.

76-473 Advanced Seminar in Linguistics
Fall or Spring: 9 units
This seminar explores advanced topics in linguistics, with a focus on a particular area of study.

Seminars focusing on topics in linguistics and discourse studies. Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.
will learn some techniques for recovering these patterns from an electronic corpus and making generalizations about their structure and distribution.

76-453 Race and Ethnicity in the Global Context
Fall or Spring: 9 units
In this course we will read the work of critics who argue that the concepts of race and ethnicity are geographically specific and historically determined. Through our readings and discussions, we will grapple with the following questions: How does what we mean by "race" change when we move our focus from the context of the United States to that of the Caribbean, England, or South Africa? How is ethnicity understood within specific social and cultural situations? How do the diasporic movements of peoples undermine or reinforce ethnic identities? We will read theoretical works examining these issues alongside novels, poetry, and plays that depict essential, ambiguous, ambivalent, or fluid racial and ethnic identities. Theoretical readings will include Franz Fanon, Stuart Hall, Anthony Appiah, James Clifford, Manning Marable, Molefi Asante, Rey Chow, Etienne Balibar, and Slavoj Zizek; Kureishi's *The Buddha of Suburbia*, Bapsi Sidhwa's *Cracking India*, Seamus Heaney's *Selected Poems*, and Derek Walcott's *Dream on Monkey Mountain*.

76-457 Topics in Rhetorical Study
Fall or Spring: 9 units
This is a seminar course focusing on a variety of special topics in Rhetoric that examine the relationships among thought, expression, and understanding within specific social and cultural situations. Topics will vary by semester. Consult detailed course descriptions available from the Department for details. May be repeated for credit.

Example: Rhetoric of Place.
In this seminar, we explore how people in Pittsburgh orient to and use local-sounding speech. We will begin with reading, research in on-line linguistic atlas materials, and fieldwork about the sources and features of accent and speech style in Southwestern Pennsylvania. We then turn to humanistic geography, social theory, and sociolinguistics to read about theories of place and contemporary sociolinguistic research that tests such theories. During the second half of the course, we design and carry out research projects that explore local speech and its rhetorical uses.

76-460 Beginning Fiction Workshop
Fall & Spring: 9 units
Prerequisite: 76-260 with a grade of A or B
Fiction workshops are a series of courses designed to develop students' analytical writing, and critical skills in fiction. The students' own work will be closely examined by the instructor and other members of the class. This course may be taken more than once for credit.

76-461 Personal Essay
Fall or Spring, once every two years: 9 units
Prerequisites: 76-260 or 76-265 with a grade of A or B and 76-460 or 76-462 with a grade of A or B
This is an advanced writing course that has been specifically designed for the student who wishes to polish and practice the skills of prose writing while pursuing the intellectual challenge of this peculiar form, the personal essay. The course is designed with the interests of both Professional and Creative writers in mind.

76-462 Advanced Fiction Workshop
Fall & Spring: 9 units
Prerequisites: 76-460 or 76-461 or 76-462 with a grade of A or B
In this course students will write the first chapter of a proposed novel. Therefore, students must enter the class with the "idea" for a novel already in hand and head. The class will concentrate on just the first chapter of the proposed novel, though an outline and summary of the whole conception will be called for. This course may be taken more than once for credit.

76-465 Advanced Poetry Workshop
Fall & Spring: 9 units
Prerequisites: 76-265 with a grade of A or B and 76-365
This workshop involves discussion of poems produced by members of the class. Emphasis is on basic techniques of prosody, structure, and imagery. This course may be taken more than once for credit.

76-467 AutoBiography Workshop
Fall or Spring, once every two years
Prerequisite: 76-260 with a grade of A or B
Dramatic or unusual experiences do not necessarily make great autobiographies. Writers must learn to shape truth and make their experiences meaningful to readers. In this workshop the focus will be on identifying what it is that makes one's own work interesting to others as a way of looking at issues outside one's own experience, and writing from one's own life with grace and control. Assignments include frequent writing exercises and forty pages of polished work. The class will also read two full-length memoirs and several shorter works.

76-469 Screenwriting Workshop
Spring: 9 units
Prerequisite: 76-269 with a grade of A or B
This workshop develops students' analysis, writing, and critical skills in screenwriting. The students' own work will be closely examined by the instructor and other members of the course. This course may be taken more than once for credit.

76-470 Advanced Professional and Technical Writing
Spring: 9 units
Prerequisites: 76-270, 76-271 or 76-379.
As the senior capstone course for professional and technical writers, Advanced Professional And Technical Writing helps students make the transition from student writers to professionals who must balance the tension between theory and the needs and expectations of their audiences. This class will draw upon rhetorical theory in order to help students understand professional and technical writing as a process of problem-solving in a variety of contexts — social, institutional, technical, ethical, and rhetorical. The course will emphasize the ethical dimensions of decision-making and information design in complex technical and rhetorical situations. Throughout the course, students are asked to think about the social and ethical consequences of their work as they write and design solutions to complex information design problems in the classroom. In the final project, students will write a series of related professional documents that will provide them with a portfolio they can take into the workplace.

76-472 Advanced Journalism
Spring: 9 units
Prerequisite: 76-372 or 76-360 or permission of the instructor.
This continuation of a two-course sequence begun in the fall semester will emphasize further refinement and use of the skills introduced in 76-372. Students will cover beats and will be assisted in finding outlets to publish their assignments. Weekly sessions will focus on the history and evolution of journalism in the 20th century as a way of understanding contemporary practices and trends. In addition, classes will include presentations of student projects; discussion of practical problems in newspapers; analysis of published stories; and visits by professional journalists.
While it is recommended that students with little to no journalism experience take 76-372 before enrolling in this course, students with previous or current journalism experience are encouraged to contact the instructor for permission to enroll. This course may be taken more than once for credit.

76-476 Rhetoric of Science
Fall or Spring: 9 units
This course is an introduction to some of the most recent concepts and developments in an excitingly interdisciplinary field known as rhetoric of science. Through readings related to historical and contemporary issues, we examine basic questions concerning the relationship of science to the language and conventions in which it is expressed: What does it mean to speak of a rhetoric of science? Does language use affect the way in which scientific discoveries are made? The ways in which they are understood and valued? Public
perceptions of and support for science and research? Policy related to science? Throughout the course we will grapple with these and related questions with the help of relevant theories from philosophy, sociology, cultural studies, and classical rhetoric. Guided by key rhetorical concepts, we will consider a number of case studies from the history of science and technology. Our effort will be mainly devoted to understanding and explaining science as a profession with specific norms of interaction, and as a field in which knowledge is produced according to certain norms, conventions, and practices. Rhetoric will allow us to see how scientists use language to represent the world, develop new ideas, and communicate their work among themselves and to the public.

76-479 Marketing, Public Relations, and Corporate Communication
Spring: 9 units
Prerequisite: 76-270 or 76-271
Effective marketing and internal and external communication are essential to the success of businesses, non-profit agencies, academic institutions, public interest groups, and other groups of people with a shared purpose and identity to promote. This course explores problems and solutions that apply to marketing and communication in a broad range of business settings, where professional communicators manage relationships with a wide variety of constituencies including customers, investors, news agencies, employees, local communities, and local, regional, and national government agencies. This course will help you develop the written and oral communication skills to handle the wide variety of tasks demanded of a professional communicator in such settings. You will learn how to plan and develop a coherent approach for all of an organization’s communications as well as effective marketing tactics for achieving business objectives. Topics covered will vary somewhat by semester but generally include corporate branding, messaging, and positioning; crisis communication; public, media, government, community, and investor relations; internal employee communication; Web publishing and corporate Web sites; annual reports; measurement and evaluation of communication effectiveness; knowledge management; and customer relationship management.

76-480 Document Design
Fall: 12 units
Prerequisites: 76-271 or 76-270
This course is intended to develop your understanding of three concerns related to document design for print publications: 1) the theory you need to understand visual/verbal communication, 2) practice in solving the problems that put that theory to use, and 3) the practical knowledge of desktop applications — PageMaker, Illustrator, Photoshop — necessary to create effective documents. Projects will be tied into class instruction concerning basic perceptual composition, typography, grid features, and the cohesion of word, image and visual design. Finally, we will discuss document creation as a design art that has both historical and collaborative features. In relating the document to its collaborative production process, we will discuss the importance of the printer/client relationship, the need for the careful selection of printing papers, and the problems that can be encountered as an artifact moves from document to distribution. The course meets two days a week as a seminar and a third as a required lab in which students learn and practice required software applications.

76-481 Writing for Multi-Media
Fall: 9 units
Prerequisite: 76-270 or 76-271. Note: 76-480 is not a required prerequisite, but students who have had 76-480 or 51-261 or 51-262 will find it to be an advantage.
When you listen to a talking head on screen while a graphic is displayed behind the speaker and a stream of running text provides additional information at the bottom of that screen, you are having a multimedia experience. As such, you are also having a multimodal experience because you are looking at static and animated images, hearing sound, and reading text simultaneously or in quick succession. The growing demand for such multimedia applications in fields such as advertising, documentation, training, entertainment, and education creates an opportunity for writers to push their practice into innovative areas. This class will prepare you to enter these fields by teaching the strategies and skills needed to make compelling interactive experiences. Specifically, we will focus on developing your ability to conceptualize, design, and create multimedia applications. Areas of focus will include: strategies for understanding and documenting audience needs and expectations and the typical process and artifacts involved with multimedia production. We will also explore how best to write for multimedia applications, and how writing can effectively define such an artifact before it is produced. Using Macromedia Flash, students will produce several multimedia pieces suitable for their portfolios. The course includes lab instruction in the relevant software.

76-482 Comparative Rhetoric
Fall or Spring: 9 units
This course serves a two-fold purpose. It attempts (1) to address the theoretical and methodological challenges in cross-/inter-cultural communication from a rhetorical point of view and (2) to examine critically the way comparative studies of different rhetorical traditions/systems are currently conducted. In particular, it is concerned with the rhetorical problems we face when comparing different contexts, e.g., to analyze how issues of and support for science and research? Policy related to science? Throughout the course we will grapple with these and related questions with the help of relevant theories from philosophy, sociology, cultural studies, and classical rhetoric. Guided by key rhetorical concepts, we will consider a number of case studies from the history of science and technology. Our effort will be mainly devoted to understanding and explaining science as a profession with specific norms of interaction, and as a field in which knowledge is produced according to certain norms, conventions, and practices. Rhetoric will allow us to see how scientists use language to represent the world, develop new ideas, and communicate their work among themselves and to the public.

76-487 On-Line Information Design
Fall & Spring: 12 units
Prerequisites: (1) 76-270 or 76-271 and, (2) 76-480 or instructor permission
Students are required to register for both 487 & 488. The only exception to this policy is for IS/CD students who have completed 76-382 or 72-262.
This course introduces students to issues and practices in the design of on-line information. The primary focus is on the design of textual information, though issues in on-line design for other media such as pictures, sound, animation and video, are discussed, especially as they relate to the integration of text and these media. The course focuses on 5 main areas: 1) the major theories, methodologies, and practices of on-line information design, 2) research evidence about the effectiveness of various designs, 3) evaluation of existing on-line information designs, 4) skill and practice in solving design problems involving on-line information design, and 5) background knowledge necessary to succeed in the interdisciplinary world of information design. The course includes a required lab component that covers basic HTML, images, tables, animation, imagemaps, interactive forms, Web interfaces to databases, and basic Java-scripting.

76-494: Medical Communications
Fall: 9 units
Prerequisites: 76-270 or 76-271 or 76-397 or permission of the instructor. Medical Communications focuses on how medical and health care information is constructed and “transferred” between experts, health care providers, educators, researchers, patient support groups, and patients who are often not experts but need a thorough understanding of the information to make important health care decisions. The course is appropriate for you if you are planning a career in health-care related profession or if, as a writer, you want to build your writing and communication skills in a specific, well-defined discourse community. We will identify how basic rhetorical strategies — such as how experts view their audiences and how information is structured and delivered — operate within the boundaries of a specific community, as well as how technology alters the way that information is both constructed and distributed. Throughout the course, you will 1) explore the interactions of current theory and practice in medical communication, 2) study an historical overview of medical communication, and 3) explore the provider/patient relationship from rhetorical standpoint.
Course Descriptions

76-501/502 Senior Honors Thesis I & II
Fall (501) & Spring (502): 9 units each semester
Prerequisites: Seniors with a 3.25 overall GPA and a 3.5 average in major courses. Registration is via invitation from H&SS.

An Honors Thesis may be written by invited students in all four majors offered by the Department. The thesis may take the form of an academic research project or a book-length manuscript. For students in the English BA, the thesis will generally take the traditional form of an academic research project. For students in the BA in Creative Writing, the thesis could be an academic research project or a book-length manuscript in fiction, poetry, or non-fiction. For students in Professional or Technical Writing, the project may be a traditional academic research project, a research project focusing on problems in professional or technical writing, or a hands-on project that addresses problems or issues in professional or technical communication.

History

Undergraduate Courses

79-104 Introduction to World History
All Semesters: 9 units
Introduction to World History challenges students to think analytically about the major historical processes that shaped and continue to shape cultures and civilizations. The course is based on a series of case studies that focus on shifting power relations between and within civilizations. Three major themes connect the several topics discussed throughout the semester: issues of authority and inequality within civilizations; encounters and conflicts between civilizations; and patterns of continuity and change across space and time. The course demonstrates how historians explain what has happened in the past and in various civilizations and cultures; presents the kinds of evidence that historians use to reconstruct the past; and examines the interpretations historians make based on this evidence. The semester begins with a consideration of the rich culture of medieval Iberia and then moves on to discuss: the encounters between the "old" world and the "new"; the emergence of a transatlantic society; industrialization in Europe and China; environmental imperialism in India; and tradition and modernity in post-colonial Africa.

79-112 Race, Nationality, and Culture in American Society
Intermittent: 9 units
This course examines the interplay of race, ethnicity, and nationality in the development of the United States. We evaluate the comparative role of these factors as different groups interacted over time in American society.

79-113 Culture and Identity in American Society
Intermittent: 9 units
This discussion course focuses on economic identity from the era of Benjamin Franklin to the dot-com bust of recent years. We will study changing ideas about the American Dream, considering how class, gender, race, ethnicity, religion, and occupation shape our assessments of ourselves and each other. Readings include memoirs, poems, and fiction from authors such as Thoreau, Frederick Douglass, and Arthur Miller. Assignments include a readings journal and short essays.

79-150 Freshman Seminar: Bioethics in Historical Perspective
Intermittent: 9 units
This course will examine such issues as use of animals and humans in medical research, contraception and abortion, and genetics and eugenics in two distinct historical periods: our own time and the period from about 1870 to 1940. We will compare and contrast how these issues have been framed in these two periods, as well as identifying who supports what positions and why. In so doing, we will seek to understand the social, economic, and cultural contexts of specific ethical stances and the groups that support them.

79-151 Freshman Seminar: Women & Consumer Society in Europe & the U.S. 1945-60
Intermittent: 9 units
The course compares the experiences of women as mothers, workers, and consumers from 1945 to 1960 in Germany and the U.S. Its major goal is to understand how women came to be defined as the quintessential consumer of the mass consumption societies of the booming 1950s and to explore how this definition affected women. We look at women's relationship to consumer society from various angles; at the impact of World War II on attitudes towards women; at advertising; at notions of "woman's place" in the home; at critiques of such notions; at the ways in which politicians and women's organizations accepted or resisted the division of labor that made men producers and women consumers. Finally, the course considers the case of women who did not fit the role of homemaker/consumer.

79-152 Freshman Seminar: Religion and Politics in the Middle East
Intermittent: 9 units
This course will explore the intersection between religion and politics in the various countries throughout the Middle East. We will look at the historic relationship among Islam, Judaism, and Christianity and what they have to say about the nature of government and relations among the states. We will also consider the impact of religion on both domestic and foreign policy in selected countries, the role of religion in fueling the various conflicts plaguing the region, the phenomenon of religious fundamentalism, and the implications for US policy towards the Middle East.

79-154 Freshman Seminar: Education & Society in Comparative Perspective
Intermittent: 9 units
This course will analyze the evolution of key educational patterns and cultural characteristics of the United States and Russia during the past century and a half, with particular concern for distinguishing between education and culture. Educational innovation and reform movements in both countries, and the impact of each country on the other, will receive special attention, including such specific topics as the ideas of John Dewey, the Dalton Plan of schooling, the Project Method, the Core Curriculum, and the impact of Sputnik on American science education. Distinctive cultural achievements of both countries will also be highlighted, especially through art and music. The course will include secondary readings, primary documents, museum visits, and films.

79-155 Freshman Seminar: Rethinking Race: The Shaping of the African American Experience
Intermittent: 9 units
This course examines major issues in the development of African American urban life, from slavery to recent times. Students will explore major works that have shaped the field of African American urban history; pinpoint the strengths and weaknesses of past scholarship; and develop their own theoretical and methodological approach to the subject. In addition to weekly discussions of assigned readings, students will write a 15-20 page paper based upon an assessment of available scholarship as well as an examination of primary sources in various published sources, microfilm, and archival collections at Carnegie Mellon and the University of Pittsburgh.
This course will examine the use of psychoactive drugs in American history from a cultural and historical perspective, focusing chiefly on alcohol, opiates, marijuana, tobacco, and cocaine. We will explore both cultural patterns of drug use and policies directed at perceived problems associated with such use. Attempts to control use of various drugs, through law and policy and through informal social controls, will be examined. Primary texts, including narratives by drug users and perceived problems as described by social reformers and policy makers, will also be read.

This course is an introduction to comparative slavery and emancipation in New World societies. It examines the evolution of the African slave trade and involuntary labor and their impact on the development of North America, South America, and the Caribbean Islands. It explores the distinctiveness of the overall Atlantic system and differences among slave societies. Major themes of the course include: tensions between domination and resistance; cultural adaptation of bound people; women and families; free people of color; and the relationship between race, class, and gender in systems of forced labor. Students will engage a variety of texts, including first-hand testimonies of slaves, traders, and owners in Africa, Europe, and the Americas.

Robert Coles, author of The Call of Stories, says that we all have accumulated stories in our lives, that each of us has a history of such stories about our lives, and that no one's stories are quite like anyone else's. In this course we will read a series of fictional stories written by hyphenated-Americans and analyze their experience through their characters. We will identify the common issues raised across a number of authors and time periods, question why certain issues are raised and others are not, compare these fictional accounts to historians' representation of the immigrant and hyphenated-American experience, examine whether the issues identified have changed over time in fictional accounts, and compare and contrast different ethnic-American authors writing at roughly the same time. We will, through the eyes of fiction writers, try to capture the essence of what it's like to be a hyphenated-American.

Living in a society still struggling to come to grips with its own history of slavery, American scholars have often imposed words like "slavery" and "freedom" onto African contexts. But, such labels have the effect of masking dynamic social institutions in pre-colonial Africa. This course will interrogate the multiple ways that these institutions functioned before the period of the trans-Atlantic slave trade and the multiple ways that African communities transformed their institutions in response to it. Students will engage a variety of historiographical debates in secondary sources and first-hand testimonies of "slave's" primary sources.

This course will examine the role violence has played in shaping American race relations. We will consider the dynamics that generate racial violence, how society responds to such outbreaks, and how leaders attempt to soothe tensions. Topics will include slave rebellions, lynchings, and urban race riots.

Most history courses engage students in what is essentially the consumption of other historians' work. The centerpiece of such histories is the presentation of a carefully selected and defined research problem or agenda, and a narrative of the historian's findings and conclusions, with an explanation of evidence and methods playing an important but subordinate role. This seminar seeks to reverse this order in certain key respects. It places at center stage the fundamental tasks and motivations that historians face at the outset of their research, and of the many issues of research and presentation that pose additional challenges and choices for them along the way.
Course Descriptions

79-202 The History of Public Policy in the United States
Intermittent: 9 units
Because the United States has a federal system of government, public policy can be made on various governmental levels—national, state and local. The Constitution provided for specific delegated powers to the federal government with residual powers going to the states, but over time, the federal government has expanded its domain. This course will examine the history of the making and implementation of public policy in the United States exploring areas of change and the various forces driving them. National security, foreign policy, business and environmental regulations, urban development, social services are some arenas in which the role of American government can be examined in relation to markets and to private sector groups. Similarly, changes in time over what constitutes full American citizenship and who has the right to vote illuminates the changing nature of American government.

79-204 20th Century America
Intermittent: 9 units
This course will look at the interaction of political, economic, technological, social, and cultural change in shaping American history during the 20th century. We will study the impact of major events (e.g., the World Wars, the Great Depression), social movements (e.g., Civil Rights, Women's Liberation), and technological developments (e.g., atomic energy, automobiles, television) on the everyday lives of Americans. We will also consider the diversity of the American experience, taking into account differences in race, national origin, gender, class, and age.

79-205 20th Century Europe
Intermittent: 9 units
This course covers aspects of western European history from 1914 to the 1990s. Its themes are the roots of the profound crisis of democracy and civil society and the parallel rise of radical intolerance in Europe between 1918 and 1945 and the causes behind the success of democratic republics since World War II. We consider the social and economic impact of the two World Wars, the extraordinary artistic vitality of the 1920s, and the reasons why some countries produced large and successful fascist movements while others did not. We also discuss the rise of Communist parties and the crisis of democratic socialism. In the post-war era we focus on European responses to revolts against colonialism, the "economic miracle" of the 1950s, anti-Communism, and student radicalism of the 1960s. Readings include primary sources, novels, reportage, and scholarly monographs.

79-206 Development of American Culture
Intermittent: 9 units
This is an introductory survey of American history from colonial times to the present. The course focuses on cultural analysis instead of the more traditional emphasis on presidents, wars, and memorizing facts or timelines. The major theme of the course is the changing meaning of freedom over three centuries. Required readings include novels, memoirs, historical documents, and a study of the concept of freedom. There is no textbook. Background facts and events are covered in lectures to provide students with context needed to think about and understand America's cultural history. Assignments include exams and essays.

79-207 Development of European Culture
Intermittent: 9 units
This course surveys the evolution of European culture from 1500-1950. It defines 'culture' broadly to include not only philosophy, literature, and art but also science, manners, sexuality, morality, and religion. Lectures, readings, and discussions will introduce students to what Europeans thought and wrote about these questions. Readings will include no 'history books' but only novels, plays, and memoirs. We will discuss these writings, on the one hand, as 'literature', that is, as examples of literary styles and themes and, on the other hand, as documents that reveal much about the philosophical and social conflicts that divided Europeans.

79-208 Theory and Practice in History and Policy
Intermittent: 9 units
(Open only to declared majors in History and Policy) This is an introductory course in the theory and practice of using formal historical study and method to address issues in public policy, either in the formation of policies or the evaluation of those policies for both their intended and unintended consequences. Students will study the theoretical underpinnings of the field of History and Policy, learn to become critical consumers of historical studies that address issues in public policy, and develop basic skills in the actual practice of applying history to policy formation and evaluation. Case analyses may focus on the regulation of markets, urban planning, the environment, public health, education, science and technology, or other policy domains. Prerequisite: 79-202.

79-209 Theory and Practice in Anthropology
Intermittent: 9 units
How has anthropology changed over its relatively short lifetime? This course will examine the major trends and schools of thought in anthropology in the twentieth century, focusing on how theory shapes the questions anthropologists ask as well as their fieldwork methods. Students will learn to find theory within ethnographic writing, both by analyzing the work of notable anthropologists and by experimenting with various theoretical orientations in their own analysis of ethnographic data. After first examining some of the 19th century influences on the emerging field of social science, we will examine how anthropologists took in the early and mid-twentieth century, focusing on how culture and social structure were understood and analyzed at this time. Next, we will turn to issues of power, practice, and history, and the influence of new theoretical approaches on anthropological conceptualizations of culture. Finally, we will explore how more recent theoretical trends, including feminist and post-modern contributions, have shaped contemporary anthropology. The course will emphasize that, though theory has developed in recognizable ways throughout anthropology's history, this development has not been linear. To show how older theoretical approaches sometimes resurface in more recent anthropological work, readings will pair classic works in the various theoretical schools with more contemporary reworkings of those same theoretical orientations.

79-210 Picturing Others: A Course on Ethnographic Film
Intermittent: 9 units
Western society has long been fascinated with the "primitive." From their earliest days, photography and movies have been used to picture these others, seeming to offer a direct account of ways of life, often familiar to us in other ways. This course will examine ethnographic films as descriptions of unfamiliar (and sometimes familiar) others. We discuss the ways films represent and portray material, examine the significance of changing techniques, and confront the problem of point of view. We also evaluate the use of visual media for social analysis in general. Students make a film or video tape, applying ideas and issues from readings and class discussion. The work with film and video require extra course hours (to be announced in class).

79-212 History of Modern Science
Intermittent: 9 units
What is the scientific outlook; what have been its applications and results; and how has it become the predominant, even characteristic, analytic approach in "western" culture? This course surveys the origins, development, achievements, and influences of modern natural science. We concentrate on major philosophical, methodological, and organizational features in the history of the physical and biological sciences from the Renaissance to the late 19th century.

79-218 The Roots of Rock & Roll
Intermittent: 9 units
This is a course about musical and social revolutions from the 1920s to 1970. In a casual lecture format (with room for discussion and regular in-class listening to recordings), we will trace the development of rock music from its early roots in blues and folk music, through the electric revolution of the 1960s, to
punk, grunge and the recent resurgence of acoustic rock. Writing and listening assignments will include short essays and record reviews. Film screenings one evening a week.

**79-219 The Holocaust in Historical Perspective Intermittent: 9 units**

Why did Hitler unleash the Holocaust against the Jews? How did he do it, and how did he get away with it? This course explores the attitudes and actions of the perpetrators, the bystanders, and the victims. Moreover, it discusses what implications and issues arise from this watershed event in World and Jewish history. It descends into the world of the Holocaust not only by reading about events and viewing several films, but also by meeting Holocaust survivors.

**79-220 Early Christianity Intermittent: 9 units**

In this course we explore the origins of Christianity. Although we deal with biblical, as well as other contemporary, materials, the approach is not theological but historical. We want to understand how and why Christianity assumed the form that it did by examining its background in the Jewish community of Palestine, its place in the classical world, its relationship to other mystery religions of the time and certain variant forms (now known as Gnosticism) which it assumed prior to the crystallization of orthodoxy.

**79-221 Religion in European Society Intermittent: 9 units**

In the sixteenth and seventeenth centuries, Europe underwent continuous religious upheaval. This course provides an introduction to the major events of the Reformation and Counter-Reformation and an assessment of the impact of these movements on the development of modern Christian life and values.

**79-222 Religion in American Society Intermittent: 9 units**

Opinion polls taken from the 1940s through the 1990s report annually that over 90 percent of Americans believe in God. Our earliest institutions, when they were not churches themselves, reflected a strong religious influence. Americans have felt religious competition so keenly in various times in our history that they have rioted in support of one denomination over another. Why was (is) this so? How have Americans experienced, thought about, and manifested their various religious beliefs throughout our history, and how have Americans interacted with fellow citizens of differing beliefs? How has religion influenced the development of our current institutions, and why do Americans believe what they do? This course examines these and other issues connected to American religious development.

**79-223 Protest and Dissent in American History Intermittent: 9 units**

What does it mean to protest in a country that was founded by revolutionaries? Are radicals heroes or traitors? Dissenters like Sarah Grimke, Frederick Douglass, Susan B. Anthony, Eugene V. Debs, Emma Goldman, Malcolm X, Cesar Chavez and others struggled for different convictions but had one thing in common: to further their causes they had to overcome the traditional aversion to radicalism in America. This course traces not only the history of particular protest movements since revolutionarystimes, but also the historical development of mainstream politics, law, and public opinion regarding radical dissent.

**79-225 Religions of China Intermittent: 9 units**

How have Chinese addressed universal questions of personal meaning and survival, and of social connection and authority, with the help of religion? This course is interested in solutions elaborated over the centuries by Chinese of all social classes. Without neglecting the textual canon, we are particularly interested in changing styles of ritual organization and practice. We examine mutual borrowing and textual canon, we are particularly interested in changing styles of and secondary material, film and illustration, lecture and discussion.

**79-230 Technology in American Society Intermittent: 9 units**

This course introduces students to the history of technological change in the United States and examines the ways that American society both shaped and was shaped by technological change. The course’s readings, films, and lectures give voice to both the prophets of technological progress in the United States and those who found technological progress as the source of social problems rather than their solution. The course aims to raise fundamental questions about technology, society, culture, and power across time and space.

**79-231 American Foreign Policy 1945-Present Fall and Spring: 9 units**

This course provides an introduction to the study of U.S. foreign policy. Its main focus will be on problems and possibilities confronting the world during the Cold War as well as global political changes in the post-Cold War era and since 9/11. Important foreign policy strategies which will be discussed include the strategy of containment, NSC-68, the Eisenhower-Dulles “New Look,” the Kennedy-Johnson “flexible response,” “détente,” the democratic peace, and contemporary approaches to combating global terror. Theoretical readings in history and political science will be used as a basis for evaluation of recent American foreign policy and key historical episodes.

**79-232 Vietnam: America's Lost War Intermittent: 9 units**

No event has had more impact on recent American history than the Vietnam War. The war began as an attempt to save the "free nation" of South Vietnam from Communism. Within a few years, it provoked enormous domestic protest, led to widespread resistance and evasion of the draft, and called the whole basis of American foreign policy into question. The war ended with the withdrawal of American troops in 1973 and the collapse of South Vietnam in 1975, but since then there has been no agreement on the "lessons" we should draw from the conflict. This course will explore the diplomatic and political origins of the war, the military conduct of the war, and the domestic political opposition to it. It will also examine popular films dealing with the Vietnam War to show how Hollywood has attempted to recreate our collective memory of Vietnam and create new myths which threaten to replace the historical reality of the war.

**79-233 The United States and the Middle East since 1945 Intermittent: 9 units**

Since the end of WWII, the United States has been repeatedly involved in Middle Eastern affairs. This course examines US interests and intrigues in the region, moving chronologically from 1945 to the present. Issues covered include the Cold War in the Middle East arena; oil politics; US as Arab-Israeli peacemaker; US military intervention in the Middle East; US and Islamic fundamentalism; Middle Eastern terrorism; and case studies concerning US relations with key Middle Eastern countries.

**79-237 Cities in History: London and Delhi Intermittent: 9 units**

The British Empire connected two great cities, London and Delhi, but even before the British came to India, Tudor London and Mughal Delhi presented a dazzling display of imperial politics and culture to the world. This course looks at the parallel destinies of these metropolises - from that period into the reign of Queen Victoria and her Indian Viceroys and then to the age of Gandhi and Churchill. Finally, it examines some of the ways in which post-colonialism and globalization have affected these two civic cultures. Art, architecture, autobiographies, diaries, poetry, films, newspaper reports and state documents will be some of the varied materials students will use for this course.

**79-240 Recent U.S. History 1945 - Present Intermittent: 9 units**

This course will explore the social and cultural history of America since World War II. Topics include: the dawn of the nuclear age,
the cold war, the beatniks, the Korean and Vietnam wars, the civil rights movement, the women’s movement, hippies, the energy crisis of the 1970s, the rise of environmentalism, yuppies, the turn toward conservatism in the 1980s. We will use music, film, television, and literature as evidence of cultural change in American society during the past 50 years.

79-241 African-American History I
Intermittent: 9 units
This course examines a series of topics—economic, demographic, social, cultural, and political—in African-American history from slavery to the Civil War. The evolution of race relations is an important component of the course, but the major emphasis is placed on the internal experiences of black people within the framework of larger socioeconomic and political processes in U.S. history. Although the course includes a general text, assigned readings revolve around detailed studies of regions, topics, and eras (e.g., the colonial, revolutionary, and ante-bellum eras).

79-242 African-American History II
Intermittent: 9 units
This course examines the black experience from Reconstruction to the present. The evolution of race relations is an important component of the course, but the major emphasis is placed on the internal experiences of black people, within the framework of larger socioeconomic and political processes in U.S. history. Although the course includes a general text, assigned readings revolve around detailed studies of particular topics (e.g., work, family, and religion) or chronological periods (e.g., the Great Migration, Depression, World War II, and the Civil Rights Era).

79-243 A History of American Urban Life
Intermittent: 9 units
This course examines the development of urban America during the 19th and 20th centuries. It explores the evolution of urban structure, the development and impact of urban technologies (transportation, water/wastewater, energy and communications), ethnic and racial change and conflict in the city, and political and policy issues. It discourses alterations in American city structure and form through the walking city, the networked city, and the development of the outer or edge city.

79-244 Pittsburgh and the Transformation of Modern Urban America
Intermittent: 9 units
This course examines 5 major themes: (1) the development of the Pittsburgh region in the 19th century from a commercial to a leading industrial center; (2) the development of the urban built environment; (3) attempts to cope with the impacts of industrialism on labor, government, and the environment before World War II; (4) the Pittsburgh Renaissances in the post-World War II period; and (5) the deindustrialization of Pittsburgh and attempts to adapt to new social-technological realities. The class will follow a seminar-type format; students will be expected to contribute to class discussions and to complete a major research study on the region. The class will make use of both visual (photographs, films) and written materials as well as using the Pittsburgh region as a laboratory through tours.

79-247 East Asians in Film
Intermittent: 9 units
The course is intended as a visual introduction to East Asian societies, as they adapted to the wrenching experiences in the 20th century. Our focus is on love and family life and the representation of both in China and Japan. The topics are seen in relationship to the Confucian ethic, and under pressure of war, rapid economic change, crime, and revolution. We also ask how East Asian filmmakers have made use of their medium, and how political and other conditions have affected their work.

79-250 Europe’s Two Revolutions: Dynamics of Change in the 19th Century
Intermittent: 9 units
This course concentrates on the major developments in the social, economic, and cultural history of Western Europe in the period from the French Revolution to the late nineteenth century. It focuses on the causes and consequences of two great revolutions, the French and the Industrial, while tracing key commonalities and differences in the evolution of English, French, and German societies.

79-253 The Development of Caribbean Culture
Intermittent: 9 units
This course is a general introduction to Caribbean histories and cultures, from before the arrival of Columbus to the present. Comprised of dozens of islands, the Caribbean has been a stage for the encounter of multiples cultures and peoples-indigenous, European, African, and Asian. It remains an area of remarkable linguistic, religious, political, and ethnic diversity in the present. In this course we will explore some of the major themes that have characterized the region’s many histories and cultures: the early cultural encounters of the period of conquest and colonization, the emergence of plantation societies, and patterns of slave resistance; nationalism, imperialism and revolution; and the place of migration, popular religion and tourism in the contemporary Caribbean. Through the exploration of such events, this course will place the connections between politics and culture at the center of our encounter with the Caribbean’s complex historical past.

79-254 The Pacific Islands: History and Culture
Intermittent: 9 units
In the mid-1920s, Margaret Mead discovered a "paradise" in Samoa. Her encounter is part of a long story of EuroAmerican explorations of the islands of the Pacific, and the responses of island peoples to those who visited, observed, and stayed in the islands. In this course, we focus on encounters as a way of examining the histories and the cultures of Pacific Island societies. We cover the "tiny" islands of Micronesia, the "dark" islands of Melanesia, and the "happy" islands of Polynesia. (The course does not cover Japan, the countries of the Pacific rim, the Philippines, Indonesia, or Australia.) Each new decade brought change and development to the Pacific, which we also analyze. Readings include anthropological texts, novels, and selected essays.

79-255 Irish History
Intermittent: 9 units
This course surveys Irish history from the earliest human settlements until the present day, with emphasis on the period since the sixteenth century. Our main objective is to understand the sources of conflict in modern Ireland. In order to do that, however, we look at a number of topics such as the role of religion in Irish society; the causes of population growth, movement and decline; changing forms of protest; and the formation of rival myths of the Irish past and its meaning.

79-256 Biology and Society
Intermittent: 9 units
This course focuses on the relationship between biology and society since the late 18th century. It explores how biology has interacted with physics, chemistry, industry, ethics, politics, law, and religion during the past 200-plus years. It also examines the ways that biology and society have evolved together, both in the United States and around the world, and have become increasingly dependent on one another in the process. Some topics covered include: late 18th century attempts to explain life processes in terms of physics and chemistry; the Darwinian Revolution; the rise of experimentalism in biology; the scientific purpose and morality of animal experimentation in 19th century physiology; the history of genetics and eugenics; the impact of atomic weapons on biology; the rise of molecular biology and biotechnology; and ecology and environmentalism.

79-258 Introduction to African History: 18th Century to Neo-Colonialism
Intermittent: 9 units
The course is designed to give students an understanding and appreciation of African history and culture from the "inside out." Though it deals with the period of European expansion in Africa, it is centered on African language/ ethnic groups, villages, and individuals as historical actors who daily make collective and personal decisions
to pass down, innovate, and borrow practices, technology, spiritual systems, etc. in the face of social, political, and economic realities. The course is also designed to get students thinking critically about how historians select and interpret sources to construct and reconstruct history at these different levels.

79-260 Mayan America
Intermittent: 9 units
This course will explore the history and culture of the Maya from before the European conquest of the Americas to the present. After a survey of pre-Hispanic Mayan societies and of the European conquest of Mexico and Central America, we will consider the experience of the indigenous Maya under Spanish colonial rule and under the rule of Latin American nation-states in the nineteenth and twentieth centuries. Finally, we will cover the recent history of political conflict and military repression in Guatemala, the Zapatista uprising in southern Mexico, and increasing Mayan migration to the United States. Drawing upon the varied perspectives of anthropology, cultural anthropology, and social history, this course will explore several recurrent themes in Mayan America, such as: conquest, adaptation and resistance; indigenous political and communal organization; popular religion; Mayan cultural and ethnic identity; "translation" and "modernity"; state violence and human rights; and indigenous political and cultural mobilization at the local, national, and transnational levels.

79-261 Europe After the Black Death
Intermittent: 9 units
The Black Death that ravaged Europe in 1347-50 was a watershed in history. This course is devoted to exploring early modern European society between 1350 and 1750. Special attention is given to social and economic factors, to questions of mentality, to forms of belief, and to cultural change. Some specific topics include: the Renaissance and Reformation in their socioeconomic contexts; the decline of magic and the "rise" of religion; riots, revolts, and revolutions; changes in mortality, life expectancy, and the sources of crisis and stability in the early modern world.

79-263 Riots, Revolts, and Revolutions
Intermittent: 9 units
The words "riot," "revolt," and "revolution" are often used imprecisely and even interchangeably. This course explores the history and meaning of all three by treating them as separate events and non-synonymous terms. Over the course of the semester, we trace the evolution of uprisings from medieval times through the middle of the twentieth century. We begin by looking at both the urban and rural turmoil of the late middle ages, move into the "pre-modern" or "pre-political" riots and revolts of early modern times, examine labor sects and early forms of labor protest before going on to consider the "great" revolutions of the eighteenth, nineteenth, and twentieth centuries: the French, the American, and the Russian. We also analyze the conjunction between wars of independence and revolutions as, for example, occurred in the North American colonies in the late eighteenth century and in Latin America in the early nineteenth century. Our focus is explicitly comparative albeit within the framework of the Western experience.

79-266 Times of Feast/Famine: Population and Family in History
Intermittent: 9 units
This course introduces students to basic principles of population analysis and to the broad outlines of the population history of the West using Malthusian models linking population to economy and society. It focuses on the social, economic, and cultural institutions which together have combined to shape the Western demographic regimes over the long term. Students learn to understand and to use some of the fundamental concepts of demographic analysis including mortality, fertility, nuptiality and migration, and tools such as life tables and age pyramids. We employ these tools to explore Malthus’s equilibrium models of population through historical case studies of "positive" (famine, epidemic) and "preventive" (household formation rules, nuptiality patterns) checks on population growth. We also examine the transformation of the Western demographic regime during the "demographic transition." While the course chooses most of its examples from the history of the West, students have the opportunity to undertake comparative analysis.

79-267 Pre-Colonial West African History 1100 to 1800
Intermittent: Mini Session - 6 units
This course examines major themes in pre-colonial West African history, Islamization, urbanization, economic specialization, identity formation, interregional and trans-Atlantic trade, and European conquest. The focus of the course is on the role of social processes and institutions and their evolution as West Africa becomes an important part of the wider Islamic and Atlantic worlds. Students will be introduced to a variety of interdisciplinary sources as we reconstruct a history which in some cases pre-dates and in others is not recorded in written sources.

79-268 From the Local to the Global: Africa in the World
Intermittent: Mini Session - 6 units
Most Americans would see Africa and colonialism when thinking of Africa's relationship to the rest of the world. While these two institutions have been critically important in shaping Africa's present condition and recent history, they only constitute a fraction of Africa's past and its interaction with the wider world. This course traces globalization to pertinent events and seeks to understand it from an African perspective.

79-270 Chinese Culture and Society
Intermittent: 9 units
Few courses provide an opportunity to look at a civilization as a whole. If we examine the Chinese quarter of humanity in this way, we can better understand the interplay of ecology and history, of class and community, and of self and society in China-and in any other society. We may also gain a new perspective on the West, whose peculiarities we too readily take as normal. This introductory course focuses on Chinese solutions to Chinese problems, as reflected in the words of the literate (e.g., philosophers and soldiers, dramatists and novelists) or in the actions of the unlettered (e.g., peasants, women and religious cultists). We proceed by making explicit their values and ours, setting up a kind of discourse across cultures. Special attention is paid to the seventeenth and eighteenth centuries.

79-271 Modern China
Intermittent: 9 units
This is a survey of the century-long period of revolutionary change that culminated with the accession of the Communists to power in 1949. We examine three large themes: the strengths and weaknesses of the old order in and after the Opium Wars, the transplantation of foreign ideologies like nationalism, liberalism, and communism into China, and the effort to create new national institutions as well as social movements at the grass-roots level. By using memoirs and analysis by Chinese and recent Western studies, the course conveys a sense of how life was lived in this violent period of transition, as well as why the Communists won.

79-272 Modern Japan 1868 to Present
Intermittent: 9 units
In just 150 years Japan has developed from an isolated, primarily rural society to the technologically advanced, industrially powerful, and urbanized nation of today. In this course we will look at the economic, social, and cultural features in Japan's history which underpin this striking change and the social and cultural costs which have accompanied it. Throughout we will consider the lives of women and ordinary citizens as well as those who became economically and politically powerful. Our texts will include historical writings of western and Japanese scholars, oral remembrances, biography, and fiction.

79-276 Japan During WWII
Intermittent: Mini Session - 6 units
This course is a social history of Japan's war in Asia from 1931 to 1945, with emphasis on Japanese perspectives. Among our topics are Japan's encroachment in China, the conditions within its Empire and at home, the cultural and military conflict on both sides of the Pacific, the Japanese-American internment in the western U.S. states, the conduct of the Pacific War, the continuing debate about the atomic bombing of Hiroshima and Nagasaki.
Course Descriptions

79-280 Russian History from the First to the Last Tsar
Intermittent: 9 units
This course covers a broad sweep of Russian history beginning with the first settlements of tribal nomads in the ninth century and ending with the fall of the 300-year-old Romanov dynasty in 1917. In our study of Russian colonization and state formation, we make the acquaintance of Mongol marauders, greedy princes, and peasant rebels, as well as Ivan the Terrible, Peter the Great, and the long succession reformers and reactionaries who occupied the Russian throne. We explore the development of a working class, and the uprising of workers, peasants, and soldiers that ultimately brought down the Tsar.

79-281 Modern Soviet History: From Communism to Capitalism
Intermittent: 9 units
This course covers a broad sweep of Soviet history from the revolution in 1917 to the turmoil of the present. Spanning almost a century of upheaval and transformation, the course examines the October revolution, the ruthless power struggles of the 1920s, the triumph of Stalin, the costly industrialization and collectivization drives, the battle against fascism, and the present attempts to create a market economy. The course provides essential background for anyone interested in understanding the explosive, history-making events in the former Soviet Union.

79-282 The Soviet Union in World War II: Military, Political, and Social History
Intermittent: 9 units
On June 22, 1941, Hitler invaded the Soviet Union. German troops quickly reached the hills above Moscow, surrounded Leningrad in the longest running siege in modern history, devastated the country’s economy, and slaughtered millions of Soviet civilians. Eventually, the Red Army came back from defeat to free the occupied territories and drive Hitler’s army back to Berlin. This course examines why and how the war was fought. Using history, films, poetry, veterans accounts, documentaries, and journalism, it surveys the rise of fascism, the Stalinist purges of the Red Army, the Hitler-Stalin pact of 1939, the Nazi massacres of Soviet Jews, peasants, and partisans, life on the home front, and the great battles of the war.

79-283 East Asia and World War II
Intermittent: 9 units
This is a history of the experience of war in East Asia (1931-1945). The course explores the rise of Japan’s empire in the context of international security concerns, with a special focus on China and the fateful impact of invasion there. It examines the cultural settings of the Pacific War, the impact of the war on civilians, and the conduct of the war on the battlefield. It concludes by re-examining the continuing debate on the atomic bombing of two Japanese cities. We explore these topics through memoirs, contemporary accounts, cartoons, scholarly studies, and a wide range of films.

79-284 Gender Relations, the Family, and Women in Russian History: 1861 to Present
Intermittent: Mini Session - 6 units
Using film, novels, interviews, and historical sources, this mini course will explore the history of gender relations, the family, and women in Russia. Beginning in the late nineteenth century, we will explore family relations in both noble and peasant families, the laws governing marriage, divorce and children, restrictions on women’s movement and education, and gender roles. We will look at the explosive changes of the Russian revolution and the radical experiments with free love and communal childcare. We will trace the development of opportunities for women in the 1930s, the painful demographic impact of WWII, and the changing culture of the post war years. We will end by examining the difficulties that rural and urban families are currently facing in the transition to a market economy.

79-288 Bananas, Baseball, and Borders: Latin America and the US from Alamo to Drug Wars
Intermittent: 9 units
Consider this: The U.S. government maintains an economic embargo on Cuba even as Cuban musicians like the Buena Vista Social Club enjoy wild popularity in the United States. Former left-wing guerrillas in El Salvador resent the U.S. government for its past support of military dictators while they anxiously wait for money to be sent from their cousins who clean office buildings in Washington DC. North Americans donate money to protect tropical forests while they consume enormous quantities of bananas grown where rainforests once stood. This course will attempt to make sense of the tumultuous and paradoxical relationships between Latin America and the United States from the early 1800s to the present. The course will go beyond state-to-state diplomatic relations in order to explore the economic, social, and cultural dimensions of the often-intimate relationship between the two regions. Readings and other course materials will focus on U.S. encounters with Mexico, Central America, Cuba, and the Andean nations.

79-289 Society and Culture in South Asia
Intermittent: 9 units
This is a survey of performative and textual traditions in South Asia - from Sanskrit literature, to Mughal architecture, down to the contemporary “Bollywood” film. It aims at giving students an introduction to the rich ad complex textures of South Asian society, and the ways in which these cultural products reflect the political strategies and social interactions of different groups and regions within the subcontinent.

79-290 Between Revolutions: The Emergence of Modern Latin America, 1789-1917
Intermittent: 9 units
When the Haitian Revolution began in 1789, everything south of the newly created United States was under European colonial rule. In Latin America, slavery was an established institution, and the Catholic Church held considerable power over the daily lives of people. However, when the Mexican Revolution began in 1910, Spanish and Portuguese colonialism had collapsed along with slavery, and the power of the church had greatly diminished. New societal institutions emerged that reflected novel ideas about the role of secular nation-states, “free market” economies, and the meanings of “civilization.” This course will use scholarly writings, fiction, film, and video to analyze the profound changes that took place in Latin American society during and between these two important revolutions. We will pay attention to the lives of both elites as well as the “everyday” people who helped to shape the region’s history.

79-295 Germany and World War II
Intermittent: 9 units
This course examines the Second World War from the perspective of the country that was central to it in every way. The course will cover: Hitler’s ideology, war plans, and military strategy; the military/technological history of the War in Europe and North Africa; the role of the SS; the Holocaust; the occupation of Europe and Resistance movements; the political, social, and economic history of the Third Reich, including popular opinion, the German Resistance, and the use of slave labor in factories and on farms. Readings will include historical studies, a novel, and a memoir/diary. Students will watch a number of films about the War on Thursday evenings (along with students enrolled in The Soviet Union and the Second World War).

79-297 Freedom Bound: Slavery/Emancipation in Brazil & the Caribbean, 1789-1940
Intermittent: 9 units
Living in a society still struggling to come to grips with its own history of slavery, North Americans are often unaware of the central role that slavery played in shaping the histories of Brazil and many Caribbean societies, including Cuba, Haiti, and Jamaica. The first part of the course will focus on the African slave trade and slave life in both rural and urban areas. Our goal will be to appreciate the complexities of slave-holding societies without losing sight of the systematic and often brutal ways in which slave owners tried to maintain control over their “property.” The second part of the course will explore the processes by which slaves, acting individually and collectively, won their freedom. However, “freedom” presented ex-slaves and their descendents with a new set of challenges. The final part of the class will focus
on the struggles of ex-slaves to establish anew livelihoods and lay claim to the rights of citizenship in post-emancipation societies. We will explore these themes by drawing on scholarly writings, literature, historical documents, film and music.

79-301 Ritual, Culture, and Identity
Intermediate: 9 units
The study of religious rituals, and of related phenomena such as secular celebrations, political rites, and “social dramas,” has an important place in the disciplines of anthropology and history. As well-defined formal events that deploy culturally familiar symbols and transform social positions and identities, rituals have long been seen as a key to the relationship between ideas and action. Among the topics investigated in this course are the roles of ritualization as a source of power for the state and its enemies, as a way of establishing group identity and reframing memory, and as a means of coping with social change and subordination. We shall compare ritual and quasi-ritual idioms and solutions across cultures, under a variety of modern as well as “traditional” conditions.

79-303 Visual Anthropology
Intermediate: 9 units
The use of photography and film in anthropology raises important theoretical and methodological questions. Using ethnographic films and selected anthropological readings as our source material, we discuss issues like: the relationship between the “observer” and the “subject”; the influence of culture on styles of interpretation; the problems of representation. Developments in anthropology, as well as in film and photography, are also considered. Students are expected to think critically about anthropology, visual imagery, and more general issues of “studying culture.” Prerequisites: 79-201
Prerequisites: 79201

79-304 Government Response to Market Failures
Intermediate: 9 units
A leading rationale for government is to do things that private markets fail to do. National defense, the Clean Air Act, the Sherman Antitrust Act, the Pure Food and Drug Act, and the Social Security Act are government responses to five classic market failures. Sometimes government intervention can make things worse than the problem was originally, leading to unanticipated consequences and “government failure.” This course will be a research course in which students choose one of five classic market failures and investigate the processes that led to major legislation, and the consequences of such legislation.

79-305 Representing Pacific Cultures
Intermediate: 9 units
From “paradise” to “hula dancers,” from Captain Cook to nuclear testing, the Pacific Islands have been looked at in a variety of ways. The people of the Islands have responded with an equally diverse set of representations. Early explorers, sailors who jumped ship, painters, surfers, and tourists - all offer descriptions of the Pacific Islands in vivid language and colorful images. Pacific Islanders create their own representations, including pictures of the “strangers” who arrived first on ships and then on planes. We will compare the evolving, competing, and complementary representations of the Pacific over a period of two centuries, asking about the impact of “representation” on politics, imperialism, art, warfare, and scholarship. The course will concentrate on the cultures known as Polynesian, primarily but not exclusively Hawaii and Aotearoa/New Zealand. Materials include travel writings, literature, photography and film, anthropology, and history.

79-307 The Anthropology of Europe
Intermediate: 9 units
This course provides a broad introduction to anthropological perspectives on European cultures in order to address some of the most important issues that arise in the study of complex societies. Among the topics that will be considered are the common themes of European cultures and the shifting meanings that have been assigned to the concept of “Europe”; the variety and diversity of European experience; and the role of local, regional, class, and national forms of identity in shaping social life. Special attention will be given to the relations between Eastern and Western Europe, the causes and dynamics of contemporary ethnic conflicts, and the problems involved in creating a liberal and democratic European Union. In addition, we will consider what contribution the study of Europe has to make to the development of anthropology, a social science that has traditionally been oriented to the study of non-Western societies.

79-308 The Politics and Culture of Memory
Intermediate: 9 units
How do societies remember? Memory is social, rather than simply individual, in context. It is cultural, rather than purely psychological, in nature. Its significance is as political as it is personal. Traversing the globe and moving from the distant past to the immediate present, this course brings a comparative and anthropological perspective to the politics of cultural memory. It explains how the wide variety of sources through which memories are produced and conveyed from written histories to oral performances, from monuments and museums to film and photography. We will begin by surveying the different ways in which the study of memory evolved and will lead to the close study of how memory works in several non-Western societies. Then we will explore the role of memory in the making of nations and families, in the formation of class and gender identities, and in recollecting and responding to the violence of slavery, colonialism, and genocide. Finally, we will consider the place and politics of memory in the writing of history by professional historians.

Intermediate: 9 units
This course addresses two fundamental questions: Have the historical experiences of blacks, women and gays in the American military been essentially similar or different? How have American military, social, political, economic and cultural contexts affected the level of participation in the military by these groups?

79-310 Culture and Power in Europe, 1945-2000
Intermediate: 9 units
This course investigates the relationship between cultural meanings and structures of political and economic power in post World War II Europe. Drawing on the work of anthropologists, historians, and others, we will consider how symbolic constructions of persons, communities, and nations have shaped understandings of crucial events and broader sociopolitical processes. Among the topics we will consider are the Cold War, processes of decolonization, the collapse of state socialism in central and Eastern Europe, the development of the European Union, the impact of globalization, and increasing tensions between Europe and the United States.

79-314 Nationalities and the New States of the Former USSR
Intermediate: 9 units
Until its collapse in 1991, the Soviet Union was a world superpower incorporating within its borders the great landmass of Europe and Asia. When the Soviet Union’s empire dissolved in 1991, a new country emerged in its place: the Russian Federation. The end of the Soviet Union has left the world with 24 new states, each struggling to formulate its identity in the wake of the collapse in Eastern Europe. Russia has been the focal point of much attention in the wake of the dissolution of the Soviet Union, because it has the largest population, the most economic power, and the largest nuclear arsenal among the new states. The collapse of the Soviet Union has also had political, cultural, social, and economic consequences for the region, as well as for the rest of the world. In this course, we will examine the history of the Soviet Union from the perspective of an anthropologist. We will explore how the Soviet Union came to be, how it functioned, and how its collapse has affected the region and the world. We will examine the history of the Soviet Union from the perspective of an anthropologist. We will explore how the Soviet Union came to be, how it functioned, and how its collapse has affected the region and the world.

79-315 History, Memory, and Patriotism in America
Intermediate: 9 units
Although Alexis de Tocqueville claimed in the 1830s that Americans had no reverence for history, in fact we have always battled over how best to remember and commemorate the nation. Frederick Douglass caused a furor in 1852 when he declared that Independence Day was a mockery for African Americans; the 1995 controversy over the Smithsonian Institution’s Atomic Bomb exhibit underscored that the tensions between history, memory, and patriotism remain deeply political. This is a course about how Americans remember and reshape their collective past to serve their particular present.
Course Descriptions

79-316 America in the Age of Lincoln
Intermittent: 9 units
After 7:22 a.m. on April 15, 1865, Abraham Lincoln "belonged to the Ages." In the century since his assassination, Americans have fought bitterly about who he was and what he continues to mean to different segments of the nation. Honest Railsplitter or Slick Lawyer? Great Emancipator or racist opportunist? Savior of the Union or demagogic tyrant? Students analyze Lincoln's own views along with the ways he has been remembered and used by politicians, protesters, poets, advertisers, and Hollywood filmmakers.

79-317 Historical Memory and Historical Sources: Reconstructing Africa's Unwritten Past
Intermittent: 9 units
Historians of Africa, particularly of the pre-colonial period, inevitability face two key questions: How do we reconstruct the past without written sources? And, how do we interpret written sources to document development and change in Africa's past when the overwhelming majority of these sources were written by non-Africans? In this course, we will examine a variety of "non-traditional" historical sources which allow us direct access to "Africans' voices" such as historical linguistics, oral traditions, oral histories, and ethnographies. After studying the methodologies that historians use to interpret these non-traditional primary sources and studying examples of historians' interpretations of them, we will read examples of the primary sources themselves. This course is designed to give students new analytic tools with which they can look at all kinds of history.

79-318 World War II in Japanese Memory
Intermittent: Mini Session - 6 units
How do the Japanese remember their invasion of Manchuria: Rape of Nanjing; Pearl Harbor: Hiroshima and Nagasaki? How do survivors, ex-soldiers, political leaders, teachers, the media, and the postwar generation discuss and write about these events for which the world has blamed their nation? We will seek answers to these questions by studying Japanese wartime history and on theories of collective remembering.

79-324 Modern Painting
Intermittent: 9 units
Examines the birth of modern painting in its historical context. Through understanding the major styles and successive movements in the development of modern art, students explore the many relationships of artist and artwork with parallel works in other media such as literature, music and film, and with parallel trends in intellectual and social history.

79-325 Art and Religion
Intermittent: 9 units
The Art and Religion course will explore several major artistic manifestations prompted by religious beliefs during the history of art. Emphasis will be on the arts; however, general historical, eschatological, and philosophical explanations will be attempted. Major religions will be brought to discussion in one or several of their artistic manifestations.

79-329 Sex, Population, Birth Control
Intermittent: 9 units
This course will explore efforts to control reproduction in the United States in the 19th, 20th, and 21st centuries. Topics include: the changing status of birth control and abortion in the context of law, medicine, and public policy; the relationship between women's rights and reproductive rights; the eugenics movement and involuntary sterilization laws; the relationship between birth control and population control; the development and impact of new contraceptive technologies; infertility and the development and use of new reproductive technologies; changes in sexual attitudes and practices; and the impact of AIDS and other sexually transmitted diseases on sex and birth control.

79-330 The American Presidency
Intermittent: 9 units
The presidential election campaign offers a context for raising some important questions about the American Presidency as it has evolved over its two centuries of existence. Among them are; How has this kind of leader functioned in the kind of society the United States has become? What political and social roles have Presidents played? How much power, and what kind of power, have they had, and how did they get it, use it, and perhaps lose it? In producing Presidential effectiveness, how crucial have individual character and personality been?

79-331 Crime and Punishment in American History
Intermittent: 9 units
Crime and punishment are among the most important issues in contemporary America. This course offers an introduction to the historical study of crime in the United States and highlights both changes in criminal behavior and the different ways that Americans have sought to deter, punish, and rehabilitate. Primary topics include historical patterns of violence, the role and organization of the police, and the evolution of punishment in theory and practice. This course also emphasizes differences in crime and punishment by race, gender, and age.

79-332 Juvenile Delinquency:Images, Realities and Shaping of Public Policy1800-1960
Intermittent: 9 units
This course will examine juvenile delinquency in historical, sociocultural, and policy contexts during the past two centuries, and will focus mainly on the United States.

Three themes will be emphasized: 1) changing legislative, judicial, correctional, and therapeutic attempts to define, punish, and rehabilitate "delinquent" youth; 2) behavior patterns of youths labeled "delinquent," and how their behaviors changed over time; and 3), images of "delinquents" as portrayed in film, social science, scholarship, government reports, and newspapers.

The course will be run in a discussion format. It will meet three times a week, with a lengthy evening session devoted mainly to viewing and discussing films from the 1930s to 1960 (e.g., "Angels with Dirty Faces," "Blackboard Jungle"). Readings will be drawn from historical, sociological, psychological, literary, and journalistic accounts of juvenile delinquency.

79-333 History of Biomedical Research
Intermittent: 9 units
This course examines the development of biomedical research in the nineteenth and twentieth centuries, focusing primarily on the U.S., but also examining research and institutional models in Germany, France and England. Beginning with the work of Pasteur and ending with an examination of the research infrastructure supported by the National Institutes of Health in the late twentieth century, the course examines the following themes: the production of scientific knowledge as a social process; the building of a biomedical research infrastructure; the balance between scientific accountability and scientific independence of the research enterprise and relationships with research patrons such as government, industry and academia. In addition, the course examines the formation and reformation of biomedical disciplines and the building of the biomedical education infrastructure, with emphasis on pharmacology, physiology, immunology, neuroscience, and genetics.

79-335 Drug Use and Drug Policy
Intermittent: 9 units
This course examines the use of psychoactive drugs in American history, as well as medical, scientific, and policy responses to that use. Drugs we will consider include alcohol, heroin, marijuana, tobacco, and cocaine. We will examine changing theories of addiction, ethnographic studies of drug using groups and the cultural meanings of drug use. We will also consider drugs as commodities in international trafficking. Although the primary focus is on the U.S., we will look at policy approaches to drug use in other countries as well, to put American drug policy in a comparative perspective.
Epidemics of infectious disease are both biological and social events. Through the perspectives of the changing ecology of disease and social construction of disease, this course examines epidemics of such diseases as bubonic plague, cholera, smallpox, and AIDS. Besides considering the social factors that help determine the epidemiology of a particular outbreak of disease, the course analyzes human responses to epidemic disease. These responses include popular attitudes toward the disease and those who contract it, as well as public health measures intended to control spread of the disease.

This course explores critical issues in the history of the American environment during the last three centuries. Among the specific topics to be covered are changing attitudes toward nature; forms of rural environmentalism; the conservation and environmental politics of the 19th and 20th centuries. Among the specific topics to be covered are changing attitudes toward nature; forms of rural environmentalism; the conservation and environmental politics of the 19th and 20th centuries.

Educational policy is at the center of efforts to make our workplaces more competitive, our civic order more humane, and our schools more effective. Debates over educational policy have revealed the tension between public and private space, centralization and federalism, wealthy communities and poor. The special features of American educational policy and institutions are examined in the light of our historical experience and the institutional patterns and finances of other nations.

In this course, we will examine several themes in the history of American childhood and education in the 17th to 20th centuries, and link them to 1) broad social changes that transformed the experience of childhood and 2) key policy changes that sought to enhance the status and well-being of children. While schooling will be a central focus, we will also study the evolving educational roles of other institutions, e.g., families, churches, workplaces, peer groups. We will also try to shed historical light on several contemporary educational controversies, such as desegregation, bilingual education, homework, sex education, religion in the schools, textbook bias, and school vouchers. Readings will include both primary historical documents and scholarly books and articles. Three exams will be required, and students will be evaluated for the leadership they demonstrate in class presentations and discussions.

Broadly conceived, this course examines the role of war in society and history. Central themes include the relationship of war to the state and its financial and managerial resources, to military technology, and to technological change in the means of production. Equally central are military leadership and the will to combat, both military and civilian. After an introduction to pre-modern warfare and to the initial development of modern armies in the 16th and 17th centuries, interest focuses on the major conflicts in the 19th and 20th centuries, including the Napoleonic Wars, American Civil War and the two World Wars.

This course will examine the Cold War as a political, ideological, technological, economic, and military contest on global scale. It will give special attention to the American role and experience. We will investigate how the Cold War started and why, how it was waged and by whom, why it lasted as long as it did, and finally how it came to an end and what the end of the Cold War suggests about its course and nature. Along the way, we will also discuss how Cold War legacies continue to shape our world.

This course explores critical issues in the history of the American environment during the last three centuries. Among the specific topics to be covered are changing attitudes toward nature; forms of rural and urban development and environmental effects; the impacts of technology and industrialism; the conservation and environmental movements; and environmental problems and prospects today.

Value is a universal human concern, one that is as much spiritual and aesthetic as it is material. However, objects of value are produced, exchanged, circulated, consumed and understood in profoundly different ways. This course is an introduction to the anthropological study of objects of value in a variety of cultural and historical contexts. We will begin by considering how anthropologists have understood the exchange of objects as gifts, both in societies in which the exchange of objects as commodities is non-existent or rare, and in societies in which gift exchanges persist alongside or even within a commercial economy. Then, after considering the forms of barter and exchange that occurred during European expansion, conquest and colonization, we will explore commodity exchange, commodity fetishism, and money, in both Western and non-Western contexts. Finally, we will consider how anthropologists have explored the contemporary politics of value, addressing such issues as: globalization; migration and the "dollarization" of economies in Latin America and Eastern Europe; local, national and global political and economic crisis; and the emergence of new kinds of commodities and money, such as the Euro.

This class is concerned with the long history of negotiating episodes designed to diplomatically resolve the Arab-Israeli conflict. Most of those efforts failed; there have been several apparent successes. Weekly case studies will focus on the contemporary peace process, 1977 through the present. Each case study concentrates on a different negotiating episode, and is accompanied by a selection of primary source documents. By examining the two together we shall explore patterns of Arab-Israeli negotiating behaviors and consider what conditions are required to bring peace to the Middle East.

This course has three major dimensions. Assumptions and propositions of the leading theories of international relations will be reviewed. This course also seeks to ensure that students clearly understand how newer theoretical approaches to the study of international relations build upon or depart from classical theories. Finally, theories will be tested against the historical record by examining major policy decisions and events such as the Cuban missile crisis, the Vietnam War, the Soviet invasion of Afghanistan, the Persian Gulf War, and the current war against global terror.

This course is based on use of historical documents and films to study problems which reshaped the world during and after the Cold War. We will examine how documentary and feature films depicted the most important events of the Cold War, such as the Korean War, the construction of the Berlin Wall, the Cuban missile crisis, and others. In addition to films, sources will include documents, lectures and readings.

This course focuses on the Arab-Israeli and Palestinian-Israeli conflicts, beginning with a historical overview and continuing on through current events. Emphasis is on primary source documents which are the milestones by which the direction of the conflicts and attempts to resolve them can be charted. Readings and discussion progress with a dual goal: to understand both the historical origins and contemporary parameters of the conflicts, and to consider the processes by which the conflicts may be moving toward resolution.
the possibilities for socialist democracy. He sent millions of people to slave labor camps, and when he died, thousands wept at his funeral. This course will combine elements of biography and social history to examine Stalin, the man, and Stalinism, the phenomenon.

79-355 The American Skyscraper: Its History and Development
Intermittent: Mini Session - 6 units
Returning to America in 1904, the novelist Henry James complained that “monsters of greed” had transformed the New York of his youth into “a huge jagged city.” During his absence, the city had developed on a massive scale, both commercially and commercially, and was beginning—not without opposition—to dominate the country’s urban skylines. Focusing on such major monuments as Adler and Sullivan’s Wainwright Building (1891), Williams Van Alen’s Chrysler Building (1930), and Mies van der Rohe’s Seagram Building (1958), this course will trace the development of America’s greatest contribution to the Western cityscape from the first “elevator buildings” of the 1870s, through the Art Deco towers of the 1920s and the gleaming glass monoliths that proliferated after World War II, to the Postmodern skyscraper of today.

79-356 Introduction to African History: Earliest Times to the Origins of the Slave Trade
Intermittent: 9 units
A beginning point for this course will be the question: how do historians reconstruct history when few written sources are available? Breaking disciplinary boundaries, the course will draw on linguistics, “climateology,” archaeology, and anthropology to reconstruct dynamic social, cultural, political, and economic processes in Africa before the arrival of Europeans and before the availability of written source materials. When written sources are available, the course will interrogate them to illuminate the changes that occurred in African societies during the early period of contact with Europeans. Lastly, by focusing on long-term processes, such as economic specialization, urbanization, and Islamization, the course will begin to put the slave trade in an African-centered perspective.

79-357 Russia Today
Intermittent: 9 units
The breakup of the Soviet Union obviously begins a new period in the history of Eastern Europe and Central Asia. Nevertheless, many older patterns are emerging anew in the wake of this new era. This course examines the causes of the Soviet breakup, its impact on the various political and cultural groups that comprised the USSR, and the prospects for the future of the former Soviet Union.

79-358 Complex Technological Systems: Past, Present and Future
Intermittent: 9 units
The Internet is one of the latest examples of a complex technological system that fundamentally alters the way that we act and think about our world. During the last two centuries such complex technological systems have emerged, ranging from transportation systems such as the railroad and mass-produces automobiles running on roads and streets. To networked information systems, including the telegraph, the telephone, and radio and television. What are the common features of these complex technological systems? When do they emerge? How far reaching are their consequences in society, business, and in other complex technological systems? Can they be predicted? Can they be controlled? Can such complex technological systems be fully comprehended and modeled? These are but some of the questions this lecture and discussion course will tackle using cases from the past, the present, and the future.

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79-359 History of African-American Families
Intermittent: 9 units
This course traces the development of family life, meanings, values, and institutions from the period of slavery up to recent times. The course engages long-standing and current debates about black families in the scholarship across disciplines (i.e. anthropology, sociology, and economics) and in the society at large. Course materials include secondary readings, primary sources, and films. The course will look at the diversity of black family arrangements and the way these have changed over time and adapted to internal and external challenges and demands. It will also situate the history of black families within a broader cross-cultural context.

79-363 American Golf: Aristocratic Pastime or the People's Game?
Intermittent: 9 units
This course will involve a whole-class effort to invent the study of golf as a legitimate academic subject. Our main perspectives will be historical and comparative, but we will situate the study of golf within the growing sociological literature on sport in American society. We will also examine representations of golf in literature, film, journalism, and computer software and evaluate a variety of current public policy debates about golf. In addition to assigned readings, students will undertake a small-scale historical research project that utilizes archival or other primary sources. (Expertise in playing golf is not a course requirement, of courses, but some familiarity with how the game is played is advisable.)

79-364 Art, Anthropology, and Empire
Intermittent: 9 units
This seminar will explore the anthropology and history of aesthetic objects, as they travel from places considered "primitive" or "exotic," to others deemed "civilized" or "Western." First, we will consider nineteenth-century anthropological attempts to develop ways of appreciating and understanding objects from other cultures, and in the process to reconsider the meaning of such terms as "art" and "aesthetics." Then we will discuss several topics in the history of empire and the "exotic" arts, including: the conquest, colonization and appropriation of indigenous objects; the politics of display at world's fairs; the processes by which locally-produced art objects are transformed into commodities traded in international art markets; the effects of "exotic" art on such aesthetic movements as surrealism, etc.; and the appropriation of indigenous aesthetic styles by "Western" artists. Finally, we will consider attempts by formerly colonized populations to reclaim objects from museums, and to organize new museums, aesthetic styles, and forms of artistic production that challenge imperialism's persistent legacies.

79-368 Poverty, Charity, and Welfare
Intermittent: Mini Session - 6 units
This course explores continuities and changes in ways that people have thought about and acted upon the problems of human poverty. Although the major focus will be on Western (Europe and the United States) traditions, students will have the opportunity to explore other societies and cultures. We discuss ways that poverty was conceived of and treated in medieval society; transformations in these views under the impacts of the Protestant and Catholic Reformations; and the development of modern welfare policy. We ask such questions as: what have been the major schools of thought on the causes of poverty? How have organized programs for the poor developed in the West and other cultures? What have been the main differences between religiously inspired and secular programs of aid to the poor? What accounts for the growth of "welfare states" in the twentieth century? Coursework includes readings, lecture and discussions, quizzes, and a research paper.

79-369 The World of Andrew Carnegie
Intermittent: Mini Session - 6 units
Carnegie Mellon University’s founder Andrew Carnegie was both shaped by and shaped the world in which he lived. This mini provides students with an opportunity to explore Carnegie’s world through biography. We read the critical biography by Joseph Wall, Andrew Carnegie, as a central text and focus on the following specific themes in Carnegie’s life and times, looking at their typicity or uniqueness to Carnegie’s personal experience: 1. the British industrial revolution and the skilled textile trades; 2. antebellum emigration in the U.S.; and the immigrant experience in the Pittsburgh region; 3. industrialization in the United States; 4. the rise of big business in the United States; 5. American labor history; and 6. the development of American philanthropy.
Course Descriptions

79-374 Women in Modern India
Intermittent: 9 units
Does the image of Indian women as helpless victims of patriarchal domination accurately reflect their lives? Or are they active in negotiating with, and even challenging gender, caste, racial and class oppressions? How far do the main issues in their lives relate to women from other times and places? One of the main themes underlying this course is the diverse ways in which we need to locate women's agency when, for most of history, women had very little voice. Another is to examine critically how the 'making' of "Modern" India, first under the auspices of a colonial state and then through a post-colonial regime, has been intimately connected to and shaped by the ideologies around gender. We will read a wide variety of texts: autobiographies, memoirs, pioneering feminist tracts, films and the products of women's 'labor', in order to 'recast' Indian women. The course will start with a set of lectures and will then be organized on a discussion basis. Students will be expected to write short papers, participate in quizzes and discussions, and to do a set of class presentations.

79-376 Making of the Modern Family
Intermittent: 9 units
This course examines continuities and changes in the family in western Europe from the medieval period through the late 19th century. Organizing themes include: the impact of the Industrial Revolution on family organization; changes in interpersonal relations within the family over time; and differences among the family patterns of diverse social classes. The family is also viewed as a unit of socialization and of social control. The approach of the course is interdisciplinary, drawing on the research of historians, anthropologists, and sociologists.

79-379 Women in American History
Intermittent: 9 units
This course explores the history of women in the United States since the mid-eighteenth century. We will examine the experiences that American women shared as they attempted to establish public and political power in changing historical circumstances. Our discussions will include the experiences of minority women and women of color as well as women from different classes and regions.

79-380 U.S.-Japanese Relations: 1853 to Present
Intermittent: Mini Session - 6 units
This mini-course will survey the partnership and/or discord which has characterized 150 years of foreign relations between the U.S. and Japan. Large themes will include race relations, military conflict, economic tensions, and international partnerships. Major topics will include treaty relations before World War II, causes and outcomes of the war in the Pacific, the U.S. Occupation after World War II, relations during the Cold War, and the U.S. and Japan's conflicting forms of capitalism. Finally we will place U.S. and Japan foreign relations in the context of the post Cold War World and suggest some predictions for the future.

79-382 African-American Women in U.S. History
Intermittent: 9 units
This is an upper-level undergraduate course that focuses on African-American women's history from the era of slavery to the present. It will address broad themes such as labor, family, community, sexuality, religion, and popular culture. The course will examine the social, political, and economic diversity of the experiences of black women within the broader context of U.S. history. The course will enhance skills that are essential to studies in the humanities: critical thinking, writing, and oral communication. Course materials include primary and secondary sources, visual images, and films.

79-384 Medicine and Society
Intermittent: 9 units
This course focuses on the relationship between medicine and society in the modern world. The emphasis is on understanding medicine and medical care as "a complex social process, embedded in the cultural matrix and laden with values." In particular, readings and classes stress the new perspectives that have reoriented the study of "medical history" in the last decades: the emphasis on the patient rather than the doctor; on the enmeshment of medicine in broader historical webs of meaning; the influence of other disciplines, such as anthropology and medical sociology on the history of medicine; the existence of a wide range of practitioners ("fringe," "popular," "quacks," "alternatives"); and finally, the importance of class, race, and gender as categories of historical analysis and as determinants of medical care.

79-386 The Global Environment: Historical Perspectives and Policy Dilemmas
Intermittent: 9 units
This course focuses on understanding the relationship between social and environmental factors. We will examine case studies from India, Latin America, and Sub-Saharan Africa. We will adopt a perspective that incorporates history, anthropology, ecology, and geography in order to explore how agriculture, energy production, mining, industry, and human migrations have altered landscapes and livelihoods. Each unit will include a discussion of contemporary policy debates about the nature of the problems and potential solutions. Course materials will include readings, videos, and fieldtrips. Participants will be required to keep weekly journals, write two papers, complete a policy action project, and contribute regularly to class discussions.

79-387 Shaping Modernity's Landscapes: An Environmental History of the Americas
Intermittent: 9 units
This course explores the history of the environment in Latin America from the colonial period to the present. Through readings, discussions, lectures, films, and field trips, it challenges students to question their assumptions about "nature" and "wilderness" in order to conceptualize historical environments as dynamic places shaped by the entanglement of biological and cultural processes. Historical case studies will be linked to contemporary policy debates over environmental problems and their potential resolutions. Throughout the term, we will strive to understand how environments shape and are shaped by the power of states, systems of production, commodity markets, and changing meanings of nature. Course material will be both historical and contemporary. This course will be run in a seminar format; I will lecture on occasion, but most sessions will include discussion.

79-388 Sociology of Religion
Intermittent: 9 units
Sociologists who study religion are interested in what social structures have evolved as people gather to express their religious beliefs; social structures both within religious organizations and in the larger culture. In this course we will read and discuss a variety of views on the sociology of religion, from early sociologists through present day studies that include the rise of orthodoxy (in a number of religions) and issues of gender, race, and class.

79-390 History of Immigration
Intermittent: 9 units
Immigration has been a major transforming force in American history, and there have always been and continue to be debates about both the benefits and the costs. This course traces the history of immigration to the United States, and how scholars who study immigration have constructed and reconstructed their thinking over the course of time. We examine how historical, social, political, and economic factors have both affected and been affected by immigration, and we consider current debates and concerns around a number of issues tied to immigration.

79-392 The Family: Historical, Sociological, and Economic Perspectives
Intermittent: 9 units
This course will explore the family from historical, sociological, and economic perspectives. We will pay particular attention to how financial support of the family has changed over time and how this activity contributes to the negotiation of roles and the construction of gender boundaries within the family. How a couple negotiates their resources-both productive (activities which bring
79-393  Sport in American History  Intermittent:  9 units  
This course provides an introduction to the history and sociology of sport in American society from the early nineteenth century to the present. We will examine a variety of sports groups which fought to gain legitimacy both as professions and as businesses, and discuss how the purpose of sports shifted from amateur play to professional activity. Central themes of the course will address issues of race, class, gender, sexuality, and governance. Sources included historical works, literary texts, and video presentations.

79-395  The Arts in Pittsburgh  Intermittent:  9 units  
This course will examine the arts in Pittsburgh, both historically and in the present. We will focus especially on art exhibits and musical events scheduled by the city's museums and concert halls during the semester. The "curriculum" will derive from the artistic presentations themselves, which will provide a springboard for reading assignments, seminar discussions, and research papers in the history of music and art. We will also examine the historical development of cultural institutions in Pittsburgh. The History Department will pay for students' admission to all museums and studios. However, students will be charged a supplemental fee of $100 to help subsidize the considerable expense of purchasing tickets for concerts and performances by the Pittsburgh Symphony, Pittsburgh Opera, Chamber Music Society, and Renaissance and Baroque Society. Attendance at all art exhibits and musical events is required. Prerequisite: Availability to attend art exhibits on several Friday and Saturday afternoons, and to attend musical events on several Monday and Friday evenings.

79-396  Music and Society in 19th/20th Century Europe and the U.S.  Intermittent:  9 units  
This course will explore the interrelations between society and classical and popular music in the nineteenth and twentieth centuries in Europe and the United States. We will examine the importance of different musical forms in the life of society and how music contributed to the making of political consciousness, especially in the twentieth century. In addition to reading assignments, seminar discussions, and research papers in the history of music, students will be taken to the performances of the Pittsburgh Symphony, Pittsburgh Opera, and Chamber Music Society. A supplemental fee of $100 will be charged to subsidize part of the considerable expense of purchasing tickets for concerts and performances. Prerequisites: Availability to attend musical events on several Monday, Friday, and Saturday evenings.

79-397  Religion and Politics in the Middle East  Intermittent:  9 units  
This course considers the nexus between government and religion in Islam, Judaism, and Christianity and the historic relationship among these three religions in the political realm. We will study the influence of religion on both domestic and foreign policy in selected Middle Eastern countries, the role of religion in fueling conflicts, the phenomenon of religious fundamentalism, the consequences for women and the implications for US policy towards the region. The course is designed for upper level students and is an accelerated version of the similarly titled freshman seminar. No prior background knowledge of religious or Middle East studies is required. Previous freshman seminar (79-152) students are ineligible.

79-400  Advanced Studies in Anthropology and History  Fall:  12 units  
More than a simple blending of fields, the joining of anthropology and history has engendered intellectual innovations in both disciplines. To better appreciate what the practitioners of these disciplines have to learn from each other, the first part of this course normally focuses on a key topic or theme (such as religion and politics, gender and the family, colonialism, or nationalism) and examines key historical and anthropological work on this subject matter. During the second part of this course, students will develop independent research projects related to the seminar's key theme in a way that enables them to bring the perspectives and methods of both disciplines to bear on a problem that is of special interest to them. Research may be based on deep reading in the literature on a topic, on ethnographic fieldwork, on archival investigation, or on a combination of these. By undertaking this work, students will gain a better grasp of how new knowledge is created and what transdisciplinary approaches have to contribute to understanding the world in which we live. Prerequisites: 79-200; 79-201; 79-209

79-409  History and Policy Project Course  Intermittent Mini Session - 6 units  
Majors in History and Policy are required to take the History and Policy Project Course Mini in the spring semester of their junior year; no other students are eligible for this course. Students read background material relevant to the project to be undertaken in the fall, identify relevant archival materials, and refine the research questions, and make preliminary research plans. Prerequisites: 79-200; 79-202; 79-208

79-410  History and Policy Project Course  Fall:  12 units  
The History and Policy Project Course is required for the History and Policy major and is taken in the fall semester of the senior year. The History and Policy majors carry out a collaborative research project which examines a compelling current policy issue which can be illuminated with historical research and analysis. Based on archival research and on contemporary policy analysis, the students develop an original research report and presentation for a client organization in the community. Prerequisites: 79-200, 79-202, 79-208, 79-409

79-412  History and Policy Research Seminar  Intermittent:  9 units  
Participants will produce individual research papers focused on the historical dimensions of a contemporary policy issue.

79-420  Advanced Studies in Social and Cultural History  Fall:  12 units  
This course will focus on a theme, concept, or category that has been central to the historical investigation of society and culture in a variety of places and times. Colloquium topics may include social groups and classes (peasants, workers), social institutions (family, state), socio-cultural identities (ethnographic research on cultural identities (nationalism), or socio-economic development (agriculture, industrialization). Examining its chosen theme from a variety of angles, the course will consider how historians of different regions have applied key theoretical approaches and definitions. Students will also engage in an independent research project on the course topic. This course is designed for advanced history majors. Prerequisites: 79-200

79-421  Social and Cultural History Research Seminar  Intermittent:  9 units  
This is a small seminar course focused on advanced readings in social history, particularly from a comparative perspective.

79-440  The Rise of Industrial Research and Development  Intermittent:  9 units  
The electric light, nylon, the atomic bomb, the transistor and integrated circuits, Post-it notes, Teflon, Silly Putty, and biopharmaceuticals are all products that emerged from organized
research and development (R&D) programs. What factors caused modern R&D? When and why did industrial R&D laboratories appear in the United States and other industrialized nations? Did their creation change the character of science, technology, and business? How has the institutionalization of R&D affected the work of the individual inventor and scientist? Does big business now dominate R&D in the United States, or does the little guy still play an important role in technological innovation? What are the unique characteristics of the different types of R&D organizations? What are the future of industrial R&D in the 21st century? These are some of the questions explored in this seminar, which is open to students from all colleges.

79-441 Science, Technology, and Business in U.S. History
Intermittent: 9 units
This reading seminar focuses on the history of science, technology, and business in U.S. history from the American Revolution to the present past. Although the course follows a rough chronology, it treats in depth several major topic and themes that are well developed in the historical literature.

79-491 Independent Study
All Semesters: 3-15 units
An Independent Study is meant for students with a special interest in an area not covered by a formal history course. Readings and other work are negotiated between the student and an individual faculty member.

79-505 Undergraduate Internship
All Semesters: 3-9 units
Interns may be placed in relevant off-campus positions where they are evaluated by both an on-the-job supervisor and the department Internship Director. Permission of the department’s Internship Director is required.

Philosophy
Undergraduate Courses

80-100 What Philosophy Is
All Semesters: 9 units
In this introductory course we will explore three major areas of Philosophy: Ethics, Metaphysics, and Epistemology. The course is divided into three sections. In each section we will read primary sources and discuss some of the main philosophic problems associated with that area. These will include: moral problems (Ethics), problems arising from the debates about free-will, personal identity (Metaphysics), and the epistemological question of how we can be sure about what we know (Epistemology). We will then introduce some theories designed to solve such problems, and try to understand the strengths and weaknesses of these theories. We will apply different techniques and theories to issues that we might encounter in the real world. We will use class discussion, homework, and papers to learn different methods of doing philosophy. These skills include: how to present a philosophical argument, what are the assumptions that justify it, what are its weaknesses and its strengths, whether such weaknesses can be resolved and, if they cannot be resolved, why.

80-102 Honors Program in What is Philosophy
Fall and Spring: Mini Session - 3 units
This three credits extension of 80-100 is open to Freshmen and Sophomores by invitation of their instructor only. The seminar meetings examine interesting puzzles and open controversies concerning topics raised in 80-100

80-104 Freshman Seminar: Mysticism
Fall: 9 units
Mysticism begins with the practice of meditation, which involves concentrated inattention to sensory distractions. Expert mystic practitioners have reported an unshakable and joyous conviction that reality is more interconnected than it seems at the everyday sensory level. Mystical philosophy grapples with the significance and interpretation of such reports and on what they tell us about the elusive line between reality and illusion. The aim of this Freshman Seminar is to provide an introduction to a range of mystical traditions drawn from different cultures and historical periods and to examine their relationships to philosophy. The course will focus in particular on the historical interplay between Hindu and Buddhist philosophy, with special attention to the latter.

80-105 Freshman Seminar: The History of Arab-Israeli Relations
Spring: 9 units
This three credits extension of 80-100 is open to Freshmen and Sophomores by invitation of their instructor only. The seminar meetings examine interesting puzzles and open controversies concerning topics raised in 80-100

80-106 Freshman Seminar: The Philosophy of Matrix
Fall: 9 units
Trinity says it's the questions that drive us; and she's right. The Matrix is filled with questions that have been wrestling for more than two thousand years. Who am I? What can I know? What should I do? What is the world really like? What is real? What is the mind, and can a computer have one? What is freedom, and do we have it? In this course, the film will serve as a starting point for explorations of the historical and contemporary philosophical answers to these questions.

80-108 Freshman Seminar: Politics and the Media
Spring: 9 units
Politics, the Media, and the Truth This course will explore how mainstream newspapers and television cover the events, political candidates, and policy issues that define the democratic process. It will detail, with a number of case studies from the last several years, the astonishing and ever-growing gap between what is real and what is reported. It will examine the fallacies of reasoning that are routine, and the profound effect such fallacies have on the society we inhabit.

80-110 Nature of Mathematical Reasoning
Spring: 9 units
This course focuses on understanding mathematical reasoning reflectively, not on mastering a particular mathematical theory like elementary algebra or calculus. It explores instances of mathematical reasoning and rigorous argumentation, with examples from the history of science and mathematics. We consider the “Let’s Make a Deal” puzzle, the counter-intuitive results of HIV testing, and how to assess the relative size of infinite sets, all problems which defy intuitive solution but which look simple after they are put in mathematical form. The course is designed for students at the freshman and sophomore levels who are not interested in a mathematically intense major.

80-120 Reflections on Science
Fall: 9 units
According to a common view of science, knowledge accumulates under the guidance of an agreed-upon “scientific method.” According to an alternative model, science is sometimes subject to revolutionary changes in which the rules of the game and what counts as relevant evidence change along with our scientific theories. This course focuses on alleged episodes of revolutionary scientific change. We begin with the Copernican revolution of the 17th century. In light of this example, we will study Thomas Kuhn’s celebrated work The Structure of Scientific Revolutions. Using Kuhn’s account as a guide, we will consider other, allegedly revolutionary episodes, including the Darwinian revolution and the alleged chaos revolution in the 1970s.

80-130 Introduction to Ethics
Spring: 9 units
This course provides both a historic and thematic survey of western ethical theory. Key figures such as Aristotle, Hobbes, Kant, Mill, and Nietzsche will be presented as background to the
thematic problems of relativism, egoism, and other concepts in ethical theory. Students will take part in the creative process of developing skills necessary to engage in reflective moral reasoning. This process will culminate in the use of interactive multimedia modules simulating real world scenarios involving difficult moral choices. Participating in a class ethics committee will provide students with opportunities for personal reflection on the ways moral reasoning can be used to expand our understanding of hard choices and moral dilemmas.

80-135 Introduction to Political Philosophy
Fall: 9 units
We will seek to trace out the historical and philosophical dimensions of the State from its origins in Ancient Greece to its current manifestation in modern society. Philosophical writings and thinkers to be considered include Plato, Aristotle, Cicero, Machiavelli, Hobbes, Rousseau, Locke, Marx, and Dewey. Contemporary discussions of political theory may include the analysis and critique of utilitarianism, liberalism, libertarianism, Communitarianism, and feminism.

80-136 Social Structure, Public Policy & Ethical Dilemmas
Fall: 9 units
Theme: Family Life and the State. All States regulate their constituent families to some extent, but the proper relationship between the state and the family has been hotly debated for millennia. In this course we will consider a variety of issues in which the interests of the state may possibly clash with the wishes and liberties of families. Our discussion will be motivated by readings from several intellectual traditions, including philosophy and sociology. Topics for discussion may include, but need not be limited to: (a) The regulation of marriage., (b) Government standards of and support for the education of children., (c) Government intervention in the promulgation of arts and literature., and (d) Abortion rights.

80-150 Nature of Reason
Fall: 9 units
This course offers an intellectual history of philosophical views regarding the nature of human reasoning in mathematics and the sciences, from ancient to modern times. The first part of the course traces the search for deductive methods for obtaining certain knowledge, starting with Aristotle and Euclid, and continuing through the Middle Ages and late Renaissance thought, to the work of Boole and Frege in the nineteenth century. The second part of the course considers the history of skepticism about empirical knowledge, covering Plato, Sextus Empiricus, Descartes, Pascal, and Hume, along with replies to skepticism in the works of Bayes and Kant. The third part of the course discusses theories of the nature of mind, culminating in the computational conception of mind that underlies contemporary cognitive science.

80-151 God in the West
Fall: 9 units
This course surveys the rise of Christianity from pagan and Jewish sources, the rise of Islam, the fragmentation of the two religious movements, and their confrontation over a millennium and a half. The course will focus on several questions and themes: Why and how did Christianity succeed in converting the Roman Empire? Why and how did Islam succeed in converting more than a billion people? How did doctrine and practice become transformed by institutionalization and circumstance? How and why did the two movements respectively fragment? How and why did secularization occur? What is “fundamentalism” and why does it endure? Ethical and doctrinal issues will also be considered, in some cases at length.

80-180 The Nature of Language
Fall and Spring: 9 units
Linguistics is the scientific study of human language. It comprises many sub-fields, in which the different aspects of language are investigated. The topics studied in linguistics range from the mechanisms of human speech production to the nature of linguistic meaning, from historical relations among languages to current linguistic change, from writing systems to abstract linguistic structure. This course will provide a broad introduction to the field of linguistics, surveying a number of the major sub-fields. The focus of the course is not on describing or analyzing one particular language, but on understanding the properties and nature of language as a human phenomenon.

80-181 Language and Thought
Fall and Spring: 9 units
The course addresses issues relating to the connections between thought and language, particularly the ways in which we express thoughts and attitudes through language. Is language necessary for thought? What are the referents of linguistic expressions: cognitive or mental entities of some sort, or things out there in the world? Does the meaning of sentences come before their truth conditions, or the truth conditions of an expression are sufficient to determine its meaning? What kind of knowledge makes it possible for speakers of a language to communicate with one another? Is the meaning of expressions determined by norms and social conventions? What is a metaphor? What exactly serves as the context of an utterance in discourse? Do speakers of different languages perceive the world differently because of their language differences? The first part of the course addresses classical philosophical issues concerning the relation of truth and meaning, as well as issues related to the meaning of verbs of propositional attitude and pragmatics. The second part of the course focuses on more recent proposals in cognitive semantics, particularly theories that utilize conceptual spaces as the main framework to represent semantic information. We will also consider ‘hybrid’ theories that describe the form-meaning relation as an idealized account of the process whereby the recipient of an utterance comes to grasp the thoughts that the utterance contains. A basic course in logic is recommended but not required.

80-195 Research Training
Fall and Spring: 9 units
This course is part of a set of 100-level courses offered by H&SS departments as independent studies for students in the College. In general, these courses are designed to give students some real research experience through work on a faculty project or lab in ways that might stimulate and nurture subsequent interest in research participation. Faculty and students devise a personal and regularized meeting and task schedule. Each Research Training course is worth 9 units, which generally means a minimum for students of about 9 work-hours per week. These courses are not applied toward a college or major requirement, although the units do count toward graduation as elective units. Additional details (including a roster and descriptions of Research Training Courses available in any given semester) are available in the H&SS Academic Advisory Center. For H&SS students only; only for second-semester freshmen, or first- or second-semester sophomores; minimum cumulative GPA of 3.0 (at the time of registration) required for approved entry; additional prerequisites (e.g., language proficiency) may arise out of the particular demands of the research project in question.

80-201 Epistemology
Fall: 9 units
Epistemology, one of the cornerstones of philosophy since ancient times, concerns the relationships between belief, truth, and knowledge. This course will explore fundamental issues in epistemology, such as the analysis of the concept of knowledge, epistemic justification and scientific method, a priori knowledge, theories of truth, skepticism, reliability, and coherence. Both classic texts and contemporary journal articles will be discussed. There are no prerequisites, but students with some philosophical sophistication and/or formal ability will be more comfortable with the material.

80-210 Logic and Proofs
All Semesters: 9 units
This novel web-based course introduces students to central issues in logic and develops their ability for constructing and refuting arguments. It addresses the question: How can one
analyze the structure of rational discourse or, more specifically, the logical structure of argumentation? An answer to this question requires: (i) uncovering the logical form of statements; (ii) defining the correctness of logical steps; (iii) formulating correct inference rules for the logical forms; (iv) designing strategies for argumentation with the inference rules. The course takes these steps for both sentential and quantificational logic. Presentation: The material is presented on-line, though some exercises must be done with pen and paper. Additional reading of a historical character will complement the systematic on-line presentation. Weekly small discussion meetings with collaborative reviews, substantive discussions and critical reflections supplement the on-line presentation.

80-211 Arguments and Inquiry
Fall: 9 units
Since ancient times, mathematical arguments have been viewed as paradigms of rational reasoning. The goal of this course is to examine the features of mathematical reasoning that give it this distinctive character and to allow it to be systematically organized through the axiomatic method. Topics include propositional and predicate logic, and their semantics; formal deduction; axioms for arithmetic and set theory; and formal models of computation.

80-212 Philosophical Analysis and Logic
Spring: 9 units
The notion of rational inquiry presupposes that there are appropriate methods to be used in the pursuit of knowledge. In this course, we will try to understand the means by which a successful argument justifies its conclusion, as well as various subtle ways in which arguments fail. Topics include Aristotle’s theory of the syllogism; the propositional logic of Leibniz and Boole; Frege’s relational and quantificational reasoning; natural deduction; paradoxes; fallacies; and (possibly) inductive reasoning.

80-220 Philosophy of Science
Fall: 9 units
In this course, we will examine some historical case studies (e.g., the Copernican revolution in astronomy) against which we will assess views pertaining to the significance, justification, and production of scientific knowledge. For example, should scientific theories be understood literally or as computational devices for deriving new predictions? Does explanation contribute to a theory’s confirmation by the evidence? Does causation exist in the world or is it nothing but the explanatory structure of the best scientific theory? Does science aim to find the truth? Is probability in the world or only in our minds? Does probability have anything to do with scientific justification? Is scientific rationality objective or culture-relative?

80-221 Philosophy of Social Science
Fall: 9 units
Can we use the scientific method to understand social phenomena like war and religion in the same way that we use it to understand natural phenomena like microchips. For example, humans possess free will and act with intentions while light rays do not; does this mean we must use different species of explanations in the two cases? Do simple social ‘laws’ exist which explain basic social norms like cooperation? Do social norms evolve in the same way as do biological species? Is our understanding of social phenomena always value laden?

80-222 Measurement and Methodology
Spring: 9 units
This course is intended as an introduction to the theory of measurement. How are scientific units chosen? Under what conditions do qualitative relationships determine quantitative ones? Why, for example, is the zero-point a conventional choice for measuring temperature, but not so for the measurement of length with rulers? We shall investigate theories of extensive measurement, with and without error. Applications will be taken from the natural and social sciences, including the development of some ‘psychometric’ scales, such as measuring the intensity of personal preferences.

80-230 Ethical Theory
Spring: 9 units
Every day, often in very subtle ways, we make judgments of value that shape our lives and our conduct. This course provides a systematic examination of foundational concepts in ethics and the comprehensive theories that explain their importance and their relationship to one another. We will therefore examine alternative treatments of concepts such as welfare and happiness, basic moral rights, and different moral virtues. We will also analyze the role of these concepts in different foundational moral theories such as utilitarian approaches, Kantian theories, Aristotelian ethics, contractarian moral theories, and possibly others as well. Primary readings will focus on source texts by Aristotle, Hobbes, Kant, and Mill along with secondary readings from more contemporary sources. Particular attention will be paid to locating specific areas of disagreement that distinguish competing moral theories so that we can evaluate them on a reasoned basis and make an informed decision about their respective merits and deficiencies.

80-235 Political Philosophy
Spring: 9 units
The central question of political philosophy can be stated in the following way: What constitutes a just society? The various answers to this question proposed by political philosophers are intertwined with the answer they give to a closely related question: (2) Why should the individual members of society follow the requirements of their society? In this course, we shall take a sustained and critical look at three alternative views of a just political society: (i) A society is just if its members gain some mutual benefit from living together. (ii) A society is just if all of its members can accept the distribution of benefits and responsibilities of their society as the product of a rational choice. (iii) A society is just if its benefits and responsibilities are distributed in proportion to what its individual members contribute. Our examination of these three views will draw upon arguments of several of the most influential contemporary political philosophers as well as those from selected figures in the history of political thought.

80-236 Philosophy and Law
Spring: 9 units
Have you ever wondered what would happen to you if you were clutched by the law on criminal charges, whether justly or unjustly? Or, what defenses would be available to you, according to the law, whatever the charges? Or, what sort of rationales define and delimit criminal offenses and available defenses to specific criminal charges? This course investigates principles, rules, procedures, sensibilities and practical realities of the criminal law in action. Our focus will be the law governing homicide, which, while aiming to protect our most basic human interest in life itself, also allows for the taking of human life. This apparent conundrum provides a compelling invitation to philosophical inquiry. While the law is steeped in apparent intractabilities of conflicted human values, it must also be very practical and decisive. The intersection of Philosophy and Law invites reflection on the relationship between facts and values, the complementarity of scientific and humanistic perspectives, and the interdependence of theory and practice. For depth of perspective, we will (1) analyze in considerable detail controversial real-life scenarios and cases to (2) test the principles underlying the criminal law and legal defenses to the most serious of charges, criminal homicide (e.g., insanity, diminished capacity, duress, provocation, necessity, self-defense, “battered woman” and other “syndromes”), (3) analyze philosophic and legal concepts of justifiability, excusability, culpability, responsibility and criminal liability, and (4) examine similarities in legal and philosophic reasoning. To vivify these issues and illustrate the criminal law, its precepts and procedures in action, we will (5) make extensive use of videos and role-play to ‘visit’ courtrooms, cases, and scenarios. Overall, (6) the course aims to challenge and sharpen your analytical reasoning skills.
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80-241 Ethical Judgments in Professional Life (Professional Ethics)
Fall: 9 units
This is a self-paced course that examines the numerous ethical issues, problems and dilemmas that confront professionals in such areas as medicine, law, engineering, the media, government and the natural and social sciences. As a self-paced course, video and audio tapes and an electronic bulletin board are employed to create a virtual classroom for student discussions. This course meets one day a week.

80-242 Conflict, Culture and Dispute Resolution
Fall and Spring: 9 units
This course is about strategic choice and bases for choosing strategies for dealing with human conflict. The course has two dimensions: (1) methodology and (2) applications. (1) We will critically examine current models of conflict and conflict resolution, including specific techniques for negotiating conflict in principled ways, methods for addressing moral conflicts and disagreement, for identifying, weighing and balancing conflicting values and interests. (2) We will apply strategies for conflict resolution on societal, inter-group, inter-personal and intra-personal levels; in particular, we will use in-depth case studies to examine the application of conflict-resolution methods to large-scale social conflicts (such as the Waco disaster) and to polarizing social controversies (such as abortion, euthanasia, gun control and violence in American society). We will make heavy use of video case studies and innovative multimedia technology developed at the Department's Center for the Advancement of Applied Ethics.

80-243 Business Ethics
Intermittent: 9 units
Various moral mazes that confront managers in the contemporary business organization will be the focus of this course. Topics treated will include: conflicts of interest, whistleblowing, confidentiality and privacy, environmental issues, sexual harassment, diversity in the workplace, international business ethics, and corporate social responsibility. Codes of business ethics, ethics audits, recommendations from the U.S. Sentencing Guidelines Commission, ethics hotlines, business ethics officers, corporate ethics committees, and other mechanisms designed to address the ethics of business will also be examined.

80-244 Environment Management and Ethics
Spring: 9 units
Participants in this course will examine and pose answers to the following question: "What are the legitimate environmental responsibilities of organizational managers and how can they be fulfilled?" This query will provide the course with its major theme and framework. But in order to do justice to it, three interrelated areas that are presupposed by this question will need to be explored first. These areas are: 1) ethics, 2) management ethics and 3) environmental ethics. The first half of the course will concentrate upon these three areas. The second half of the course will explore answers to the lead question about management and the environment by employing the insights gained during the first half. Here participants will first empirically review and evaluate past and current management practices with respect to the environment, organizational policies on the environment and the role of government in the process of determining environmental responsibilities in management. Environmental concerns on the international level and their impact upon organizational management, the emergence of the "environmental affairs manager" within organizations, balancing environmental responsibilities with other management responsibilities and examples of management responses to environmental crises will also be examined during this portion of the course. Case studies in management, environment and ethics will be analyzed.

80-245 Medical Ethics
Fall and Spring: 9 units
This course provides an introduction to core ethical issues in health care, medical research, and public policy. Topics include: the moral responsibilities of health care providers to patients and various third parties such as the government or insurance companies, the status of health as a social good, and questions of individual liberty and social responsibility at the ends of life including issues such as abortion, physician assisted suicide, and the definition of death. We will also examine specific ethical issues in the conduct of medical research and look at the impact of technological innovation on our notions of health, disease, life, death, and the family. If time permits, we may also discuss issues related to genetics and cloning. While the course engages such substantive ethical issues it also attempts to sharpen students’ skills in practical reasoning through argument analysis, analytical reasoning, and the application of theory and principles to particular cases.

80-246 Criminal Justice in America: Ideals and Realities
Spring: 9 units
This course applies selected theories of procedural and social justice to a major public institution. It explores 1) the nature and impact of police, lawyer and prosecutor practices, 2) the effects of (criminal) justice legislation, 3) issues of racial and gender disparities in both the system and its outcomes and 4) improvements and alternatives currently being proposed, implemented and assessed in many jurisdictions.

80-250 Ancient Philosophy
Fall: 9 units
This course provides a broad survey of Ancient Greek philosophy from the pre-Socratics, through Socrates, Plato, and Aristotle, to the later Hellenistic writers. Through careful study of primary texts we will explore some of the historical and intellectual movements that led up to and culminated in the flourishing and downfall of Periclean Athens. A study of Socrates (as represented in Plato's early dialogues) will lead to an in-depth reading of Plato's Phaedo, Meno, and sections of the Republic. We will then explore Aristotle's systematication of philosophy through selections from the Metaphysics, De Anima, and the Nicomachean Ethics. The course will conclude with an examination of Epicurean and Stoic movements from the Hellenistic period. This course provides a strong foundation in the history of philosophy, and the history of western moral, political, metaphysical, epistemological, and psychological thought more generally.

80-251 Modern Philosophy I
Fall: 9 units
Descartes’ project to doubt all received knowledge and begin from scratch marked the beginning of an intellectual upheaval, helping to launch what is now called the Modern period of philosophical thought; the Western world is yet today the heir of modernism. Locke, Leibniz, Hume, and Kant are several of the most important figures of this period. We will examine works of these thinkers, exploring both the new sorts of questions that these philosophers raised and their new methods of doing philosophy, which together mark a fundamental break with the traditions that preceded them.

We will devote special attention to the new theories of knowledge they proposed. The philosophical revolution of the 17th and 18th centuries occurred during a time of great scientific progress and political upheaval in Europe; as part of our course we will consider the relation of certain of these developments to the new questions and methods of the modern philosophers. (This course complements Modern Moral Philosophy, but either may be taken independently.)

80-252 Kant
Spring: 9 units
Immanuel Kant's 'Critical philosophy' may be seen as the result of his attempts to determine the sources of human knowledge, and to find metaphysical foundations for Newton's mechanics. This course will involve readings in some of Kant's major works, as well
as secondary sources. Emphasis will be placed on understanding Kant’s thought in the context of contemporary intellectual developments and on his theory of human cognition.

80-253 Continental Philosophy  
Spring: 9 units  
This course provides students with an overview of key historical and philosophical developments in European Philosophy. The cultural and historical background for 20th Century Continental Philosophy covers Descartes, Kant, Kierkegaard, and Nietzsche. Hegel and Marx are also options. Early to mid-20th Century Continental Philosophy covers the central tenets of phenomenology and existentialism (e.g., intentionality, Being-in-the-World, Bad Faith). This part will involve selections from the works of, for example, Husserl, Heidegger, Sartre and Merleau-Ponty. Finally, cultural and philosophical trends such as Structuralism, Hermeneutics and Post-modernism (e.g., Derrida, Foucault, Lyotard and Habermas) will be addressed.

80-254 Analytic Philosophy  
Spring: 9 units  
This course examines the revolutionary impact on philosophy and contemporary thought of several scientific breakthroughs that occurred at the turn of the century. By the 1920s, a number of scientists and philosophers were sufficiently impressed by the recent rush of scientific progress to become hopeful that the end of the long tradition of philosophical deadlock was finally within reach. Buoyed in particular by Einstein’s theory of relativity and the invention of modern logic, they created a new kind of scientific philosophy with the goal of applying logical and empirical methods to philosophical problems. With the endorsements and contributions of such leading thinkers as Einstein and Russell, the new movement quickly gathered momentum and was a major intellectual force until its disruption by the Second World War. From Wittgenstein’s language-oriented philosophy to the scientific study of such notions as information, computation, and inference, the modern fields of linguistics, cognitive science, and information and computer sciences all owe a debt to these sources, as does of course contemporary philosophy. This course will be centered around selected readings of Frege, Russell, Wittgenstein, and the Vienna Circle, as well as the post-war reception by Quine and others.

80-255 Pragmatism  
Fall: 9 units  
American Pragmatism represents an energetic attempt to bridge the divergent cultures of science and the humanities. The movement’s founder, C.S. Peirce, was trained in chemistry and worked as a physicist, but he was also deeply concerned with the movement’s founder, C.S. Peirce, was trained in chemistry and the divergent cultures of science and the humanities. The American Pragmatism represents an energetic attempt to bridge humanistic cultures.

80-256 Modern Moral Philosophy  
Fall: 9 units  
This course will address some of the central themes of the moral philosophy developed in the 17th and 18th centuries. Much of the philosophy produced in this time was motivated by great social upheavals, including the Thirty Years War, the Glorious Revolution in Britain and the French Revolution, as well as monumental developments in the sciences, including Galileo’s and Newton’s new physics which overthrew the traditional Aristotelian physics. The moral philosophy of this period opened many new areas of debate undreamed of by pre-17th century philosophers, and remains profoundly influential in our time. In this course we will study the moral theories of some of the most important figures of this period, including Hobbes, Locke, Hume, Rousseau and Kant. Topics for discussion will include: (a) The “new” natural law theories that attempted to show that moral precepts are independent of religion, (b) The naturalist and conventionalist accounts of justice proposed during this time, (c) Alternative accounts of the roles that sentiment and rationality play in moral life, (d) Kant’s new rationalist account of the moral law, and (e) The proper role, if any, of “social contract” arguments in justifying and explaining human institutions. Please note that this course complements 80-251, Modern Philosophy I, but may be taken independently of that course.

80-257 Nietzsche  
Spring: 9 units  
During his life in the late nineteenth century, Friedrich Nietzsche was a relatively obscure German philosopher. Since his death however, he has become deeply influential and well known, and was a source of inspiration for many important twentieth century thinkers. Despite this popularity, Nietzsche’s philosophy is mysterious and often misunderstood. Much of his writing consisted of aphorisms, rather than more traditional prose and arguments, and many of his positions seemed to contradict one another. This course will cover a broad range of Nietzsche’s writings, focusing on such central concepts as the will to power, eternal recurrence, and the oft misunderstood Übermensch (“overman”). Throughout, we will focus on developing a consistent interpretation of an enigmatic philosopher whose views have been mischaracterized throughout the past century.

80-258 Leibniz, Locke, and Hume  
Spring: 9 units  
This course will take a close look at the theories of knowledge of three major thinkers of the seventeenth and eighteenth centuries: John Locke, Gottfried Wilhelm Leibniz, and David Hume. Selections from Locke’s An Essay Concerning Human Understanding, Leibniz’s reply in New Essays on Human Understanding, and Hume’s views in The Enquiries Concerning Human Understanding as well as secondary sources will be discussed.

80-270 Philosophy of Mind  
Fall: 9 units  
The course offers an introduction to some of the basic questions in the Philosophy of Mind: What is the real nature of mental states? (the ontological problem); What sort of property (if any) confers truth evaluability and content on certain psychological states? (the semantical problem); How do we know that other agents have consciousness and enjoy mental states at all? What are the minimal conditions of personhood? (the epistemological problem); What sort of data is admissible to construct a ‘science of the mind’? What are the relationships between ‘folk’ and scientific psychology? (the methodological problem); Which is the role of contentful psychological states in the explanation of behavior? How the intentionality and thought of individual agents connect with their social nature and their communal experience? (the problem of psychological explanation). Each year the course pays particular attention to a topic or a family of topics. In the recent years focal points have been (a) recent theories of consciousness, (b) the status of the so-called computational theory of mind (alias functionalism), (c) the tension between computational and associationist models of the mind (d) the nature of desires and emotions.

80-271 Philosophy and Psychology  
Spring: 9 units  
Throughout both of their histories, philosophy and psychology have had a close relationship. This course will examine some of the many ways in which philosophical and psychological theories
have mattered for each other, both in the past and present. In particular, we will begin by examining a series of historical cases in which philosophy and psychology have intersected, such as Kant’s influence on Helmoltz’s psychological theories, or the influences of psychological behaviorism on philosophical logical positivism (and vice versa). We will also consider, in significantly more depth, a more recent intersection of philosophy and psychology: the philosophical problem of free will, and recent research on its psychological and neuroscientific foundations.

80-275 Metaphysics
Spring: 9 units
The overall focus of this course will vary. Typical topics include the problem of personal identity, the nature of human freedom, the nature of the self, the nature of reality and being, the nature of causality, and the question of whether solutions to such problems can be given. Classical as well as contemporary philosophic texts will be studied.

80-276 Philosophy of Religion
Fall: 9 units
In order to expand our ideas about what religion could be, the course begins with a brief cross-cultural review of some major religious traditions around the world. Then we turn to some more traditional arguments for and against theism, including the ontological, cosmological, and design arguments, the argument from religious experience, the argument from miracles and historical testimony, and the problem of evil. We will also consider whether morality ultimately depends on God’s sanctions and (yes, here it is at Carnegie Mellon) whether life would be meaningless if God did not exist.

80-280 Introduction to Linguistic Analysis: Syntax
Fall: 9 units
The goal of this course is to equip students with the vocabulary and skills needed to engage in the analysis of linguistic data. The course will focus on one or more of the following topics: syntactic analysis (analysis of sentence structure), phonological analysis (analysis of linguistic sound systems) or semantic analysis (analysis of sentence interpretation). Other topics may be included. In each segment of the course, an appropriate formal framework will be presented, to be used as a tool of analysis. Using this tool, you will develop your ability to describe linguistic phenomena accurately, to make linguistic generalizations, and to propose accounts of these generalizations within a given theoretical framework.

80-291 Issue in Multimedia Authoring
Fall: 9 units
This course emphasizes the philosophical, cultural, and sociological aspects of multimedia. The course will explore these issues historically and thematically by looking at central figures in the early days of computers and communication theory (e.g., Alan Turing and Claude Shannon) and recent work by writers such as Brenda Laurel (Computers as Theatre), George Landow (HyperText 2.0), and Janet Murray (Hamlet on the Holodeck: The Future of Narrative in Cyberspace). This is not a technical course in issues relating to the creation of multimedia software. It is a course concerned with the meaning of multimedia authoring in its contemporary societal context.

80-300 Minds Machines, and Knowledge
Fall: 9 units
Theories of Cognitive Architecture explore how systems are designed so they can behave intelligently. Such theories can readily be divided into those that are biological and those that are computational. The computational models in turn can roughly be divided into theorem provers and networks. In this edition of Minds, Machines and Knowledge we will look at the historical sources of the two kinds of computational accounts, and at a contemporary presentation of a biological account. The sources of the theorem prover account are Kant and Carnap, with some help from Bertrand Russell. We will make some comparisons with contemporary computational theories. The biological account is Patricia Churchland’s.

80-305 Rational Choice
Fall: 9 units
This course will cover selected topics in rational choice theory, which informally is the analysis of how to make correct decision in a given context. The course offers an introduction to the main normative theories of rational choice: von Neumann-Morgenstern theory of expected utility, Anscombe-Aumann’s account and Savage’s theory of choice under uncertainty. Possible topics may include, and are not limited to: individual choice under uncertainty and related issues in the psychology of judgment and decision making, problems of public choice in which a group of individuals must collectively make a decision, game-theoretic problems of conflict and coordination, alternative approaches to the problem of fair division of goods as well as recent theories that abandon the Bayesian assumption that the decision maker’s beliefs can always be represented by a unique probability distribution. This course focuses on the role that formal methods can play in the analysis of decisions and alternative applications of decision theory to issues in philosophy and social science.

80-310 Logic and Computation
Fall: 9 units
Among the most significant developments in logic in the twentieth century is the formal analysis of the notions of provability and semantic consequence. For first-order logic, the two are related by the soundness and completeness theorems: a sentence is provable if and only if it is true in every interpretation. This course begins with a formal description of first-order logic, and proofs of the soundness and completeness theorems. Other topics may include: compactness, the Lowenheim-Skolem theorems, nonstandard models in arithmetic, definability, other logics, and automated deduction.

80-311 Computability and Incompleteness
Spring: 9 units
The 1930’s witnessed two revolutionary developments in mathematical logic: first, Gödel’s famous incompleteness theorems, which demonstrate the limitations of formal mathematical reasoning, and second, the formal analysis of the notion of computation in the work of Turing, Gödel, Herbrand, Church, Post, Kleene, and others, together with Turing’s results on the limits of computation. This course will cover these developments, and related results in logic and the theory of computability.

80-312 Philosophy of Mathematics
Spring: 9 units
The 20th century witnessed remarkable and novel developments of mathematics - with deep roots in the 19th century. The beginnings of these developments were beset with foundational problems and provoked a variety of programmatic responses: logicism, intuitionism, and finitism. For a deeper study of basic issues, we review a part of classical Greek mathematics (the theory of proportions) that is closely connected to the foundations of analysis in the 19th century. We analyze set theoretic and constructive approaches, and discuss fundamental metamathematical results and their philosophical implications. A "reductive structuralist" position will finally provide a perspective for understanding the abstract character of mathematics as well as its usefulness in applications.

80-314 Logic in Artificial Intelligence
Spring: 9 units
An introduction to several formalisms used in knowledge representation and database theory. The emphasis is placed on nonmonotonic logic, conditional logic and belief revision methods. We will also study recent issues in the logos of knowledge and belief and consider applications in distributed AI. Several methodological problems in AI are discussed.

80-315 Modal Logic
Fall: 9 units
An introduction to first-order modal logic. The course considers several modalities aside from the so-called alethic ones
(necessity, possibility). Epistemic, temporal or deontic modalities are studied, as well as computationally motivated modals (like 'after the computation terminates'). Several conceptual problems in formal ontology that motivated the field are reviewed, as well as more recent applications in computer science and linguistics. Kripke models are used throughout the course, but we also study recent Kripkean-style systematizations of the modals without using possible worlds. Special attention is devoted to Scott-Montague models of the so-called 'classical' modalities.

80-316 Probability and AI
Fall: 9-12 units

In this course we will examine foundational questions about the concepts of causality and probability, how artificial intelligence techniques can be used to solve some of the computational problems presented by the use of probabilities and representations of causal relations, and how probabilities and representations of causal relations have been incorporated into recently developed expert systems. The foundational questions we will examine are: What do causal and probabilistic statements mean? How can probabilities and causal relations be inferred? Are there any axioms relating causal relations to probability distributions? What are the advantages and disadvantages of using probabilities as compared to alternative representations of uncertainty? We will then discuss recent developments in Artificial Intelligence (e.g. Bayesian networks) which have solved some of the long-standing computational problems associated with the use of probabilities and statements about causal relations. Finally, we will study in detail some expert systems, such as QMR and Pathfinder, which have incorporated these new techniques in order to perform medical diagnosis.

80-317 Constructive Logic
Intermittent: 9 units

This multidisciplinary junior-level course is designed to provide a thorough introduction to modern constructive logic, its roots in philosophy, its numerous applications in computer science, and its mathematical theories. Some of the major topics to be covered are intuitionistic logic, inductive definitions, functional programming, type theory, realizability, connections between classical and constructive logic, decidable classes.

Prerequisites: 15151 or 15211 or 15212 or 80210 or 80211

80-318 Computation and Proof Search
Intermittent: 9 units

Can one mechanize significant parts of mathematical reasoning? To answer this question, we carry out a case study for Gödel's incompleteness theorems and some theorems of set theory. That requires extensive preparatory work in Parts 1 and 2 of the course. In part 1 we survey problems that led to the search for a notion of computability, look at a number of different notions, and give a convincing conceptual analysis that is based on work by Turing, Post, and Gandy. The decision problem was solved negatively using such rigorous notions of computability. The theorem of Church and Turing asserts that there is no mechanical procedure deciding whether or not a sentence in the language of first-order logic is a logical truth. However, Gödel's completeness theorem guarantees that every logical truth can be proved - in a suitable calculus. A variety of procedures have been developed to search systematically for proofs. Part 2 investigates "proof search procedures" for natural deduction calculi.

80-319/719 Computability and Learnability
9 units

This course is conceived as an alternative way to fulfill the 80-311, Computability and Incompleteness requirement for students who are more interested in rationality, learning, and cognition than in logic and the foundations of mathematics. A solid grounding in the theory of computability will be provided, but the applications will concern computational learning theory, which studies what can be learned or discovered by computational agents from empirical data rather than what can be proved in a logical system. The application is more natural than it might seem at first.

The problem of induction is that a general law may be refuted by the next observation, no matter how long it has withstood test. But there is a parallel problem about algorithmic halting: no matter how long a computation fails to halt, it may halt as soon as a world-be decision procedure concludes that it never will. In both cases, the difficulty can be sidestepped by entertaining methods that converge to the right answer without announcing when they have done so. We will delve into this analogy, using the theory of computability to investigate such questions as what machines can learn, whether machines could discover uncomputable truths, why irrational machines may be smarter, and what good it would do to have an infinite regress of methods, each of which checks whether its predecessor will find the truth.

All topics covered are self-contained, but students are expected to have some basic background in logic, computation, or discrete mathematics. The text will consist of handout lecture notes. The course grade will be based on exercises and two short papers that will provide vital practice in writing articles for conference proceedings.

80-321 Causation and Social Policy
Fall: 9 units

Policy makers face causal questions. For example, does violence on TV cause violence in life, and if so, what policies can we institute that will actually curb it? Does the death penalty actually deter criminals? Do tough drug laws reduce drug use? This course investigates how social and behavioral scientists establish causal claims, and how policy makers rely on or systematically ignore such science. We examine what causal claims mean and how they connect to statistical data, and we discuss the limits of standard techniques for establishing causal claims. We will consider all of these issues first theoretically, and then in the context of several case studies, including the effect of media violence on real violence. Knowledge of social science and/or statistics is not required, but is desirable.

80-322 Philosophy of Physics
Spring: 9 units

This course examines philosophical problems in the development of modern physics. Topics include the philosophical significance of Einstein’s theory of relativity, interpretations of quantum mechanics, and the relationship between these two theories. Other topics may include the philosophy of space and time, the epistemology of geometry, the significance of modern cosmology, and chaos theory.

80-323 Philosophy of Biology
Spring: 9 units

This course will focus on a range of foundational problems in evolutionary biology, including the possibility of meaningful explanations and laws, evolutionary explanations of human behavior from sociobiology and evolutionary psychology, and controversies over the meanings and roles of a variety of foundational concepts (including fitness, adaptation, optimality, and probability). Philosophers have historically played a central role in these debates, and so we will examine the ways in which the theory and practice of evolutionary biology have changed in light of philosophical arguments and observations. This course will be accessible both to philosophers interested in the epistemological and metaphysical status of evolutionary biology, and to biologists interested in better understanding the foundations of their field. Although there are no formal prerequisites for this course, students will be expected to have taken courses in either philosophy or biology.

80-330 Research Ethics
Spring: 9 units

This course covers foundational issues in the ethical evaluation and regulation of research involving human subjects. It begins with a historical overview of the origins of research ethics after
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World War II as a response to high profile cases of abuse or scandal. This unit covers "classic cases" including the Tuskegee syphilis study, the Willowbrook hepatitis study, the Jewish Chronic Disease Hospital Case, and others. It also covers seminal documents such as the Nuremberg Code, the Belmont Report, and the current federal regulations known as the Common Rule. Against this historical backdrop, the course then examines foundational philosophical issues in human-subjects research including ethical issues in clinical trial design, the concept of equipoise and the use of placebo controls, the requirements of justice in the research context, and the values of privacy and informed consent. The course will touch on ethical issues in non-biomedical areas of research such as psychology, the social sciences and computer science, and end with issues at the cutting edge of current debate.

80-335 Seminar: Philosophy Politics and Economics
Spring: 9 units
Theories of rational choice and strategic interaction occupy a central place in modern economics, political science and political philosophy. This course will explore applications of decision and game theory to these three fields, with a special emphasis on issues such as social cooperation, public goods, and distributive justice.

80-340 Environmental Ethics and Decision Processes
Fall: 9 units
The use of limited natural resources such as water, land, and energy sources inevitably produces conflicts over access, regulation and policy, environmental standards, and enforcement. Traditional means of settling such conflicts, and particularly the legal system, often do not address fundamental differences in values and goals of the parties, or include all stakeholders (such as future generations). Legal battles are often costly, socially as well as economically. A promising innovation, Alternative Dispute Resolution, involves the use of negotiation and mediation to resolve environmental disputes. Based on a series of environmental case studies, this course will explore the nature of ADR methods: the values implicit in the processes, the types of outcomes they produce, and the criticisms that have been raised.

80-341 Computers, Society and Ethics
Spring: 9 units
This course explores many of the social and ethical issues that have emerged in the wake of the significant advances that we have witnessed in computer science and information technology (IT). Computers and communications technologies have had an increasing impact on the whole of society and have raised new and difficult ethical questions. In turn, these ethical issues have spurred the need for a consideration of new policies and regulations. In this new world of IT, some are concerned about the protection of their privacy while others find problems of censorship and, more generally, restrictions on information access to be their main focus as a problematic social issue. This course will address these and other issues such as: questions of free speech, surveillance in the workplace, intellectual property and copyright, information acquisition and ethics and the Internet.

80-342 Ethics and Oppression
Spring: 9 units
Women and minorities are oppressed in the US and around the world. Taking oppression as a given, this course explores its nature, causes, consequences and ethical issues that arise from it. Topics include the role of institutions, the media, violence and internalized oppression. A central question concerns moral obligations that arise when people learn about oppression. Results of efforts to free human interactions and social structures from oppression and/or to ameliorate the consequences of oppressive systems and societies are also explored.

80-344 Environmental Ethics
Fall: 9 units
This course will survey numerous philosophical and ethical aspects of the environmental movement. It will focus upon such topics as the nature of environmental responsibility, anthropocentric versus biocentric considerations of the environment, animal rights, obligations to future generations and the "land ethics" of Aldo Leopold. It will explore the arguments found in the debates over radical environmental activism, deep ecology, social ecology and eco-feminism. Environmental justice, issues of environmental rights, the possibilities of sustainable environmental practices and the causes of our ecological condition will be discussed in this course as well.

80-346 Value Fact and Policy
Fall: 9 units
This seminar is about how appraisals of value and fact interact in the deliberation and evaluation of public policy. Policy making and debate entail value judgments and evaluation (the weighing and balancing of competing values, interests and goals) as well as assiduous fact finding. When we disagree about the facts of the matter, we may think that we have a good idea of how to go about settling the disagreement. But what do we do when we disagree about values? That is a central question for this seminar. But policy issues cannot be intelligently debated absent facts. And the factual issues may be arguable and complex: we encounter political, sociological, cultural, psychological issues as well as legal and ethical questions. For depth of perspective, so that we can become well versed in the relevant factual as well as value controversies, the seminar will focus on specific policy disputes regarding crime and violence. A commonsense framework for deliberating and evaluating public policy will be proposed and critiqued.

80-380 Philosophy of Language
Spring: 9 units
What constitutes an adequate theory of meaning for ordinary language? This question, which is central to the philosophy of language, will be the focus of the course. In answering it, we will confront many additional questions, including: what view of meaning allows for the construction of such a theory? What is the relation between what a sentence means and what a speaker means? What is the connection between linguistic form and linguistic meaning? While we will explore classic philosophical answers to these questions, we will also investigate recent work in which the emerging insights of formal linguistics are used to shed new light on these old problems. The course will involve a significant amount of reading, and several paper assignments. While this is an introduction to the philosophy of language, it is not an introduction to philosophy. Students enrolling in this course should have taken at least one philosophy course in which they read from the philosophy literature and were required to write at least one paper. Students interested in the course who lack this background may request permission from the instructors to enroll.

80-405 Game Theory
Spring: 9 units
The first part of course will be a standard introduction to noncooperative games. The second part will cover experimental game theory and formal models that take into account social preferences, fairness and reciprocity motives. Prerequisites: 80305 and 80605

80-411 Proof Theory
Fall: 9 units
This course is an introduction to Hilbert-style proof theory, where the goal is to represent mathematical arguments using formal deductive systems, and study those systems in syntactic, constructive, computational, or otherwise explicit terms. In the first part of the course, we will study various types of deductive systems (axiomatic systems, natural deduction, and sequent calculus) for classical, intuitionistic, and minimal logic. We will prove Gentzen's cut-elimination theorem, and use it to prove various theorems about first-order logic, including Herbrand's
course, we will adopt the model-theoretic, truth conditional approach which is standard in linguistic semantics. Our talk of ‘meaning’ will thus be restricted to the assignment of model-theoretic objects — individuals, sets, functions, and so on — to expressions of the language. This approach utilizes translation of natural language into a formal language (logic); part of the task, then, is to identify an appropriate logic to serve as the translation language. No background in linguistic theory is required for the course. However, students must be comfortable with basic set theory and with quantified first-order (predicate) logic. This formal background will be assumed.

80-511 Thesis Seminar
Spring: 9 units
This course provides a forum for the presentation and detailed discussion of research done by students, be they undergraduates working on their Senior Thesis or graduate students engaged with their M.S. thesis.

80-512 Seminar on Causation
Fall: 9 units
This course explores the foundations of causation. It examines how causal claims connect to both probability and to counterfactuals. Under a variety of background assumptions, and a variety of senses of “reliable”, we will examine which causal inferences can be made reliably. We will also examine recent developments in statistics and artificial intelligence relating to causal inference.

80-513 Seminar of Philosophy of Mathematics
Fall and Spring: 9 units
The seminar discusses mathematical, logical, and philosophical work that is important for the foundations of mathematics. That may range from constructive consistency proofs for classical theories through conceptual analyses of central mathematical notions to the discussion of ontological and epistemological issues.

80-514 Seminar on Philosophy of Science
Fall: 9 units
A graduate level critical review of standard issues in the philosophy of science. Topics will include determinism, predictability, confirmation, probability, causation, lawlikeness, explanation, the aims of science, the content of scientific claims, the rationality of belief in scientific claims.

80-515 Seminar on the Foundations of Statistics
Spring: 9 units
The seminar focuses on some single important foundational work, or body of work, and investigates it and related research from a contemporary point of view. For example, when Savage’s Foundations of Statistics is the course’s focus, the class goals include understanding how Bayesian decision theory differs from its rivals, and understanding where Savage’s position is located within the current Bayesian program. Other seminar thinkers whose writings have served as the course’s focus in different terms include, R.A. Fisher, Harold Jeffreys, J.Neyman, and A. Wald. Prerequisites: This is primarily a graduate level class. Instructor permission is required for undergraduates.

80-516 Seminar on Metaphysics
Intermittent: 9 units
This seminar focuses on some single important foundational work, or body of work, and investigates it and related research from a contemporary point of view. For example, when Savage’s Foundations of Statistics is the course’s focus, the class goals include understanding how Bayesian decision theory differs from its rivals, and understanding where Savage’s position is located within the current Bayesian program. Other seminar thinkers whose writings have served as the course’s focus in different terms include, R.A. Fisher, Harold Jeffreys, J. Neyman, and A. Wald. Prerequisites: This is primarily a graduate level class. Instructor permission is required for undergraduates.

80-517 Seminar in Social and Political Philosophy
Spring: 9 units
The seminar’s topic changes every year. In the past, it covered subjects such as the nature of social norms, the evolution of institutions and the use of dynamic models in the social sciences.

80-518 Seminar on Epistemology
Spring: 9 units
This seminar focuses on prominent issues in contemporary epistemology. Standard topics in the field will be studied in the light of recent research in artificial intelligence, cognitive science as well as social and decision sciences. Topics considered in recent years include ‘local’ theories of induction, the problem of how to represent belief and how to justify belief change, as well as issues related to the viability and structure of current theories of ‘radical probabilism’ in Bayesian epistemology. The seminar discusses not only issues in ‘classical’ epistemology, but also more recent naturalistic and pragmatist approaches.

80-519 Seminar History of Philosophy
Spring: 9 units
This course focuses on seminal figures, eras, or movements in the history of philosophy. Although the specific topic of the seminar varies, the goals of the course are to situate important philosophical tests or ideas within a broader historical context and to provide a systematic critical investigation of those ideas. Topics of the seminar might include: Aristotle’s Ethjics, Plato, Hume, Kant’s First Critique, The Empiricists, The Rationalists, History of Philosophy of Mathematics.
80-520  Categorical Logic  
*Fall: 9 units*  
This course focuses on applications of category theory in logic and computer science. A leading idea is functorial semantics, according to which a model of a logical theory is a set-valued functor on a category determined by the theory. This gives rise to a syntax-invariant notion of a theory and introduces many algebraic methods into logic, leading naturally to the universal and other general models that distinguish functorial from classical semantics. Such categorical models occur, for example, in denotational semantics, e.g. treating the lambda-calculus via the theory of Cartesian closed categories. Similarly, higher-order logic is treated categorically by the theory of topoi. Note: this course will begin with a 3 week refresher of basic category theory - CS students can start after immigration by reviewing on their own.

80-521  Seminar on Methodology  
*Fall: 9-12 units*  
The basic idea behind this course is a deep mathematical analogy between Hume’s problem of induction and uncomputability: Hume asks how you could tell for sure that the sun will always rise and Turing asks how a computer could tell for sure that a computation will never end. Systematic exploration of this analogy has led to a sub-discipline of computer science known as computational learning theory. The aim of this course is to apply ideas from computational learning theory to such standard philosophical issues as skepticism and underdetermination, the nature of scientific justification, how Ockham’s razor helps us find the truth, whether a computer could converge to the truth about a radically non-computable theory, and a computational solution of the problem of infinite regresses. Graduate students from other departments and undergraduates with training equivalent to 80-311 or 80-319 are welcome.

80-522  Seminar on Ethical Theory  
*Fall: 9 units*  

80-523  Seminar on the Philosophy of Language  
*Intermittent: 9 units*  

80-595  Senior Thesis  
*Fall and Spring: 9 units*  

### Modern Languages  
**Undergraduate Courses**

82-081  Academic Writing for Non-native Speakers of English  
*Intermittent: 9 units*  
This course is designed for undergraduate non-native speakers of English who want to further develop their abilities to communicate in written English. It provides students with opportunities to increase their control of English grammar, sentence structure, vocabulary and appropriate usage expected in academic work. Students will write several short reports and essays. Prerequisite: None.

82-082  Oral Communication for Non-native Speakers of English  
*Intermittent: 9 units*  
The purpose of this course is to give undergraduate non-native speakers of English opportunities to improve their oral communication skills in English. The focus will be on pronunciation, fluency, grammatical accuracy and vocabulary. The in-class learning activities will include impromptu and prepared speeches, oral summaries, seminar speeches, and film reviews. Since listening comprehension enhances speaking, the course also includes listening comprehension activities to improve accuracy and to initiate discussion. Prerequisite: None.

82-083  Written Communication for Non-native Speakers of English  
*Intermittent: 9 units*  
This course serves as an introduction to the kinds of academic writing tasks undergraduates encounter during their first semesters at Carnegie Mellon. Students will be introduced to common academic tasks such as writing summaries, critiques and short essays. They will also have opportunities to further develop their command of written English grammar, vocabulary and appropriate usage expected in academic work. Prerequisite: None.

82-084  Communication Skills  
*Intermittent: 9-12 units*  
This course provides opportunities for integrated skills development, which means that the class activities are designed to strengthen students’ abilities to use and understand English. In this course, we will watch current American films to provide topics for discussion and a springboard for language learning activities. Students will work on increasing their listening comprehension, strengthening their discussion skills, expanding their vocabulary (including American English idioms) and developing their ability to write short summaries and reviews. Prerequisite: None.

82-085  Reading and Writing in a Multi-Cultural Setting  
*All Semesters: 9 units*  
Fulfills CCR2 Requirement for H&SS and a Designated Writing Course for other colleges. This course is intended for international and American students who speak English as a second language. The class focuses on the American experience as told from multicultural perspectives in the form of essays, poetry, fiction, and film. Students will consider how these experiences are affected by issues of ethnicity and race, sex, and gender, health and illness, class, religion, and education. Emphasis will be placed on helping students develop strategies for advancing oral and written interpretations of texts through various modes of argumentation, including summary, synthesis, and analysis. The course encourages students to examine their responses to the selected texts as a means of exploring their own identities within American culture and discovering how their own individual histories and cultural backgrounds influence the meanings they make.

82-101  Elementary French I  
*Fall and Spring: 9,12 units*  
This course is for students who have never studied French. The emphasis is on all four skills (listening, speaking, reading, writing) and on cultural information as it is presented in the text and through homework assignments. Regular participation in class is mandatory (four in-class hours per week). In addition, this course requires that students spend time in the Modern Language Resource Center (MLRC) using different multimedia tools (audio CD, video, CD ROM, ML server, Internet) to complete assignments. Information on how to use these tools will be provided. The elementary level is designed to help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. If a student has studied French before, then s/he must take the placement exam. Instructions for taking the placement exam are in Baker Hall 160. Prerequisite: No previous instruction in French.

82-102  Elementary French II  
*Fall and Spring: 12 units*  
This course is designed for students who have taken first-semester French at Carnegie Mellon or its equivalent. The emphasis is on all four skills (listening, speaking, reading, and writing) and on cultural information as it is presented in class and through homework assignments. Regular participation in class is mandatory (four in-class hours per week). In addition, students will be required to spend some time in the Modern Language Resource Center (MLRC) using different multimedia tools to complete assignments. Information on how to use these tools will be provided. The elementary level is designed to
help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. If a student has studied French before, then s/he must take the placement exam. Instructions for taking the placement exam are in Baker Hall 160. Prerequisite: 82-101 or placement test for previous instruction in French. Prerequisites: 82101 or 82103

82-103 Elementary French I Online
Fall: 12 units
This course is designed for students who need a more flexible approach to language learning than that offered in a standard classroom course. All materials are Web-based, with extensive use of Internet technologies for research, writing, and communication. There is a required weekly class meeting for training and for group activities, plus individual weekly meetings with a tutor or the Instructor for conversation and practice. See www.languageonline.org for a more detailed description of requirements and class structure before enrolling. Prerequisites: No previous study required. If a student has studied French before, then s/he must take the placement exam. Instructions for the placement exam are in BH 160.

82-104 Elementary French II Online
Spring: 12 units
A continuation of 82-103, Elementary French I Online. There is a required weekly class meeting for training and for group activities, plus individual weekly meetings with a tutor or the Instructor for conversation and practice. See www.languageonline.org for a more detailed description of requirements and class structure before enrolling. Prerequisites: French 82-101, 82-103 or permission of the Instructor. Students new to French study at Carnegie Mellon must take the placement exam. Instructions for the placement exam are in BH 160.

Prerequisites: 82101 or 82103

82-106 Intensive French Language and Culture: Elementary Level
All Semesters: 0-18 units
Transfer credit for study abroad in France, a French-speaking country, or other approved program at the Elementary level. Credit determined after consultation with the transfer credit advisor for French.

82-110 Self-Study in Less Commonly Taught Languages
Intermittent: 12 units
From time to time, the Department may offer a two-semester self-instructional sequence of study in one of the so-called less commonly taught languages (e.g., Indonesian, Polish, Swahili). The course will provide individualized language instruction for students working at their own pace in consultation with a tutor using materials identified by the National Association of Self Instructional Language Programs. Courses emphasize the development of oral-aural skills and introduce basic reading and writing. Students must be prepared to devote at least 15 hours per week to individual study in addition to the time spent each week in consultation with their tutor. Enrollment in the course is limited. Prerequisite: Permission of the Department Head.

82-121 Elementary German I
Fall and Spring: 12 units
An introduction to German for students with no previous background in the language. Listening, speaking, reading, and writing skills are developed in a context that introduces information on culture and life in German-speaking countries of today. Includes work with audio-visual and internet materials. The elementary level is designed to help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. Four hours of in-class instruction per week. Prerequisite: None. If a student has studied German before, then s/he must take the placement exam. Instructions for taking the placement exam are in Baker Hall 160.

82-122 Elementary German II
Fall and Spring: 12 units
This course, a sequel to 82-121, is intended for students with one semester of college German (or equivalent). Listening, speaking, reading, and writing skills are developed in a context that introduces information on culture and life in German-speaking countries of today. Includes work with audio-visual and internet materials. The elementary level is designed to help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. Four hours of in-class instruction per week. Prerequisite: 82-121 or approved equivalent.

82-123 Directed Language Study: Elementary German I & II
Fall and Spring: 12 units
This course is a directed, Instructor-supervised version of the courses 82-121 and 82-122. It is recommended for (i) students who are well motivated and have the time, self-discipline, and desire to work independently, and (2) students whose schedule precludes enrollment in the regular elementary course. This course develops the fundamental language skills as outlined in the description of 82-121 or 82-122. Students complete the same work as in 82-121 or 82-122 as well as supplementary video materials. Written work is turned in for correction. Tests covering each unit of material will be taken according to a schedule determined by the Instructor. The Instructor will be available during office hours or by appointment for individual consultations and for testing. Students are permitted to take only one semester of 82-123. YOU MUST ATTEND THE FIRST MEETING. IF YOU CANNOT ATTEND, CONTACT THE INSTRUCTOR BEFORE THE MEETING.

82-126 Intensive German Language and Culture: Elementary Level
Intermittent: 6-24 units
Transfer credit for study abroad in Germany, a German-speaking country, or other approved program at the Elementary level. Credit determined after consultation with the transfer credit advisor for German.

82-131 Elementary Chinese I
Fall: 12 units
This course is for beginners in Mandarin Chinese. Its goal is to train students in the basic skills of listening, speaking, reading and writing for daily communication in Chinese. Students will learn the phonetic transcriptions of Chinese (Pinyin) for speaking and listening as well as Chinese characters for reading and writing. Basic vocabulary and sentence patterns used in everyday life are taught so that students will be able to carry on simple conversations on everyday life topics. Students will be introduced to cultural issues through class, extracurricular activities and multimedia programs. The elementary level is designed to help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. Prerequisite: None.

82-132 Elementary Chinese II
Spring: 12 units
This course is the continuation of the elementary Chinese course sequence for beginning students of Mandarin Chinese. Its goal is to continue to train students in the basic skills of listening, speaking, reading and writing for everyday communication. Based on the vocabulary and sentence structures taught in the first semester, students will learn more useful expressions and sentence structures necessary for use in everyday life. A large part of the class time will be devoted to conversations related to topics on daily life. While emphasis is laid on the communicative skills of listening and speaking, students will continue to learn to read and write short paragraphs and essays in Chinese characters. To facilitate the study of the language, different aspects of Chinese culture and society will be introduced through poetry reading, group activities, multi-media programs, and research project throughout the course. The elementary level is designed to help students learn to reflect upon and draw upon
strategies used by good language learners in their second language study. Prerequisite: 82-131 or approved equivalent. Prerequisites: 82131

82-135 Intensive Elementary Chinese Intermittent: 12 units
This course is designed for students who have some basic knowledge of spoken Chinese, but know little of how to read and write Chinese. While students will be trained in all the four language skills of listening, speaking, reading and writing simultaneously, the focus will be on the study and practice of Chinese characters. Based on their speaking ability, students will learn how to communicate in writing in everyday situations. In addition, the acquisition of standard pronunciation and Chinese cultural awareness will be also stressed. After the study of this course students will be well equipped to continue their study of Chinese at the intermediate level. Prerequisite: None

82-141 Elementary Spanish I Fall and Spring: 12 units
A two-semester course sequence (82-141, 82-142) for beginning students emphasizing the development of communicative language proficiency: oral practice, aural comprehension, reading, writing, and group discussion. Use of Internet technologies for research, writing and communication (chat and b-boards). There is a weekly class meeting for training and for group activities, plus individual weekly meetings with a tutor or the Instructor for conversation and practice. See www.languageonline.org for more detailed description of requirements and class structure before enrolling. Prerequisite: None. If a student has studied Spanish before, then s/he must take the placement exam. Instructions for taking the placement exam are in Baker Hall 160. Prerequisites: 82141 or 82143

82-142 Elementary Spanish II Fall and Spring: 12 units
The second part of a two-semester course sequence (82-141, 82-142). Prerequisite: 82-141, placement score, or permission of the Instructor. If a student has studied Spanish before, then s/he must take the placement exam. Instructions for taking the placement exam are in Baker Hall 160. Prerequisites: 82141 or 82143

82-143 Elementary Spanish I Online Fall: 12 units
This course is designed for students who need a more flexible approach to language learning than that offered in a standard classroom course. All materials are Web-based, with extensive use of Internet technologies for research, writing and communication (chat and b-boards). There is a required weekly class meeting for training and for group activities, plus individual weekly meetings with a tutor or the Instructor for conversation and practice. See www.languageonline.org for a more detailed description of requirements and class structure before enrolling. Prerequisite: No previous study required. If a student has studied Spanish before, then s/he must take the placement exam. Instructions for the placement exam are in BH 160.

82-144 Elementary Spanish II Online Spring: 12 units
A continuation of 82-143, Elementary Spanish I Online. This course is designed for students who need a more flexible approach to language learning than that offered in a standard classroom course. All materials are Web-based, with extensive use of Internet technologies for research, writing and communication (chat and b-boards). There is a required weekly class meeting for training and for group activities, plus individual weekly meetings with a tutor or the Instructor for conversation and practice. See www.languageonline.org for a more detailed description of requirements and class structure before enrolling. Prerequisite: 82-141, 82-143 or permission of the Instructor. Students new to Spanish study at Carnegie Mellon must take the placement exam. Instructions for the placement exam are in BH 160.

82-146 Intensive Spanish Language and Culture: Elementary Level All Semesters: 0-18 units
Transfer credit for study abroad in a Spanish-speaking country or other approved program at the Elementary level. Credit determined after consultation with the transfer credit advisor for Spanish.

82-147 Accelerated Elementary Spanish Fall: 12 units
This course is specially designed for students who are not true beginners of Spanish and therefore not appropriately placed in 82-141 but who may lack adequate preparation to enter the second semester of Spanish. Students will engage in a rapid review of first-semester Elementary Spanish materials and then progress to complete the entire elementary level of Spanish (the second semester) in one semester. Upon successful completion, students will be prepared to continue at the intermediate level. The course emphasizes the development of communicative proficiency though oral practice, aural comprehension, reading, writing, and study of cultural aspects of Spanish-speaking countries. Prerequisites: Permission of the instructor and an appropriate placement exam score

82-161 Elementary Italian I Fall: 9, 12 units
A two-semester course sequence (82-161, 82-162) for beginning students emphasizing the development of communicative language proficiency: oral practice, aural comprehension, reading, writing, structural analysis, and language learning resource center work. Also a study of cultural aspects of Italian. The elementary level is designed to help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. Note: This is a 12 unit course. A 9 unit version of this course that does not fulfill DCR3 credits may be offered during a semester for Music students only.

82-162 Elementary Italian II Spring: 9-12 units
A two-semester course sequence (82-161, 82-162). The elementary level is designed to help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. Prerequisite: 82-161, 82-163 or approved equivalent. Note: This is a 12 unit course. A 9 unit version of this course that does not fulfill DCR3 credits may be offered during a semester for Music students only. Prerequisites: 82161 or 82163

82-163 Directed Language Study: Elementary Italian I & II Fall and Spring: 12 units
A self-paced version of 82-161/162, for highly-motivated students, capable of working independently. Weekly practice session, language laboratory work with audio and video tapes, periodic achievement tests, and individual consultation. Students are permitted to take only one semester of 82-163. Prerequisite: None.

82-171 Elementary Japanese I Fall: 12 units
A two-semester course sequence (82-171, 82-172) for students with no background in Japanese. The course emphasizes the development of communicative language proficiency: oral practice, aural comprehension, reading, writing, and the study of cultural aspects in Japanese society. Furthermore, the elementary-level language course is designed to help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. Four hours in-class instruction per week, plus mandatory homework. Prerequisite: None.
82-172 Elementary Japanese II  
Spring: 12 units  
A sequel to Elementary Japanese I (82-171). This course continues to further the development of communicative language proficiency: oral practice, aural comprehension, reading, writing, and the study of cultural aspects in Japanese society. Furthermore, the elementary-level language course is designed to help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. For hours in-class instruction per week, plus mandatory homework assignments. Prerequisite: 82-171 or approved equivalent.

82-176 Intensive Japanese Language and Culture: Elementary Level  
Intermittent: 6-24 units  
Transfer credit for study abroad in Japan or other approved program at the Elementary level. Credit determined after consultation with the transfer credit advisor for Japanese.

82-181 Freshman Seminar  
Spring: 9 units  
This course is intended to fulfill the Freshman Seminar requirement of the General Education Program. The specific topic and instructor will vary from semester to semester. Taught in English. Prerequisite: None.

82-182 Freshman Seminar: Language and Culture: Language in its Social Context  
Intermittent: 9 units  
This course will explore the relationship between language and culture as it manifests itself in language use in a wide variety of speech communities throughout the world. The purpose of the course will be to demonstrate the multifaceted and complex relationship between language and culture and how language use both exemplifies cultural values and simultaneously serves to reinforce them. The course will consider a wide variety of topics, all of which demonstrate implicit cultural differences and attitudes as manifested in language use. Illustrative examples include analysis of the relationship between language and thought (the Sapir-Whorf linguistic relativity hypothesis); standard versus vernacular languages; attitudes toward language acquisition as it differs from one speech community to another; bilingualism and multiculturalism in this country and throughout the world; diglossia; language, literacy and education; non-verbal aspects of language use; gender-based differences in language and culture; sociolinguistic variables in the ethnography of speaking; language loss and language maintenance; politics, language planning and language policy and the impact of languages in contact. Prerequisite: None.

82-183 Freshman Seminar: Constructions of Memory and Modernity  
Fall: 9 units  
This course will focus on the arts in society during the period of intense modernization that begins in the middle of the nineteenth century (the Second Empire in France), with an emphasis on the late nineteenth century and the early years of the twentieth century (approximately until the time of World War I [1914-1918]). We will read a wide range of literary, historical, and cultural works in an interdisciplinary, comparative perspective. Our focus is on the cultures of Western Europe and the U.S., with an emphasis on French, Anglo-Irish and English, and German works; the readings will be complemented by study of the visual arts, especially Impressionism and photography, theater, and opera. We will view some of the latter works on film and video, when available. Prerequisite: None.

82-184 Freshman Seminar: The Birth and Death of Tragedy  
Intermittent: 9 units  
This is a BHA (Bachelor of the Humanities and the Arts) freshman seminar, taught in English, and it addresses one of the most important questions in the development of Western culture: what is tragedy, how did it evolve, and what does it mean today? Starting with Aischelle’s Oresteia and Aristotle’s Poetics, the seminar explores the nature of tragedy in ancient Greece as a theatrical experience, a literary form, and an expression of Greek culture. Friedrich Nietzsche’s essay The Birth of Tragedy offers an interpretation of the meaning of tragedy in its original context and a link to the nature of tragedy in the modern world. Richard Wagner’s music drama Tristan und Isolde and his theoretical essays, including “Art and Revolution” and “The Art-Work of the Future” further illustrate and develop the theme, showing how a dominant representative of nineteenth century culture sought to reevaluate and reclaim the tragic form, linking it with an extensive critique of modern culture. Thomas Mann’s Death in Venice provides an early twentieth century variation on the theme of tragedy, and Sigmund Freud’s Civilization and its Discontents, like Nietzsche’s essay, provides a framework for placing tragedy in its cultural context. Finally, Arthur Miller’s Death of a Salesman provides a modern American version of the problem of tragedy. Students in this seminar are asked to write short papers every two to three weeks, and the in-class focus is on intensive discussion and analysis of the texts. Prerequisite: None.

82-186 Freshman Seminar: Introduction to Russian Culture  
Intermittent: 9 units  
This course will deal with important cultural achievements of the Russian people in different areas. The main focus will be on the analysis of relationships between Russian and Western cultural traditions. The topics chosen for analysis are significant for Russian cultural history. Class discussions will help students in understanding and appreciating some specific ways and achievements in the development of Russian popular culture. Distinctive aspects of Russian high culture will also be highlighted, especially through art and music. This course will include secondary readings, primary documents, and films. Prerequisite: None.

82-189 Independent Study in Language and Culture: Elementary Level  
Fall and Spring: 6-12 units  
An opportunity for students who wish to complement their course work at the Elementary Level and pursue further study at this level. In conjunction with a faculty member, students will arrange a program of study to explore aspects of the target language and culture. Prerequisite: Permission of the Instructor.

82-191 Elementary Russian I  
Fall: 12 units  
This course begins the Russian language sequence and is offered in the Fall semester only. The course takes a proficiency-based approach to teaching basic skills in listening, speaking, reading and writing. Language is presented in communicative contexts illustrating cultural aspects of daily Russian life. Special emphasis is given to developing oral competency. Attendance is required at four hourly meetings per week. One to two hours per day outside of class must be devoted to practice in the Language Learning Resource Center and to other oral and written homework assignments. The elementary level is designed to help students learn to reflect upon and draw upon strategies used by good language learners in their second language study. Prerequisite: None.

82-192 Elementary Russian II  
Spring: 12 units  
The second part of a two-semester course sequence (82-191, 82-192). Prerequisite: 82-191 or approved equivalent.

82-198 Research Training: Modern Languages  
Fall and Spring: 9 units  
This one-semester research internship is open to second semester freshmen and sophomores with a 3.0 GPA or by petition. The intention of this internship is to involve students in a faculty research project in its early stages. The Undergraduate Coordinator maintains a listing of participating faculty and the current projects on which they are willing to supervise student interns. The general interests of Modern Languages faculty include three broad categories: second language acquisition, cultural studies, and the development of innovative multi-media
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applications to language teaching. It is intended that students carry out a piece of individual research which will require about ten hours per week. They will be expected to produce a final report. Weekly meetings with the supervising faculty member will be arranged. Students may take this seminar only once. Prerequisite: Permission of the Instructor.

82-201 Intermediate French I
Fall and Spring: 9 units
An integrated approach to the study of the French language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken French. This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness and self-realization while developing proficiency in French. This course is designed to strengthen listening, speaking, reading and writing, within the context of an evolving French culture. Varying with each semester, the course will use classic French texts as well as songs, excerpts from newspapers, magazines or films. Prerequisite: 82-102/104, placement score, or permission of the Instructor.

82-202 Intermediate French II
Fall and Spring: 9 units
An integrated approach to the study of the French culture and language by means of literary and cultural texts and analysis, coupled with a review of elements of French grammar. Intensive practice in written and spoken French also constitutes the basis for this course as a preparation for the advanced level. Students are invited to explore the French and Francophone worlds as they intersect and sometimes clash, with the goal of fostering better cross-cultural awareness. Texts may include: novels, short stories, newspaper articles, songs, television and film. Three hours of in-class instruction per week. Prerequisite: 82-201, 82-203, placement score, or permission of the Instructor.

82-203 Intermediate French I Online
Fall: 9 units
An integrated approach to the study of the French language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken French. This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness and self-realization while developing proficiency in French. This course is a parallel offering designed for students who need a more flexible approach to language learning than that offered in a standard classroom course. All materials are Web-based, with extensive use of Internet technologies for research, writing and communication. There is a required weekly class meeting for training and for group activities, plus individual weekly meetings with a tutor or the instructor for conversation and practice. See www.languageonline.org for a more detailed description of requirements and class structure before enrolling. Prerequisite: 82-102, 82-104, or permission of the Instructor. Students new to French study at Carnegie Mellon must take the placement exam. Instructions for the placement exam are in BH 160. Prerequisites: 82201 or 82203

82-206 Intensive French Language and Culture: Intermediate Level
Intermittent: 0-18 units
Transfer credit for study abroad in France, a French-speaking country, or other approved program at the Intermediate level. Credit determined after consultation with the transfer credit advisor for French.

82-221 Intermediate German I
Fall and Spring: 9 units
The overall goal of Intermediate German I is to further develop your linguistic and cultural knowledge, allowing you to feel more comfortable as a user of German. By the end of the semester, you should be able to: . use and understand German in everyday situations. . communicate effectively in general areas and in individual areas of interest. . understand general cultural perspectives in contemporary Germany. . read and understand authentic materials from German-speaking countries. A balance of activities will help the development of all four skills and of cultural knowledge, and assessment of progress will occur across skills throughout the semester. This is a content-based course, best titled "Der Au'enseiter in der deutschen Kultur." We will look at various examples of "outsiders" in German-speaking countries, and compare and contrast their home culture with the culture of German-speaking countries. We'll be using listening activities for intermediate students and reading children's books written for native speakers. These materials include authentic and up-to-date language and cultural information. You will also complete cultural activities using materials from the web. Taught in German. Prerequisite: 122 or 123 (part 2) or approved equivalent.

82-222 Intermediate German II
Fall and Spring: 9 units
You should already be able to: . use and understand German in some basic situations. . communicate effectively in general areas and in individual areas of interest. . understand general cultural perspectives in contemporary Germany. . use authentic materials from German-speaking countries on the web. In this class, you will expand and develop these skills and work on speaking in paragraphs, not just in sentences. A balance of activities will help the development of all four skills and of cultural knowledge, and assessment of progress will occur across skills throughout the semester. Throughout this course, the emphasis is on effective communication, without neglecting linguistic accuracy. This is a content-based course, best titled "Bilder von Amerika aus dem 20. Jahrhundert." We will investigate European perceptions of America in the early and late 20th century. We will compare and contrast these perceptions with our own pictures of German-speaking countries. Taught in German. Prerequisite 221 or approved equivalent.

82-226 Intensive German Language and Culture: Intermediate Level
Intermittent: 6-24 units
Transfer credit for study abroad in Germany, a German-speaking country, or other approved program at the Intermediate level. Credit determined after consultation with the transfer credit advisor for German.

82-231 Intermediate Chinese I
Fall: 12 units
This course is the continuation of Elementary Chinese II (82-132). Students will continue to learn the basic skills of listening, speaking, reading and writing for daily communication. More
variety of expressions and complicated sentence structures will be taught so that students can carry on daily conversations on various topics related to modern Chinese Society. While equal emphasis will still be given to both Pinyin and characters, students will be encouraged to use more and more Chinese characters with the help of Pinyin. Activities related to the broad spectrum of the Chinese culture will be organized to facilitate the language learning with knowledge of the cultural background of the language. Prerequisite: 82-132 or permission of the instructor.

82-232 Intermediate Chinese II
Spring: 12 units
This is the second semester of Intermediate Chinese, a continuation of the Elementary Chinese course for beginning Chinese students. It aims at helping students expand their vocabulary and knowledge of grammar of the Chinese language by learning more new words, expressions and sentence patterns needed for everyday communication and by consolidating their knowledge through oral and written practice in and out of class. In this course, students will participate in classroom discussions in Mandarin Chinese on various topics concerning everyday life and study and learn to write short paragraphs on those topics in Chinese characters. Different aspects of Chinese culture will also be introduced throughout the course through audio and video tapes, lectures and discussions. Prerequisite: 82-231 or permission of the instructor.

82-235 Intensive Intermediate Chinese
Intermittent: 12 units
This course is the continuation of Intensive Elementary Chinese (82-135). Students will continue to learn the basic skills of listening, speaking, reading and writing for daily communication, while more focus is on reading and writing Chinese characters. More variety of expressions and complicated sentence structures will be taught so that students can carry on daily conversations on various topics related to modern Chinese Society. Activities related to the broad spectrum of the Chinese culture will be organized to facilitate the language learning. This course can be a substitute for 82-232 for Chinese Minor. Prerequisite: 82-135 or equivalent. Instructor’s approval is required to register for this course.

82-236 Intensive Chinese Language and Culture: Intermediate Level
Spring: Variable units
Transfer credit for study abroad in China, a Chinese-speaking country, or other approved program at the Intermediate level. Credit determined after consultation with the transfer credit advisor for Chinese.

82-241 Intermediate Spanish I
Fall and Spring: 9 units
An integrated approach to the study of the Spanish language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken Spanish. This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness and self-realization while developing proficiency in Spanish. The first part of a two-semester course sequence (82-241, 82-242). Prerequisite: 82-142 or approved equivalent.

82-242 Intermediate Spanish II
Fall and Spring: 9 units
An integrated approach to the study of the Spanish language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken Spanish. This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness and self-realization while developing proficiency in Spanish. The second part of a two-semester course sequence (82-241, 82-242). Prerequisite: 82-241 or approved equivalent.

82-243 Intermediate Spanish I Online
Fall: 9 units
An integrated approach to the study of the Spanish language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken Spanish. This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness and self-realization while developing proficiency in Spanish. This course is a parallel offering designed for students who need a more flexible approach to language learning than that offered in a standard classroom course. All materials are Web-based, with extensive use of Internet technologies for research, writing and communication (chat and b-boards). There is a required weekly class meeting for training and for group activities, plus individual weekly meetings with a tutor or the Instructor for conversation and practice. See www.languageonline.org for a more detailed description of requirements and class structure before enrolling. Prerequisite: 82-142, 82-144, 82-147 or permission of the Instructor. Students new to Spanish study at Carnegie Mellon must take the placement exam. Instructions for the placement exam are in BH 160.

82-244 Intermediate Spanish II Online
Spring: 9 units
An integrated approach to the study of the Spanish language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken Spanish. This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness and self-realization while developing proficiency in Spanish. A continuation of 82-243, Intermediate Spanish I Online. This course is a parallel offering designed for students who need a more flexible approach to language learning than that offered in a standard classroom course. All materials are Web-based, with extensive use of Internet technologies for research, writing and communication (chat and b-boards). There is a required weekly class meeting for training and for group activities, plus individual weekly meetings with a tutor or the Instructor for conversation and practice. See www.languageonline.org for a more detailed description of requirements and class structure before enrolling. Prerequisite: 82-241, 243, or permission of the Instructor. Students new to Spanish study at Carnegie Mellon must take the placement exam. Instructions for the placement exam are in BH 160.

82-246 Intermediate Spanish Language and Culture:
Intensive Level
Intermittent: 0-18 units
Transfer credit for study abroad in a Spanish-speaking country or other approved program at the Intermediate level. Credit determined after consultation with the transfer credit advisor for Spanish.

82-261 Intermediate Italian I
Fall: 9 units
An integrated approach to the study of the Italian language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken Italian. This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness and self-realization while developing proficiency in Italian. A two-semester course sequence (82-261, 82-262) for intermediate-level students. An integrated approach to the study of Italian language and culture, consisting of grammar review, readings, and intensive practice in written and spoken Italian. Prerequisite: 82-162 or approved equivalent.

82-262 Intermediate Italian II
Spring: 9 units
An integrated approach to the study of the Italian language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken Italian. This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness and self-
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realization while developing proficiency in Italian. The second part of a two-semester course sequence (82-261, 82-262). An integrated approach to the study of Italian language and culture consisting of grammar review, readings and intensive practice in written and spoken Italian. Knowledge of pre-war writers. Students learn not only a body of English, with no previous knowledge of Japanese assumed. It is intended both for individuals who want to gain a better understanding of modern Japanese society, as well as for students of the Japanese language.

82-276 Intensive Japanese Language and Culture: Intermediate Level
Fall and Spring: 9-18 units
This course further develops communicative proficiency through intensive practice in written and spoken Russian. Complex grammatical structures and stylistic variations are mastered and extensive vocabulary is acquired. Through reading materials, fictional and non-fictional, acquaintance is made with the basic components of Russian cultural literacy as well as the distinctive cultural aspects of daily Russian life. Attention is directed toward the dynamic interaction of language and culture in order to foster cross-cultural awareness. Four hours of in-class instruction plus additional hours in the Language Learning Resource Center are mandatory, as are written homework assignments. Prerequisite: 82-192 or approved equivalent.
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82-280 Learning About Language Learning
Fall: 9 units
This course is designed for students majoring or co-majoring in Modern Languages or for students seriously contemplating undertaking the study of a foreign language at a future time. Experienced language learners bring to the tasks of learning a new language all sorts of general knowledge about the ways in which languages work as well as techniques for putting this knowledge to practical use. The objectives of this course are to provide students with a basic introduction to those areas of linguistics and psycholinguistics that will facilitate their language learning. Co-requisite: Study of a foreign language.

82-281 Tutoring for Community Outreach
Intermittent: 6-12 units
Students participate in a community outreach program and work in Pittsburgh Public Schools with elementary, middle or high school students of ESL, French, German, Japanese, or Spanish. The high school experience invites advanced students, majors, or minors in French, German, Japanese, or Spanish to work with language students at Schenley High School or Taylor Allderdice High School. Activities in the high schools may involve tutoring, may be remedial, or may be for enrichment. At Schenley High, Carnegie Mellon students may aid in students' preparation for International Baccalaureate Exams in the Spring. During the early weeks of the semester, students will meet individually with the faculty liaison to arrange their community outreach activities and also as a group to prepare for their experience. Depending on the number of units to be earned, during the course of the semester, students will spend a certain number of hours per week engaged in some of the following activities: attending and participating in the individual and group meetings, tutoring four to six hours per week, reading and preparing for the school visits, keeping a journal of tutoring experiences, writing a paper at the end of the term that reflects experiences. Students earn 6 units by spending 4 hours per week at a school site plus completing related activities. Students earn 9 units by spending 6 hours per week at a school site plus completing related activities. Grade will be Pass/Fail, based on the student's fulfillment of the plan set at the beginning of the semester. Prerequisites: Permission of the faculty liaison plus completion of an information sheet and clearance forms available in the Department of Modern Languages.

82-289 Independent Study in Language and Culture-Intermediate Level
Fall and Spring: 9-18 units
An opportunity for students who wish to complement their course work at the Intermediate Level and pursue further study at this level. In conjunction with a faculty member, students will arrange a program of study to explore aspects of the target language and culture. Prerequisite: Permission of the Instructor.

82-291 Intermediate Russian
Fall: 9 units
This course explores definitions of culture and analyzes the dynamic role of language in culture and culture in language, with an aim to foster cross-cultural awareness while developing proficiency in Russian. The second part of a two-
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82-293 Introduction to Russian Culture
Intermittent: 9 units
Russia is one of the oldest European countries and long ago achieved world recognition for its outstanding contributions to Western traditions in art, architecture, music and ballet. This introductory course, based on primary documents, secondary readings, film and music, will help you to understand the distinctive cultural spirit of this great nation. Prerequisite: 82-291 or approved equivalent.

82-294 Topics in Russian Language and Culture
Intermittent: 9 units
"The Fine Arts in Russia" is a multi-purpose course designed primarily to introduce the "Golden Treasures" of Russian culture to a wide audience. The most outstanding works, artists and periods in the development of Russian architecture, painting, theatre, film and music comprise the content of the course. Specific topics in architecture include: ancient Russian building types, traditional Moscow style, Shchetel and Moscow Modernism, and the cultural monuments of St. Petersburg. Topics in painting include: ancient Russian icons, the Tretyakov gallery in Moscow, the "Fellow Travelers" movement, and the Russian avant-garde. Specific topics in theatre and film include the directing methods of Stanislavsky, Meyerhold and Vakhtangov. Attention is also devoted to Russian ballet, opera, and music. Genres include folk and popular song as well as art song and opera. The course permits some individualization and is so designed to accommodate both those who study Russian (at any level) and those who do not. Assignments will consist of reading, viewing, listening, writing brief essays and making oral presentations. Students of the Russian language will be assigned some materials and tasks in Russian appropriate to their level. Students of Russian song will be provided opportunities to work on diction, and as with students of Russian drama, will be familiarized with the cultural background appropriate to the repertoire. Students of Russian art and architecture will be encouraged to apply their graphic skills to the mastery of the course material. PREREQUISITES: None. All persons who would like to consider the course are urged to contact Russian Studies Director, Charlene Castellano, at cc62@andrew.cmu.edu for further information.

82-301 French for Reading Knowledge
Intermittent: 9 units
This course offers an introduction to the written French language for undergraduate students in the humanities. Students will be introduced to the structure of the French language in order to prepare them for their own research needs that will require consultation of sources in French. The course is not intended to develop writing, listening and speaking skills, nor is it intended to prepare students for further study in the regular undergraduate French program. It is intended to help them meet specific needs in their research in areas such as history, art and music history, literature, and literary and cultural studies. Prerequisite: Permission of the Instructor.

82-303 French Culture
Fall and Spring: 9 units
The purpose of this course is to advance grammatical, communicative and cultural proficiency, through an in-depth study of France and the French. Attempts will be made at defining the French "identity" or what it means to be French, through the study of aspects of French history, French institutions, regions, literature, etc. Examples may be drawn from television and films, songs, and complete literary works, spanning the ages. Great emphasis will be placed on the expression of critical judgment in both oral and written form, documented through readings and personal research. Prerequisite: Completion of the intermediate level or the equivalent. Prerequisites: 82202 or 82204

82-304 The Francophone World
Fall and Spring: 9 units
This course introduces the student of French to several of the francophone regional cultures outside of France, including North and West Africa, Belgium, Quebec, and the Antilles. The culture commonly associated with the French language is the primarily Christian and Cartesian European tradition. Through the experience of this course, you will learn of the multiple synthetic cultural realities which have arisen through the colonial and post-colonial processes of contact between European and non-European cultures, and which are now expressed through the medium of the French language. Materials studied will include novels, short stories, essays, newspaper and scholarly articles, film, documentary video and song. The course also introduces students to the formal requirements of continuing cultural study, thus assignments will include analyses that demonstrate the ability to express critical judgments in both written and oral form, using accepted academic conventions for research documentation and exposition. Prerequisites: 82-303 or permission of the instructor. Prerequisites: 82202 or 82204

82-305 French in its Social Contexts
Fall: 9 units
This course will focus on culture through language variation in spoken and written forms of French. Readings, videos, web use, and in-class conversations will involve phonological and sociolinguistic aspects of the French language and language change, its use regarding different registers and regional languages within France, the question of social identity through language, immigration and generational issues, and an exploration of the distinctive francophone uses of the French language. In addition, students will be prepared to discuss current issues in France and francophone regions/ countries by using multimedia tools available in the Modern Language Resource Center (MLRC). Students will also work on the French phonological system. Three hours of in-class instruction per week plus mandatory laboratory work outside of class. Prerequisite: Completion of at least one 300-level French course, placement score, or permission of Instructor. Prerequisites: 82303 or 82304

82-306 Intensive French Language and Culture: Advanced Level
Intermittent: 0-18 units
Transfer credit for study abroad in France, a French-speaking country, or other approved program at the Advanced level. Credit determined after consultation with the transfer credit advisor for French.

82-323 Germany, Austria and Switzerland in the 20th Century
Fall: 9 units
This course advances proficiency in communicative and grammatical skills in the German language and knowledge of German-speaking cultures through the study of important events, trends, and people of the twentieth century in Germany, Austria, and Switzerland. Examples will be drawn from literature, newspapers, television, film and other sources. Students will be expected to complete assignments that demonstrate the ability to express critical judgments in both written and oral form, documented through readings and personal research. Prerequisite: 82-222 or approved equivalent.

82-324 Contemporary Germany, Austria and Switzerland
Spring: 9 units
This course advances proficiency in communicative and grammatical skills in the German language and knowledge of German-speaking cultures through the study of important events, trends, and people of contemporary Germany, Austria, and Switzerland. Examples will be drawn from literature, newspapers, television, film and other sources. Students will be expected to complete assignments that demonstrate the ability to express critical judgments in both written and oral form, documented through readings and personal research. Prerequisite: 82-222 or approved equivalent.
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82-325 Introduction to German Studies
Fall: 9 units
The Italian literary theorist Franco Moretti has written that "Germany is a sort of Magic Stage, where the symbolic antagonisms of European culture achieve a metaphysical intractability, and clash irreconcilably. It is the centre and catalyst of the integrated historical system we call Europe." This course is a general introduction to German culture, German history, and German society, with a focus on Germany's role as center and catalyst of the European system. The course is conducted entirely in German. Its goal is to provide students with a basic level of cultural literacy about the German-speaking world. In the course, we will study major trends from the earliest days of German civilization through the middle ages but with primary emphasis on the last 250 years and with a special focus on problems of national, political and cultural identity. Students coming out of the course should have a broad understanding of the language. These language phenomena will be introduced through texts as well as multi-media programs closely related to various social issues in China to provide students with the necessary knowledge of the language and its background. Classroom discussions will be an important part of the course followed by the practice of writing of essays on topics related to various social issues in China. With Pinyin as a help, students are required to use both the traditional and simplified forms of Chinese characters in their reading and writing. Prerequisite: 82-222 or approved equivalent.

82-326 Intensive German Language and Culture: Advanced Level
Intermittent: 6-24 units
Transfer credit for study abroad in Germany, a German-speaking country, or other approved program at the Advanced level. Credit determined after consultation with the transfer credit advisor for German.

82-331 Advanced Chinese I
Fall: 9 units
This course is designed for students who have reached the intermediate level of proficiency in the use of Chinese language. With emphasis on the communicative functions of the language, it aims at covering students' language process competency in all four skills of listening, speaking, reading and writing. More complex language phenomena needed for communication in a variety of discourse will be introduced through texts as well as multi-media programs closely related to various social issues in China to provide students with the necessary knowledge of the language and its background. Classroom discussions will be an important part of the course followed by the practice of writing of essays on topics related to various social issues in China. With Pinyin as a help, students are required to use both the traditional and simplified forms of Chinese characters in their reading and writing. Prerequisite: 82-232, 82-235 or approved equivalent.

82-332 Advanced Chinese II
Spring: 9 units
A continuation of Advanced Chinese I, this course is designed to train students with the ability to use Chinese language to deal with abstract topics they may encounter in their life. Students will continue to learn more complex language phenomena in order to do exposition, explanation, description and argumentation with the language. These language phenomena will be introduced to students together with their social and cultural background through texts and multi-media programs related to various social issues. Classroom discussions will be the major form of practice. Students will discuss and comment on issues related to family, love, marriage and other human relations as well as the economic situations in the Chinese society by using their language skills in narration, description, comparison, argumentation, etc. Students will also be required to write short articles of 300-500 Chinese characters on various topics discussed in class. Prerequisite: 82-331 or approved equivalent.

82-333 Introduction to Chinese Language and Culture
Fall: 9 units
This course will introduce the students to the Chinese language and culture from a historical as well as contemporary point of view. It is intended to help students develop awareness of and sensitivity to Chinese culture and society and to gain a better understanding of Chinese ways of thinking. Students will be exposed to different aspects of Chinese culture and their relationship with the language. Class activities will include lectures by the Instructor and guest speakers, seminars, movies, video and other multimedia materials. Hands-on experience will also be a part of the course. This course is conducted in English with no knowledge of Chinese language required. Those who take this course toward Chinese Minors will be assigned extra work in Chinese to fulfill the requirement for the extra 3 units. Prerequisite: 82-232 or approved equivalent for students seeking credit toward the Chinese minor. No prerequisites for non-minors.

82-334 Structure of Chinese
All Semesters: 9 units
This is an upper-level Chinese course for students who have reached intermediate level of Chinese. It aims at helping students further develop and refine their Chinese speaking and writing skills. This course will deal with major structural phenomena in Modern Chinese through the study of sample texts. Special emphasis will be given to high frequent errors and individual weaknesses on particular problematic elements and sentence structures that are common among non-native Chinese speakers. After the study of this course, students are expected to have a more comprehensive and systematic understanding of the structure of the language, which will help them lay a solid foundation for their language proficiency. Prerequisite: 82-232, 82-235 or approved equivalent.

82-335 Readings in Chinese
Intermittent: 9 units
This is an upper-level Chinese reading course for students who have reached intermediate level of Chinese. It aims at helping students further develop and refine their Chinese reading and writing skills. Its major goal is to train students the ability to read in Chinese with fluency and proficiency within a format of rich cultural content. Readings will include traditional fables, mini-stories and articles on the lifestyle and social changes in modern China. While class discussion will be the major form of class activities, students are also expected to enhance their vocabulary building and improve their sense of Chinese language through extensive reading and writing assignments. Prerequisite: 82-232 or approved equivalent.

82-336 Intensive Chinese Language and Culture: Advanced Level
All Semesters: Variable units
Transfer credit for study abroad in China, a Chinese-speaking country, or other approved program at the Advanced level. Credit determined after consultation with the transfer credit advisor for Chinese. Prerequisites: 82232

82-337 Mandarin Chinese for Oral Communication I
Fall: 9 units
This is an upper-level course focused on the improvement of students' oral communicative competence and self-expression in Chinese. It is designed for students who have reached intermediate level in reading and writing Chinese but have little knowledge of mandarin Chinese pronunciation, as well as those who aim to further improve their speaking in Chinese. Emphasis will be given to helping students develop the accuracy and fluency which characterize the speech of native Mandarin speakers. Students will be introduced to Pinyin, the phonetic system of Mandarin Chinese, and work to refine and perfect their speaking skills through special attention to different styles, colloquialisms, and dialectal variations of contemporary spoken Mandarin. Course materials will include authentic Chinese TV programs, documentaries, films, recorded materials, and contemporary literary and non-literary texts. Students will be required to participate in intensive speaking activities, such as interviewing native speakers of Chinese, oral presentations, discussions, debates, and special projects. At the end of the course, students are expected to carry on oral communication with native Mandarin speakers in a clearly participatory fashion on topics related to various social issues in Modern China. Prerequisite: 82-232, 82-235 or approved equivalent.
82-338 Chinese for Oral Communication II
Spring: 9 units
This course is designed for students who have reached an intermediate level in reading and writing Chinese, and who would like to promote their oral communicative competence and knowledge of Chinese culture. It is a seminar-type class that relies on active participation from the students. Students will practice various conversational tasks, such as giving presentations, participating in discussions and debates, interviewing, describing, and interpreting. Topics will include current events and cultural trends in the U.S. and China, analysis of Chinese culture and comparisons with other cultures, contemporary Chinese television shows and movies, and other debatable and interesting issues. Prerequisite: Intermediate level in reading and writing Chinese. Permission of the Instructor.

82-341 Advanced Spanish Transfer Credit
All Semesters: Variable units
This course number is given to advanced courses in Grammar, Composition, Conversation, or other appropriate advanced coursework taken as part of a study abroad program or at another institution. Prerequisite: Prior permission of the major or minor advisor in Spanish.

82-342 Spain: Language and Culture
Fall and Spring: 9 units
This course is part of the post-intermediate, 300-level program that forms the introduction to the major or minor in Spanish. Students may begin with any one of the three or they may be taken concurrently. Spain focuses on the cultures of Spain, the autonomous regions and the creation of a national identity as a reaction to the multiple ethnicities that have inhabited the peninsula since ancient times. The course will focus on the building of reading and writing skills will be complemented by continued oral practice in the form of small and large group discussions and class presentations. Treatment of reading selections is designed to increase students general familiarity with a variety of genres, devices, and discourse types and to build a foundation for the department’s more advanced courses in literature, history and culture. Writing assignments will involve reflective essays, individualized research, and the generation, expression, analysis and re-writing of ideas. Prerequisite: Completion of the intermediate level or the equivalent.

82-343 Latin America: Language and Culture
Fall and Spring: 9 units
This course is part of the post-intermediate, 300-level program that forms the introduction to the major or minor in Spanish. Students may begin with any one of the three or they may be taken concurrently. Latin America focuses on the cultures of Spanish-speaking countries in the Americas (excluding the United States), and the unique hybrid cultures formed from the fusion of indigenous, European and African influences. The course advances proficiency in grammatical accuracy, the ability to communicate one’s ideas in Spanish, and cultural proficiency. The focus of in-class activities is on written and non-written sources such as history, literature, film, art, and elements of popular culture; the building of reading and writing skills will be complemented by continued oral practice in the form of small and large group discussions and class presentations. Treatment of reading selections is designed to increase students general familiarity with a variety of genres, devices, and discourse types and to build a foundation for the department’s more advanced courses in literature, history and culture. Writing assignments will involve reflective essays, individualized research, and the generation, expression, analysis and re-writing of ideas. Prerequisite: Completion of the intermediate level or the equivalent.

82-344 US Latinos: Language and Culture
Fall and Spring: 9 units
This course is part of the post-intermediate, 300-level program that forms the introduction to the major or minor in Spanish.

Students may begin with any one of the three or they may be taken concurrently. A course that would analyze the history of the Hispanic presence in what is today known as the United States, since the period of the Spanish exploration and colonization of North America to the present. We will be examining the writing of native, immigrant and exile Hispanics in the context of the geographical, political and societal borders that exist between U.S. mainstream society (black and white) and other sectors of society. Prerequisite: Completion of the intermediate level or equivalent.

82-345 Hispanic Literary and Cultural Studies
Intermittent: 9 units
This course is an introduction to the social, political, and economic forces that have shaped the more than two thousand-year old cultures and histories of Spain and Latin America. We shall trace the development of new expressions of cultural identity in the Americas, resulting from five hundred years of transculturation in Spain, Latin America, and the U.S., with a focus on the interactions between the different parties. Prerequisite: Completion of two of the three introductory 300-level language and culture courses or Instructor approval. Prerequisites: 82342 and 82343

82-346 intensive Spanish Language and Culture: Advanced Level
Intermittent: 18,24 units
Transfer credit for study abroad in a Spanish-speaking country or other approved program at the Advanced level. Credit determined after consultation with the transfer credit advisor for Spanish.

82-371 Advanced Japanese 1
Fall: 9 units
A two-semester course sequence (82-371, 82-372) for advanced-level students. This course emphasizes the acquisition of effective use of oral and written Japanese through readings, interviews with native speakers, class discussions, oral presentations and writing assignments. Students should be able to advance not only their Japanese language skills but also their understanding of contemporary Japan. Prerequisite: 82-271/82-272 or approved equivalent. Prerequisites: 82272

82-372 Advanced Japanese II
Spring: 9 units
A sequel to Advanced Japanese 1 (82-371). This course continues to further improve communicative competence in oral and written Japanese for advanced-level students. Through readings, interviews with native speakers, class discussions, oral presentations, and writing assignments, students should be able to advance not only their Japanese language skills but also their understanding of contemporary Japan. Prerequisite: 82-371 or approved equivalent.

82-373 Structure of the Japanese Language
Intermittent: 9 units
This course provides the overall characteristics of the Japanese language as a language system, including its sound system, word formations, word classifications and grammar. A major part of this course, however, will focus on Japanese functional grammar. We will discuss the similarities and differences of Japanese to other languages such as Korean, Chinese, and English. Japanese will also be analyzed from the viewpoint of language universals. The analysis of grammar will be explained based on written/oral data. Students are given opportunities to analyze discourse data in order to highlight discussion points in class. The course is taught in English. While previous Japanese language is required for this course, familiarity with Japanese will help you grasp the linguistic relevance of discussion topics. Prerequisite: None.

82-374 Technical Japanese
Intermittent: 9 units
This course is the first course in Technical Japanese. It will introduce students to expository styles in Technical Japanese. It
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will explore technical terms and concepts in electrical engineering, computer science and computer engineering. In addition, it will enable students to acquire knowledge of some key topics in Technical Japanese. This course will also provide students with practical information as well as cultural information in the contexts of Japanese science and technology. Furthermore, the students are given an opportunity to work with a Japanese student/researcher for a final project. 82-272, or permission of the instructor.

82-376 Intensive Japanese Language and Culture: Advanced Level
Intermittent: 9 units
Transfer credit for study abroad in Japan or other approved program at the advanced level. Credit determined after consultation with the transfer credit advisor for Japanese.

82-380 Independent Study in Second Language Acquisition
Spring: 9 units
An opportunity for students who wish to pursue independent supervised study in second language acquisition (SLA). In conjunction with a faculty member, students will arrange a program of study to explore aspects of SLA. Prerequisite: Permission of the Instructor.

82-383 Introduction to Second Language Acquisition
Fall: 9 units
This course provides an introduction to research and theories in Second Language Acquisition (SLA). Processes that underlie the learning and use of second languages are examined from four perspectives: 1) as linguistic knowledge, 2) as a cognitive skill, 3) as a personality-mediated process, and 4) as a socio-culturally mediated process. Factors examined include: age-related differences, the influence of the first language, the role played by innate (universal) principles, the role of memory processes, attitudes, motivation, personality and cognitive styles, and formal versus naturalistic learning contexts. Issues that arise from the course readings are investigated through practical experience in applying theoretical knowledge to small-scale empirical research projects. Students are also provided with opportunities to consider the relevance of these issues to their own language learning experiences. Prerequisite: None. However 82-280 “Learning about Language Learning” is strongly recommended.

82-384 Language and Culture: Language in its Social Context
Intermittent: 9 units
The focus of this course is an examination of the dynamic role that language plays in a multitude of social contexts throughout the world. The goal of the course is to develop students' sensitivity and awareness to the dual role of language both as a reflection of prevailing social attitudes and as a force that serves to perpetuate many social attitudes and roles. This complex relationship between language, society, culture and personal identity will be demonstrated by examining language use in a wide variety of speech communities throughout the world. The course will consider numerous diverse topics, all of which demonstrate implicit cultural differences and attitudes as manifested through language use. Examples of topics to be considered include standard versus vernacular languages; dialects and variation, language attitudes, bilingualism and multiculturalism in the United States and throughout the world; diglossia; language, literacy and education; non-verbal aspects of language use; gender-based differences in language and culture; socio-linguistic variables in the ethnography of speaking; language loss and language maintenance; political, language planning, language policy and the impact of languages in contact. The course will be taught on a seminar basis and will involve regular fieldwork activities to bring the themes of the course to life. Prerequisite: None.

82-385 Language Across the University
Fall and Spring: 3-12 units
Language credit may be attached to any course, independent study, or project unit for which a student receives content-area academic credit. The program is available at the discretion of the responsible content-area faculty, who should be sufficiently skilled in the chosen language to be able to evaluate the technical content of a student's work. The student, content-area faculty and language faculty negotiate a plan for the semester's work, designed to consume approximately three hours per week for three units of academic credit. The course may be repeated on multiple occasions. Prerequisites: Intermediate level language proficiency or above and permission of a content-area faculty member and the Department of Modern Languages.

82-387 The Film Festival
Intermittent: 9 units
The Film Festival is an annual offering which rotates between the Departments of English, History and Modern Languages, with a different annual theme selected by the Instructor. A core element every year is the study of the Film Festival itself as a global cultural and economic phenomenon. Students in the course will also participate in the planning, promotion and running of a public film festival based on the annual theme and presented to the Carnegie Mellon and Pittsburgh film communities in McKeeny Auditorium. Prerequisite: None.

82-388 Understanding Second Language Fluency
Fall: 9 units
This course will explore the notion of second language (L2) fluency from various perspectives. The major objective of the course will be to help students develop an understanding of what it means to be “fluent” in a second language and to help them improve their OWN fluency. We will examine the notion of “fluency” itself and explore several of the common assumptions, definitions, contradictions and problems associated with the use of “fluency” as a commonly used term, in both first and second languages. Students will undertake a series of fieldwork projects in their second language. These projects will include explorations of native speaker perceptions of L2 fluency and analyses of how these subjective perceptions relate to actual features of language use. Students will analyze samples of their own L2 speech to see how their second language use coincides with commonly used references to fluency and ways in which they may improve their own language fluency.

82-389 Independent Study in Language and Culture-Advanced Level
Fall and Spring: 3-12 units
An opportunity for students who wish to complement their course work at the Advanced Level (in 300-level courses) and pursue further study at this level. In conjunction with a faculty member, students will arrange a program of study to explore aspects of the target language and culture. Prerequisite: Permission of the Instructor.

82-391 Advanced Russian I
Fall: 9 units
This course seeks to enhance listening-comprehension skills while perfecting the linguistic and stylistic practices of advanced students. Intensive study is made of varied literary, journalistic and colloquial texts in audio-visual and print media. Focus is on rapid vocabulary expansion as well as correction of high frequency syntax errors that persist beyond the intermediate level. Practice in the Language Learning Resource Center, additional to three class hours per week, is mandatory for the evolution of aural/oral fluency. Written compositions and translations, assigned for homework, are required for the development of grammatical accuracy and stylistic appropriateness. All class discussions are conducted in Russian. Prerequisite: 82-292 or approved equivalent.

82-392 Advanced Russian II
Spring: 9 units
The second part of a two-semester course sequence (82Prerequisite: 82-391 or approved equivalent.

82-396 The Faust Legend at Home and Abroad
Intermittent: 9,12 units
This course introduces students to the basic outlines of the Faust
story, and examines its nineteenth- and twentieth-century manifestations in the novels, plays, operas and of Great Britain, Germany, France, Hungary, the Czech Republic, Russia and the United States. On the assumption that cultures reveal something distinctive about themselves by the particular way in which they adapt the legend, this course aims to discover how and why these Faustian works of art respond and contribute to the social, political and historical context in which they are produced. On what is the persistence of the Faust legend based? To what needs does it speak? How does the history of its own, continual reemergence affect the meanings it communicates? These questions are entertained as the following works are studied: Christopher Marlowe’s "The Tragical Life of Doctor Faustus", Johann Wolfgang von Goethe’s “Faust: A Tragedy”, Charles Gounod’s "Faust", George Sand’s "A Woman’s Version of the Faust Legend”, F. W. Murnau’s "Faust", Ivan Turgenev’s “Faust”, Mikhail Bulgakov’s “Master and Margarita”, Busoni’s "Doktor Faust", Vaclav Havel’s "The Ploughmen’s Incident", Istvan Szabo’s "Mephisto". Prerequisites: None for 9 units; an additional 3 units, requiring permission of the instructor, can be earned for work done in Russian.

82-397 Russia’s Demons Intermittent: 9-12 units
Demons and devils, ghosts and goblins, witches and werewolves: Russian literature, art and music and are riddled with them. Where have they come from and why have they stayed? Under what conditions has Russian life conjured them, and what has their power been for creating conditions of their own? This course aims to find out by peering into the netherworld of demonic fantasy by the light of Russian social history from the nineteenth century to the current day. The core of the course is comprised of readings drawn from the literature of Pushkin, Lermontov, Gogol, Dostoevsky, Bely, Lunacharsky, Bulgakov and Zamятин. Additional attention is paid to Vrubel’s painting and Prokofiev’s music, among others. Prerequisite: All work is conducted in English, three hours per week, for 9 units, for which there are no prerequisites. Under the course number 82-397, an additional 3 units can be awarded for work conducted in Russian during one additional hourly meeting per week; for the additional credits, 82-292 or permission of the Instructor is required.

82-399 Special Topics Russian Intermittent: 3-12 units
Special topics courses accommodate a variety of themes accessible to students beyond the level of Advanced Russian. The aim of these courses is to further the development of reading, writing, listening and speaking skills, while conducting in-depth examinations of specific aspects of Russian culture. Prerequisite: 82-391, approved equivalent, or permission of the Instructor.

82-401 Quebec Society Intermittent: 9 units
This course involves the study and discussion of a broad range of both social and cultural artifacts related to the evolution of a modern francophone society in Quebec over the last half-century. Materials studied will include novels, poetry, historical texts, newspaper articles, film, television, documentary video and song. Prerequisites: 82-303 and 82-304 or approved equivalent.

82-404 Francophone Realities Spring: 9 units
This course introduces students to the political and sociological histories of former African colonies. Authors will vary by offering. The literary component of the course involves analyses of francophone authors, examining their roles in the written medium as they attempt to overcome colonialism and its effects on Africa. Prerequisites: 82-303 and 82-304 or approved equivalent.

82-406 The European Union Spring: 9 units
This credit will be given when students have completed advanced interdisciplinary content-based coursework in French, in a study abroad or internship program. Prerequisite: third year coursework, see the transfer credit advisor prior to registering in an abroad program or in an internship.

82-408 Matisse, Chagall, Picasso & Their Contemporaries: Art & Museums on the Riviera Intermittent: 9-12 units
This course examines the lives and work of the major 20th century artists (Chagall, Cocteau, Léger, Matisse, Picasso and Renoir) as well as some of their contemporaries who are prominently associated with the art of the Riviera. Considering the artists’ personal stories, the course provides a "social art history" and a multidisciplinary focus which includes an understanding of the historic context, geographic setting, and artistic milieu in which these artists lived and worked, complemented by a conceptual exploration of what a museum is, its physical space and its role in society. The course will be taught in English with assigned readings and related assignments in French for French minors and majors. Prerequisite: None *Students of French who want course credit toward the major or minor in French will register for an extra 3 units of coursework in French. In this case, prerequisites are completion of 82-303 or 82-304, or approval of the instructor.

82-410 Advanced Research in French Francophone Language and Culture Fall and Spring: 9 units
In this course, students will study the core curriculum of the 82-305 course, which is to say, a focus on culture through language variation in spoken and written forms of French. Readings, videos, web use, and in-class conversations involve phonological and sociolinguistic aspects of the French language and language change; its use regarding different registers and regional languages within France; the question of social identity through language; immigration and Accidental issues; and an exploration of the distinctive francophone uses of the French language. In order to achieve these goals, students do personal work on improving their control of the French phonological system, and discuss current issues in France and francophone regions/countries by using multiple media, as well as their own monitor and works of art. Prerequisites: 82303 or 82-304

82-415 Topics in French and Francophone Studies Fall: 9 units
A series of innovative courses exploring French and Francophone literature and culture through a thematic or conceptual focus. Some courses are offered in the context of European Studies as well. Some course topics include Writing and Viewing the Other: French and Francophone Approaches to Theater, Fiction, and Film; Feminine/Masculine: Images of Gender Identity in French Modernism; Images of Paris: Art, Gender, and Cultural Identity in the Capital of the Nineteenth Century; Staging French Modernity: The Twentieth Century; Writing, Painting, Monument: Portraits in French Modernity; Classical and Baroque culture; and Emerging Literature: Twentieth-Century Francophone Writing. Prerequisite: Completion of third year courses or permission from the Instructor.

82-416 Topics in French and Francophone Studies Spring: 9 units
A series of innovative courses exploring French and Francophone literature and culture through a thematic or conceptual focus. Some courses are offered in the context of European Studies as well. Some course topics include Writing and Viewing the Other: French and Francophone Approaches to Theater, Fiction, and Film; Feminine/Masculine: Images of Gender Identity in French Modernism; Images of Paris: Art, Gender, and Cultural Identity in the Capital of the Nineteenth Century; Staging French Modernity: The Twentieth Century; Writing, Painting, Monument: Portraits in French Modernity; Classical and Baroque culture; and Emerging Literature: Twentieth-Century Francophone Writing. Prerequisite: Completion of third year courses or permission from the
Instructor.

82-420 German Classical Literature
Intermittent: 9 units
This course, conducted entirely in German, provides a basic introduction to the literature of Enlightenment, Sturm und Drang, and classicism in Germany during the second half of the eighteenth century and at the beginning of the nineteenth century. Classical literature appeared in Germany at a later date than in the other major European countries; for this reason German classical literature tends to be more accessible linguistically to contemporary readers than some other classical literatures. The course will begin with the remarkably lucid and relevant work of Lessing, in particular his plays Emilia Galotti and Nathan der Weise—both programmatic statements of Enlightenment rationality and critical bourgeois consciousness. We will then move on to the brief but important Sturm und Drang period, exploring Goethe’s revolutionary novel Die Leiden des jungen Werther, Schiller’s radical drama Die Räuber, and Lenz’s disturbing play Der Hofmeister. The focus will be on Sturm und Drang as a uniquely German phenomenon, and on the reasons for its rapid development and quick demise. Our exploration of classical literature will continue with Goethe’s Faust I, one of the great masterpieces of western literature and probably the most celebrated and influential work in the German literary canon. We will also devote time to close reading and aesthetic appreciation of some of Goethe’s most beautiful poems. An examination of Schiller’s letters Über die ästhetische Erziehung des Menschen will round out our exploration of German classicism as an idealistic aesthetic movement. Students will be asked to complete five brief writing assignments over the course of the semester, and to take midterm and final examinations. Prerequisite: Completion of 82-325 or approved equivalent.

82-421 German Literature of the Nineteenth Century
Intermittent: 9 units
Readings from Romanticism through Realism. Prerequisite: Completion of 82-325 or approved equivalent.

82-422 German Literature of the Early Twentieth Century
Intermittent: 9 units
From its inception in 1871, Second German Empire promised to be an industrial, cultural and military powerhouse on the continent of Europe. But when the hand of the Iron Chancellor, Otto von Bismarck, was removed from the helm by Kaiser Wilhelm II in 1890, the “New Germany” charted a course that would lead to a catastrophic conflict with its neighbors to the west (England and France) and to the east (Russia). This course exam works by some of the major authors of this period (Mann, Wedekind, Hauptmann, Rilke, Kafka) as well as modern film adaptations of their works. Readings will also include seminal thinkers such as Nietzsche, Freud, Marx and Einstein. And, we will engage the visual arts through a survey of the German Expressionists. The purpose of this course is to examine a wide variety of “cultural artifacts” against the backdrop of the political, social, and economic currents of the period. Prerequisite: Completion of 82-325 or approved equivalent.

82-423 Postwar German Literature
Intermittent: 9 units
How did Germany and Austria attempt to come to terms with the physical, social and cultural devastation caused by the Second World War in the postwar period? How did they deal with (or why did they ignore) the Holocaust? What were the enduring effects of the political division of Germany and of Austrian neutrality? These and other questions will be the focus of “Postwar German Literature”. We will examine texts from all three literary genres (poetry, novels and plays), as well as essays and letters, and also consider several works that have been adapted for film. Readings from authors such as Wolfgang Borchert and Ingeborg Bachmann as well as the three Nobel Prize winning authors of the period: Hermann Hesse (1946), Heinrich Böll (1972) and Günter Grass (1999).

Prerequisite: Completion of 82-325 or approved equivalent.

82-424 The New Germany
Spring: 9 units
This course explores contemporary culture in German speaking Central Europe. Prequisites: Completion of 82-325 or approved equivalent.

82-425 Studies in German Literature
Intermittent: 9 units
A series of innovative courses exploring German literature and culture through a thematic or conceptual focus. A recent course topic includes Germany During the Second Empire. Prerequisite: Completion of 82-325 or approved equivalent.

82-426 Studies in German Literature
Intermittent: 9 units
A series of innovative courses exploring German literature and culture through a thematic or conceptual focus. Prerequisite: Completion of 82-325 or approved equivalent.

82-427 Nazi and Resistance Culture
Intermittent: 9 units
This course will explore what happened to German culture from 1933 to 1945. In particular, it will examine the Nazi assault on modern (or “degenerate”) art and the artistic response of the German resistance to Nazi tyranny. Arts explored will include literature, film, music, and the visual arts. Students will be required to view at least five films from the period. The last several weeks of the course will deal with the continuing implications of 1933-1945 for German culture today. Prerequisite: Completion of 82-325 or approved equivalent.

82-428 History of German Film
Intermittent: 9 units
Throughout the twentieth century, the German cinema has consistently been one of the most productive and creative national cinemas in the world. During the first three decades of the twentieth century, some of the great classics of silent cinema were produced in Germany. Many of these films were highly influential throughout the world, particularly in the United States, where some of the great German directors and film stars settled in the late 1920s and 1930s, frequently for political reasons. In the late 1960s and 1970s, German directors developed a unique filmic style based on an attempt to come to terms with the German past and on a critique of Hollywood’s domination of the world entertainment industry. The history of German cinema closely reflects the history of the German nation in the twentieth century. The course, taught in German, will cover this entire history, from 1895 to the present, with a particular emphasis on the Weimar period (1918-1933) and the renaissance of “New German Cinema” in the 1970s. Also considered will be the cinema of the Second and Third Empires, the cinema of the German Democratic Republic, and the resurgence of German comedy in the 1990s. Directors studied include Friedrich Murnau, Fritz Lang, Leni Riefenstahl, Rainer Werner Fassbinder, and Wim Wenders. Prerequisite: Completion of 82-325 or approved equivalent.

82-433 Topics in Contemporary Culture of China
Fall: 9 units
This four-year Chinese course aims at providing students with the opportunity to learn authentic Chinese used in various forms of Chinese media. Through close contact with integrated and annotated authentic TV news broadcasts and newspaper reports, editorials and feature articles on topics related to various social issues of contemporary China, students are expected to make a breakthrough in their comprehensibility of Chinese media. Class discussion, debates and presentations on various topics will be the major forms of activities followed by essay writing to expose students to the contemporary culture of China and prepare them to function in various ways in the real situation of China in the
future. Prerequisite: 82-332 or approved equivalent.

82-434 Studies in Chinese Traditions
Spring: 9 units
This course is designed for students who have reached the advanced level of Chinese. It aims to introduce students to the traditions of Chinese culture and the study of different styles of Chinese literature, both modern and classical, including excerpts from famous novels, essays, and classical poems. Students will not only learn the difference between spoken and written styles of Chinese and between modern and classical Chinese but also understand more deeply the influence of Chinese traditions on civilization. With this knowledge, combined with their ability to express themselves in Chinese, students will be adequately prepared to function in the real situations of China in the future. Prerequisite: 82-332 or approved equivalent.

82-435 Advanced Reading in Chinese
Intermittent: 9 units
Prerequisites: 82324

82-436 Introduction to Classical Chinese
Intermittent: 9 units
This course is designed for students who have reached the advanced level of Modern Chinese and would like to promote their knowledge and skills in reading Classical Chinese, a language shaped in the latter half of the first millennium B.C. which still persists as a living medium of expression today. The course aims to introduce students to the basic syntactic patterns of Classical Chinese and the most frequently used Classical Chinese vocabulary. In the course, we will read representative selections from ancient Chinese texts, chosen for their historical value, beauty, and influence on later writers. With this knowledge and training, students will be equipped to read the Chinese Classics and gain a deeper understanding of the history of Chinese civilization, culture, and language. Moreover, knowledge of Classical Chinese will help students read and understand sophisticated modern Chinese texts, which make frequent use of Classical allusions and constructs. Prerequisite: 82-332 or approved equivalent

82-441 Studies in Peninsular Literature and Culture
Intermittent: 9 units
A sociocritical approach to the study of Spanish literature. A survey of representative authors considered in the context of the cultural heritage of Spain. Prerequisite: Completion of 82-345 or permission of Instructor.

82-442 Analysis of Spoken Spanish
Intermittent: 9 units
This course is an introduction to Spanish Linguistics. The main goal of the course is to provide students with the opportunity to learn the tools of linguistic analysis and to apply them to the study of Spanish. Attention will be given to different levels of analysis in linguistics including phonetics, phonology, morphology, and syntax. Course time will be divided between lecture, problem-solving exercises, and discussion. Students will have the opportunity to write and present a research paper in specific areas of Spanish linguistic contexts according to their interests. Prerequisite: Advance course work in Spanish, 80-280 or 82-383, or permission of instructor.

82-443 Spanish Reading and Translation Workshop
Intermittent: 9 units
This course is of interest to advanced Spanish majors and minors as well as non-specialists seeking to develop reading and translation skills in Spanish. The course will be conducted as a workshop to allow different populations to participate in the class. There will be an emphasis on both individual and group work, different theoretical models of translation and literary pieces, journal articles, critical essays, and materials from Internet services and bulletin boards. For students with advanced Spanish background (major & minors), the reading and translation workshop will offer an advanced-level grammar and stylistics review, a vocabulary builder and increased exposure to Hispanic language and culture. Prerequisite: For Spanish majors and minors, completion of all 300-level coursework or approved equivalent.

82-444 The Structure of Spanish
Intermittent: 9 units
This course investigates the processes that contribute towards the unification and fragmentation of Spanish as a single language. Some of the specific topics discussed include: Spanish language history, distribution of Spanish throughout the world, processes of standardization, variation in phonology, morpho-syntaxis, lexis, pragmatic functions of language (e.g.: politeness, forms of address, etc.), and Spanish in contact with other languages. Students will develop their discourse analytical skills through practical language activities and field projects. They will improve their ability to express themselves in academic Spanish through class discussions, presentations, and by producing a final research paper. Prerequisites: Students must have completed 82-345 and 82-442 or have some previous coursework in linguistics.

82-446 Political Drama of Spain
Spring: 9 units
This course will focus on political drama from Spain. The themes of tyranny, oppression, freedom, and honor will be examined in works by Spanish playwrights such as Miguel de Cervantes, Lope de Vega, Calderón, the Duke of Rivas, Alfonso Sastre, and Antonio Buero Vallejo. Special attention will be given to the social and historical contexts of the works. Films and critical articles will complement the study of the primary texts. Readings, class discussions, and all assignments will be in Spanish. Prerequisite: Completion of 82-345 or permission of Instructor.

82-450 Advanced Research in Hispanic Language and Culture
Fall and Spring: 9 units
This course permits in-depth, 400-level study in the following courses: 82-342 Spain: Language and Culture, 82-343 Latin America: Language and Culture, and 82-344 U.S. Latinos: Language and Culture. Students will meet with the regularly scheduled 300-level class, read additional texts, and produce research assignments as agreed upon by the Instructor and student. Focus is on a deeper understanding and individualized research of the course topics. Prerequisite: By permission of the Instructor only.

82-451 Studies in Latin American Literature and Culture
Intermittent: 9 units
A sociocritical approach to the study of Latin American literature and a survey of representative authors considered in the context of the cultural heritage of Latin America. Prerequisite: Completion of 82-345 or permission of Instructor. Prerequisites: 82345

82-452 The Latin American Fin de Siglo: Modernity, Modernismo, and Underdevelopment
Intermittent: 9 units
In this course, we shall use print media, film, music, dance, fashion, diet, art and architecture to study the anthropological and cultural ramifications of politico-economic and socio-cultural events surrounding the turn-of-the-century era (1880-1920) in
Latin America and relate them to the current fin de siglo and millennium. We shall analyze the effects of the increasingly globalized nature of the world economy in order to understand the effects of U.S. and European interference and investment in Latin America and how these two world powers have shaped its cultural production in the early and late 20th century. Prerequisite: Completion of 82-345 or permission of Instructor.

82-453 Voices from Within: The Crisis of Latin American Identity Spring: 9 units
An introduction to the complex fabric of Andean, Southern Cone, Hispanic and Caribbean cultures with supplementary materials from the arts (music, film, photography, painting, architecture, etc.) and religion. The course will focus on issues of identity by examining the literary and artistic (self)representation of Indigenous, African and European people in this specific context of miscegenation and its unique sociopolitical, economic and cultural origins and implications. Prerequisite: Completion of 82-345 or permission of Instructor.

82-454 The Hispanic Caribbean: Rhyme, Reason and Song Intermittent: 9 units
This course will cover a broad range of topics, all of which will shed light on how to define the identity of the Hispanic Caribbean, its history and reality, and its cultural expression. Texts for this course will primarily include literary and non-literary pieces (chronicles, historical and political essays, legal treatises, poetry, and song lyrics), and photography, music, art and food. Some of the topics that will be covered through the varied literary, legal, and musical texts are a profile of the Caribbean region, the history of colonization, the institutionalization of race, color and difference, slavery, the sugar plantation and its shaping of regional history and economics, tobacco, sugar and coffee culture, religious syncretism, the urban/rural experience, the Trujillo dictatorship in the Dominican Republic, the Puerto Rican dilemma-territory, statehood or independence, the Cuban revolution, contemporary Hispanic Caribbean and U.S. Latino expressions. Prerequisite: Completion of 82-345 or permission of Instructor.

82-455 Topics in Hispanic Studies Fall: 9 units
A series of inquiries into an aspect of Hispanic literature, such as a literary movement, a genre, a theme or the work of a single author (e.g., Knights, Rogues, Saints/Caballeros, Pícaros, Santos; Latin American Short Story and Essay: Literary Mediations; Portrayals of Family Life in Twentieth-Century Spain; The Other in Latin American Literature and Film; Writing Women in Spain; Revolutions & Literature in 20th Century Central America). Prerequisite: Completion of 82-345 or permission of Instructor. Prerequisites: 82345

82-456 Topics in Hispanic Studies Spring: 9 units
A series of inquiries into an aspect of Hispanic literature, such as a literary movement, a genre, a theme or the work of a single author (e.g., Knights, Rogues, Saints/Caballeros, Pícaros, Santos; Latin American Short Story and Essay: Literary Mediations; Portrayals of Family Life in Twentieth-Century Spain; The Other in Latin American Literature and Film; Writing Women in Spain; Revolutions & Literature in 20th Century Central America). Prerequisite: Completion of 82-345 or permission of Instructor. Prerequisites: 82345

82-457 Contemporary Latin American Texts: Revision, Rewriting and Representation Intermittent: 9 units
This course is an overview of contemporary Latin American ?texts? dealing with issues of historical representation, autochthonous heritage, popular culture and gender roles. By ?texts? we shall understand conventional and unconventional literary material, film, art, slides and music. The course will explore formal and "rhetorical" problematic, as well as the relationship between fiction and imaginary solutions to real cultural and political conflicts. We shall consider the functions of myth and history in Latin American society and the revisionist role of contemporary texts. We shall also examine the categories and implications of historized fiction and "literaturized" history with particular attention to the power dynamic present in the segregation of the traditional disciplines which are History and Literature, conceived institutionally as reality and fiction, respectively. Prerequisite: Completion of 82-345 or permission of Instructor.

82-474 Topics in Japanese Studies: Youth Culture Intermittent: 9 units
Japanese society is currently confronted with a massive array of social and cultural anomalies among its youth. In the culture with its values and expectations, their literary and artistic (self)representation of Indigenous, African and European people in the specific context of miscegenation and its unique sociopolitical, economic and cultural origins and implications. Prerequisite: Completion of 82-345 or permission of Instructor.

82-477 Japanese Conversation Analysis Spring: 9 units
Through analysis of various registers of the Japanese Spoken language, this course aims to provide analytical tools for Japanese conversational analysis and to provide opportunities to students to practice high proficiency level of oral communication skills such as formal speech, job interviews, and business communication. Formality, politeness, and gender differences are some of the major topics discussed in this course as well as speakers' perspectives, attitudes and emotions. This course is offered in Japanese. Prerequisite: 82-372 or equivalent.

82-480 Social and Cognitive Aspects of Bilingualism Intermittent: 9 units
This course introduces students to the nature and extent of bilingualism in individuals and diverse communities in the US and abroad, with an emphasis on the social, historical and political forces that shape the language varieties and abilities of bilinguals. There is also a brief exploration of the psycholinguistic features that characterize bilingual individuals. It also addresses the challenges and opportunities that bilingualism poses for multilingual societies and individuals. Students will develop their knowledge and critical analysis skills of bilingualism through readings, group discussions, field projects and a research paper. Pre-requisites: Students must have completed 82-280, 82-180, 82-384, 82-382 or by permission of the instructor.

82-481 Research Methods in Second Language Acquisition Spring: 9 units
Introduces students to research methodology as it applies to language learning and language teaching. An examination of different approaches currently used in Second Language Acquisition (SLA) research ranging from experimental studies to case studies. The goal is to develop an ability to critically evaluate, design and implement sound SLA research. Prerequisite: None.

82-483 Topics in Modern Languages Intermittent: Variable units
Introduces students to research methodology as it applies to language learning and language teaching. An examination of different approaches currently used in Second Language Acquisition (SLA) research ranging from experimental studies to case studies. The goal is to develop an ability to critically evaluate, design and implement sound SLA research. Prerequisite: None.

82-484 Language Assessment Spring: 9 units
Theoretical and practical study of aspects of language testing. Purposes and types of language tests are examined in relation to theories of language use and language teaching goals. Testing practices and procedures related to language research and language teaching are also discussed. The course also includes the planning, writing, and administration of tests, and basic test
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82-485  Topics in Modern Languages, Literature and Cultures
All Semesters: 9 units
Prerequisite: None.

82-486  Independent Study in Languages
Intermittent: 9-18 units
An opportunity for students who wish to complement their course work at the 400-level and pursue further advanced study. In conjunction with a faculty member, students will arrange a program of study to explore aspects of the target language and culture.
Prerequisite: Permission of the Instructor.

82-487  Writing in a Second Language
Intermittent: 9 units
This course will provide students with a comprehensive understanding of second language (L2) writing by surveying fundamental issues in empirical research, alternative theoretical perspectives, and pedagogical practices in L2 writing. Topics include text, psychological, and social models of L2 writing instruction and learning. Students are expected to carry out a research project on a focused topic of their choosing concerning L2 writing.
Prerequisites: 82-382 or permission of the Instructor.
Prerequisites: 82383 or 82783

82-491  Literature, Politics and Film in Russia & East Europe
Today
Intermittent: 9,12 units
This course aims to familiarize the student with the cultural geography of contemporary East Europe, including Russia. Visual texts serve to outline the power politics that have shaped East European and Russian/Soviet cultures from World War II to the present, dramatic day, while verbal texts reveal a range of personal responses to current crises affecting national identity, human rights, gender roles, and the natural environment. While the first of these is the predominant concern of the course, the other three attract a good deal of attention as they take shape in the modes of cultural discourse by which national identities are formulated. The course seeks to sample this discourse mainly in fictional literature and feature film; however, a small number of nonfiction essays and documentary films are seen to demonstrate the breakdown of traditional genres that characterizes intellectual production in times of political flux.
Prerequisites: None for 9 units; an additional 3 units, requiring permission of the instructor, can be earned for work done in Russian.

82-492  The Historical Imagination in Nineteenth-Century Russian Literature
Intermittent: 9,12 units
Pushkin, Gogol, Turgenev, Lermontov, Dostoevsky and Tolstoy all ruminated upon their nation's historical destiny. This course aims to describe the role played by imagination in these authors' efforts to wrench from Russia's past a vision of her future. Emphasis is placed upon the figurative operations of language that allow narrative to function as a guidepost to a collective mission and a map of the individual's location within the projected historical scheme. Lecture and discussion formats are combined at each Written papers, oral presentations, and participation in discussions are required, as are reading assignments of approximately 200 pages per week.
Prerequisites: The course is offered in English, three hours per week, for 9 units, for which there are no prerequisites. An additional 3 units are awarded for work conducted in Russian during one additional hourly meeting per week, for which 82-292 or instructor's permission is required.
Prerequisites: 82292

82-493  Joseph Brodsky in Context
Intermittent: 9 units
The purpose of the course is to explore the biographical facts, political circumstances and cultural histories underlying the paradoxical and poignant trajectory of Joseph Brodsky's outstanding achievements as poet, playwright, essayist and spokesman for literature's value to ethics and education. His work is deeply rooted in the artistic efflorescence of the "Silver Age" in twentieth century Russian poetry, but takes equal inspiration in the metaphysical poetry of England's Renaissance and Modern ages. To read Brodsky is thus to read Anna Akhmatova, Marina Tsvetaeva and Osip Mandelstham, on the one hand, and John Donne, George Herbert, T.S. Eliot, and W.H. Auden on the other. Works by and about these authors as well as Brodsky thus comprise the reading matter of the course. Poetry, essays and literary criticism are read with a view toward textual explication as a starting point for engaging the larger issues by which any literature subsists. To study the career of this most unusual writer in its bilingual, bicultural context is to confront the most fundamental questions about the means by which cultures are empowered and the reasons for which they succeed or fail to coexist in any given place and time. The language of the course is English for all readings, lectures and discussions. No knowledge of Russian is required, but those who can are invited to read in Russian as well. The course follows a predominantly seminar format. Reading and writing assignments are required, as is participation in classroom discussion.
Prerequisite: None.

82-501  Special Topics: French
Fall: 3-12 units
Restricted to language majors who wish to go beyond the regular course offerings in French. Group or individual study in a subject area approved by the Instructor. Prerequisite: Permission of the Instructor.

82-502  Special Topics: French
Spring: 3-12 units
Restricted to language majors who wish to go beyond the regular course offerings in French. Group or individual study in a subject area approved by the Instructor. Prerequisite: Permission of the Instructor.

82-505  Undergraduate Internship
Fall and Spring: 1-18 units
Approved upper-class language majors may receive credit in connection with work experience related to language learning and language use outside of the classroom setting. As a rule, this experience takes the form of work involving language use or research related to language study at off-campus sites or in the Department. Work or research must be done using the language of study. For off-campus internships, there must be an on-site supervisor approved by the Instructor. Prerequisite: At least one 300-level course or permission of a departmental faculty member and the internship advisor.

82-521  Special Topics: German
Fall: 3-12 units
Restricted to language majors who wish to go beyond the regular offerings in German. Group or individual study in a subject area approved by the Instructor. Prerequisite: Permission of the Instructor and a 400-level course.

82-522  Special Topics: German
Spring: 3-12 units
Restricted to language majors who wish to go beyond the regular offerings in German. Group or individual study in a subject area approved by the Instructor. Prerequisite: Permission of the Instructor and a 400-level course.

82-541  Special Topics: Spanish
Fall: 3-12 units
Restricted to language majors who wish to go beyond the regular offering in Spanish. Group or individual study in a subject area approved by the Instructor. Prerequisite: Permission of the Instructor and completion of a 400-level course.
Prerequisites:
Course Descriptions

82-542 Special Topics: Spanish
Spring: 3-12 units
Restricted to language majors who wish to go beyond the regular offering in Spanish. Group or individual study in a subject area approved by the Instructor. Prerequisite: Permission of the Instructor and completion of a 400-level course. Prerequisites:

82-561 Special Topics: Italian
Fall: 9,12 units
An option for students who wish to go beyond the regular offerings in Italian. Group or individual study in a subject area approved by the Instructor. Prerequisite: Permission of the Instructor.

82-562 Special Topics: Italian
All Semesters: Variable units
An option for students who wish to go beyond the regular offerings in Italian. Group or individual study in a subject area approved by the Instructor. Prerequisite: Permission of the Instructor.

82-571 Special Topics: Japanese
Fall: 3-12 units
Designed for students of Japanese who wish to go beyond the regular offerings in Japanese. Most suitable for students who have their own ideas for research projects on Japan-related topics of their interest. Students may read Japanese materials (e.g., books, newspapers, magazines, WebPages) and/or speak to native Japanese speakers in Japanese to gather information, and write up findings of their projects in Japanese. Students work on their own projects individually but under the Instructor’s guidance. Prerequisite: Permission of the Instructor.

82-572 Special Topics: Japanese
Spring: 3-12 units
Designed for students of Japanese who wish to go beyond the regular offerings in Japanese. Most suitable for students who have their own ideas for research projects on Japan-related topics of their interest. Students may read Japanese materials (e.g., books, newspapers, magazines, WebPages) and/or speak to native Japanese speakers in Japanese to gather information, and write up findings of their projects in Japanese. Students work on their own projects individually but under the Instructor’s guidance. Prerequisite: Permission of the Instructor.

82-580 Senior Seminar in Modern Languages
Spring: 3 units
This mini-seminar for majors in Modern Languages focuses on general issues in second language learning. It provides an integrative and culminating experience for students as they complete their studies. The course includes consideration of language learning and language maintenance, the role of second languages in American life, issues of linguistic and cultural diversity in the United States today and discussions of multiculturalism throughout the world. The goal of the seminar is for students to reflect upon their language learning experience and to discuss the role that a second language plays in their own lives and in American society today. Co-requisite: Open only to Modern Languages Majors.

82-591 Modern Languages Honors Thesis
Fall: 9 units
Modern Language majors with outstanding academic records and intellectual promise will be given the opportunity to undertake original research under the direction of an individual faculty member. Students and faculty select the research topics. Prerequisites: Senior standing; a 3.5 QPA in one’s language major; a 3.25 QPA overall; permission of the Department Head and approved entry into the College’s Honors Program.

82-592 Modern Languages Honors Thesis
Spring: 9 units
Modern Language majors with outstanding academic records and intellectual promise will be given the opportunity to undertake original research under the direction of an individual faculty member. Students and faculty select the research topics. Prerequisites: Senior standing; a 3.5 QPA in one’s language major; a 3.25 QPA overall; permission of the Department Head and approved entry into the College’s Honors Program.

82-599 Russian Studies Thesis
Intermittent: 3-6 units
This course consists of researching and writing the thesis that is required of Russian Studies majors. It is generally completed during the senior year. See Russian Studies Major description. Work is done individually, under the guidance of a Russian Studies advisor. Prerequisite: Permission of the Instructor.

Psychology

Undergraduate Courses

85-100 Introduction to Intelligence in Humans, Animals and Machines
Fall: 9 units
A practical as well as theoretical introductory course aimed at increasing the students learning, problem solving, decision making and critical thinking skills. The course will begin by contrasting between intelligent and instinctive behaviors. It will then examine the roles that perception, learning, curiosity, problem solving, decision making, and language play in enabling humans and other animals to behave intelligently. Special attention will be paid to language in animals and to the nature of creativity. Finally, the course will examine the similarities in and differences between animals (including humans) and machine intelligence.

85-102 Introduction to Psychology
Spring and Summer: 9 units
This course examines major areas of scientific psychology in some depth, the attempt being to develop basic models of our behavior and thought that explain wide areas of our functioning. The primary focus is on the areas of neural and motivational control of behavior, memory and thought, social interaction, and psychological development. Specific topics within these areas include brain function, motivational control systems, learning, cognitive and perceptual information processing, problem solving, obedience and conformity, social interaction, emotion, attitude consistency and change, how our social, cognitive and language functions develop, the importance of childhood to adult functioning, and psychopathology. In addition to the lecture, the course includes a weekly recitation section meeting and weekly short WEB-based laboratory experiences in which students get to perform actual experiments, interpret real data, and experience many psychological phenomena.

85-111 Self-Paced Lisp Lab
Fall: 3 units
Students enrolled in 85-213, Human Information Processing and Artificial Intelligence, who are not familiar with LISP are required to take this self-paced LISP-lab. Students who are already familiar with LISP cannot take the lab for extra credit. Corequisites: 85-213

85-211 Cognitive Psychology
Fall and Spring: 9 units
This course will examine the cognitive processes underlying perception, mental imagery, short- and long-term memory, language comprehension, decision making, problem solving and skilled performance. Both the theory and the basic experimental findings will be covered in each area and the emphasis will be on the underlying information processing mechanisms.

85-213 Human Information Processing and Artificial Intelligence
Fall: 9 units
This class will review various results in cognitive psychology (attention, perception, memory, problem solving, language) and use of artificial intelligence techniques to simulate cognitive processes. Prerequisites: 15211
85-219 Biological Foundations of Behavior
Fall: 9 units
This course will provide students with a general introduction to the underlying biological principles and mechanisms which give rise to complex human cognitive, perceptual and emotional behavior. Topics to be covered include: the anatomical structure of nerve cells and how they communicate, properties of brain organization and function, processing in sensory and motor systems, biological characteristics of human cognition, and neural and hormonal influences on health and emotion. This course will focus on how emerging methods and approaches are beginning to make it possible for psychologists, computer scientists, and engineers to gain an integrated understanding of complex behavior.

85-221 Principles of Child Development
Fall and Spring: 9 units
This course is about normal development from conception through adolescence. Topics include physical, perceptual, cognitive, emotional and social development. Students will learn facts about children at various points in development, theories about how development works, and research methods for studying development in infants and children. Students will be encouraged to relate the facts, theories and methods of developmental psychology to everyday problems, social issues and real world concerns.

85-241 Social Psychology
Fall and Spring: 9 units
The focus of this course will be on how people's behavior, feelings and thoughts are influenced or determined by their social environment. The course will begin with lectures and readings on how social psychologists go about studying social behavior. Next, various topics on which social psychologists have done research will be covered. These topics will include: person perception, prejudice and discrimination, the nature of attitudes and how attitudes are formed and changed, interpersonal attraction, conformity, compliance, altruism, aggression, group behavior, and applications of psychology to problems in health care, law, politics, and the environment. Through readings and lectures on these topics, students will also be exposed to social psychological theories.

85-251 Personality
Spring: 9 units
The primary purpose of personality psychology is to understand human uniqueness—how and why it is that one person differs from others, in terms of the ways he or she thinks, feels, and acts. Students in the course will be exposed to several broad theoretical perspectives, each of which attempts to capture and understand the origins and consequences of individual distinctiveness from a slightly different vantage point. Included among these approaches are the dispositional, psychoanalytic, learning, phenomenological, and cognitive self-regulation perspectives. This is a survey course and is intended to provide students with a broad background of theory and research in the area. Class meetings consist primarily of lecture, but there is some discussion too. In addition, classroom exercises will allow students to test their own personalities.

85-261 Abnormal Psychology
Fall and Spring: 9 units
The study of psychopathology is not an exact science; nor are there many clear-cut parameters with which to differentiate "normal" and "abnormal" behavior. This course will focus on learning about and understanding the range of behaviors which fall within the province of "abnormal" psychology. Its approach will be descriptive, empirical, theoretical and conceptual. Students will examine definitions of abnormality? in an historical and contemporary context, explore issues relevant to diagnosis and patient care, be introduced to various psychological diagnostic categories, and develop an appreciation of the range of treatments for these disorders.

85-310 Research Methods in Cognitive Psychology
Fall and Spring: 9 units
This is a course in which students develop the research skills associated with cognitive psychology and cognitive science. Students learn how to design and conduct experiments, and analyze and interpret the data they collect. The course covers a variety of experimental designs, e.g., factorial, Latin Squares. Analyses of response times, qualitative data, and logical detection are also covered. Cognitive modeling will also be discussed. Topics include mental imagery, memory, and perception. The class format consists of lectures, discussions and student presentations. You must have either taken 36-309 previously or 36-309 can be taken as co-req.
Prerequisites: 85211 or 85213 Corequisites: 36-309

85-320 Research Methods in Developmental Psychology
Fall and Spring: 9 units
This is a laboratory course, in which the student will have direct experience working with children, as well as writing research reports and designing and critiquing research in child development. The purpose of the course is to develop research expertise that will assist the student both in carrying out research and in evaluating the research of others. Special emphasis will be given to the unique methodological problems associated with the study of development. You must have either taken 36-309 previously or 36-309 can be taken as co-req.
Prerequisites: 85221 Corequisites: 36-309

85-340 Research Methods in Social Psychology
Fall and Spring: 9 units
This course is designed to provide students with the necessary knowledge to evaluate research, make transitions between theory and the operations that test the theory, and to design and carry out original research. Topics will include the nature of proof and causal inference, manipulation of independent variables, measurement of dependent variables, questionnaire design, experimental and quasi-experimental, design and ethical issues involved in doing research. Survey, observational and experimental techniques as applied in both field and laboratory settings will be covered. Students will be expected to criticize completed research. They are also expected to design measures and complete their own original studies. During the course of the semester students will also be expected to design and carry out an original research project as well.You must have either taken 36-309 previously or 36-309 can be taken as co-req.
Prerequisites: 85241 or 85251 Corequisites: 36-309

85-352 Evolutionary Psychology
Fall: 9 units
This course will cover both the fundamentals of evolutionary psychology, including the theories of natural and sexual selection, with the overarching aim of providing an overview of the field at an advanced level. We will examine the relevance of evolutionary thinking to a range of psychological phenomena including problems of survival, long-term mating strategies, short-term sexual strategies, parenting, kinship, cooperative alliances, aggression and warfare, conflict between the sexes, and prestige, status, and social dominance. We will also examine evolutionary approaches to sensation and perception, development, consciousness, cognition, language, and abnormal behavior. Juniors and Seniors only or permission of instructor.

85-355 Introduction to Cognitive Neuroscience
Fall: 9 units
Cognitive neuroscience is an emerging interdisciplinary field in which psychological, physiological, and computational methodologies are brought to bear in understanding the neural basis of cognitive processes. In this course, we will consider the application of methodologies such as physiological recordings from neurons in awake, behaving animals, functional neuroimaging (PET and fMRI) of normal subjects performing cognitive tasks, behavioral studies of brain-injured patients with selective cognitive deficits, and computational modeling of normal and impaired processing, in understanding cognitive domains such as high-level vision and attention, learning and memory, reading and
language, meaning and semantics, and the organization and control of action. In each instance, the emphasis will be on how the application of converging methodologies, particularly those related to brain organization and function, leads to important insights into the nature of cognitive processes that would be difficult to obtain through any one conventional methodology alone. Prerequisites: 85211 or 85219

85-358 Pro-Social Behavior
Fall: 9 units
This course is an advanced seminar that focuses on social psychological research involving the examination of pro-social behavior. A heavy emphasis will be placed on classic research on helping (which investigates how, when, and why we help strangers), as well as the wide body of literature on social support (which investigates how we help, and seek help from, those who are closer to us). Research on both help-seeking and help provision will be covered, as well as the implications of this type of pro-social behavior for relationships and health. The course also will cover research on other types of pro-social behavior such as empathy, altruism, formation of专业知识, and social norms. A major focus of the course will be an advanced seminar in which you will be expected to read original research articles and chapters on assigned topics and come to class prepared to discuss the material. Readings will consist of theoretical and empirical articles from psychology, journals and related sources. Additional course requirements will involve short, weekly writing assignments, student presentations of research articles, and a written research proposal. Over the course of the semester, students will design and carry out a small-scale, original investigation on a topic of interest. Prerequisites: (85241 or 85251) AND (85310 or 85320 or 85340)

85-362 Applied Developmental Psychology
Intermittent: 9 units
"Developmentally appropriate" has become a popular label used to describe activities, materials, and environments designed for children. But what does it mean to be developmentally appropriate, and how is it determined? Are these activities and materials evaluated for their impact on children's development or are they simply designed with a superficial interpretation of theoretical positions or empirical findings? How do we decide what theory to apply when designing or evaluating materials, activities, or contexts for children, and are different theories more informative and applicable than others? The purpose of this class is to think deeply about how our theories and research findings have been and could be applied to support and enhance the development of children in a variety of contexts, such as at home, daycare, school, playgrounds, etc. and to evaluate different activities, materials and/or contexts in reference to various theories and empirical findings. The overall purpose of the course is to understand how theory can inform practice and vice versa. Prerequisites: 85221

85-370 Perception
Intermittent: 9 units
Perception, broadly defined, is the construction of a representation of the external world for purposes of thinking and acting. Although we often think of perception as the processing of inputs to the sense organs, the world conveyed by the senses is ambiguous, and cognitive and sensory systems interact to interpret it. In this course, we will examine the sensory-level mechanisms involved in perception by various sensory modalities, including vision, audition, and touch. We will learn how sensory coding interacts with top-down processing based on context and prior knowledge and how perception changes with learning and development. We will look at methods of psychophysics, neuroscience, and cognitive psychology. The goals include not only imparting basic knowledge about perception but also providing new insights into everyday experiences. Prerequisites: 85102 or 85211 or 85213 or 85219

85-375 Cross Cultural Psychology
Spring: 9 units
Human beings share a common genetic inheritance, but our cultural institutions differ in a bewildering variety of ways. This course explores the many different cultural expressions of basic human cognitive and social abilities and needs. We will look at cultural variations in child rearing, mother-child attachment, language socialization, categorization, reasoning, problem-solving, architecture, music, politics, warfare, food-gathering, sex roles, mental disorders, and altered states of consciousness, all with the goal of understanding how the shape of social systems and symbolic expression reflects the economic and adaptive needs of the culture and its people. Among the approaches to these phenomena we will consider are symbolic interaction, cognitive anthropology, dialectic materialism, and modern ethnomethodology. Prerequisites: 85100 or 85102 or 85108 or 85150 or 85198 or 85211 or 85219 or 85221 or 85241 or 85251 or 85261

85-380 The Historical Development of Experimental Psychology
Fall: 9 units
This course will focus on three aspects of the origin and growth of experimen-tal psychology. The first is the prehistory of psychology, which traces the origins of psychological research to the development of modern science, and in particular, its origins in philosophy and physiology, is examined. The second focus of the course is on the different approaches and attempts to define the field that have contested for dominance during much of the life of the discipline. The final major focus of the course is on the modern period (roughly the last forty years) where the influences that brought about the modern counter-revolution in psychology will be examined, and where some conjecture about likely future directions will occur. Prerequisites: 85310 or 85320 or 85340

85-382 Consciousness and Cognition
Fall: 9 units
This course will examine the relationship between cognition and consciousness. One particular focus will be on the issue of how complex the processes that are largely unconsciously controlled may be and another is on the interaction of conscious and non-conscious processes in the control of cognition. We will also very briefly examine relevant ideas about consciousness that arise in other fields such as philosophy of mind and physics. The major topics to be included will be drawn from the experience and functionality of consciousness, neuroscience approaches to consciousness, perceptual and attentional work on consciousness, cognition in altered states of consciousness (in particular, dreaming), implicit memory, and the proceduralization of higher level cognitive processes. The course will consist of our reading and discussing primary research literature from the above areas. There will be a number of short written assignments based on the weekly reading and a term paper. Prerequisites: 85211 or 85213

85-390 Human Memory
Intermittent: 9 units
Without memory, people would barely be able to function: we could not be able to communication because we would not be able to remember meanings or words, nor what anyone said to us; we would have no friends because everyone would be a stranger (no memory of meeting anyone); we could have no sense of self because we could not remember anything about ourselves either; we could not predict anything about the future because we would have no recollections of the past; we would not know how to get around, because we would have no knowledge of the environment. This course will discuss issues related to memory at all levels: the sensory registers, i.e., how we perceive things; working or short-term memory; long-term memory or our knowledge base. We will discuss the differences between procedural/skill knowledge, and declarative/fact knowledge. The topics of memory monitoring, feeling and knowing, spread of activation within memory (priming), implicit memory, and amnesia will also be covered. Prerequisites: 85221 or 85213

85-392 Human Expertise
Fall: 9 units
The process of becoming an expert involves many changes, some quantitative and some qualitative. This course will provide an up-to-date account of the theory and data concerning the
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This course allows the student to explore ways in which the mind shapes language and language shapes the mind. Why are humans the only species with a full linguistic system? Some of the questions to be explored are: What kinds of mental abilities allow the child to learn language? What are the cognitive abilities needed to support the production and comprehension of sentences in real time? How do these abilities differ between people? Are there universal limits on the ways in which languages differ? Where do these limitations come from cognition in general or the specific language facility? Why is it so hard to learn a second language? Are there important links between language change and cultural change that point to links between language and culture?
Prerequisites: 80150 or 80180 or 80181 or 82382 or 85108 or 85211 or 85213

85-422 Infancy
Intermittent: 9 units
The purpose of this course is to provide students with an extensive background in the field of infant development and to acquaint them with the special methodological and theoretical problems that characterize research in the field. The course will be discussion-oriented and each student will be required to participate actively in both preparing for and contributing to discussion. Specific content areas to be covered include perception, memory, conceptual development, attachment, emotions, social development, and the origins of language. We will cover general readings as well as conflicting empirical studies and theoretical accounts that we will attempt to disentangle and resolve in class discussion.
Prerequisites: 85221

85-423 Cognitive Development
Spring: 9 units
The general goals of this course are that students become familiar with the basic phenomena and the leading theories of cognitive development, and that they learn to critically evaluate research in the area. Piagetian and information processing approaches will be discussed and contrasted. The focus will be upon the development of childrens information processing capacity and the effect that differences in capacities have upon the childs ability to interact with the environment in problem solving and learning situations.
Prerequisites: 85221

85-429 Cognitive Brain Imaging
Fall: 9 units
This seminar will examine how the brain executes higher level cognitive processes, such as problem-solving, language comprehension, and visual thinking. The topic will be addressed by examining what recent brain imaging studies can tell us about these various kinds of thinking. This new scientific approach has the potential of providing important information about how the brain thinks, indicating not only what parts perform what function, but also how the activity of different parts of the brain are organized to perform some thinking task, and how various neurological diseases (e.g. aphasia, Alzheimer’s) affect brain activity. A variety of different types of thinking will be examined, including short-term working memory storage and computation, problem solving, language comprehension, visual thinking. Several different technologies for measuring brain activity (e.g. PET and functional MRI and also some PET imaging) will be considered, attempting to relate brain physiology to cognitive functioning. The course will examine brain imaging in normal subjects and in people with various kinds of brain damage.
Prerequisites: 85221 or 85213 or 85411 or 85412 or 85414 or 85419

85-442 Health Psychology
Spring: 9 units
This course is concerned with how behavior and psychological states influence the development of and recovery from disease. The class provides an overview of existing psychological and epidemiological data on the relationship between behavior and disease and addresses the issue of how behavior, emotion and cognition can influence the disease processes. Topics include: measures and concepts, stress and disease, stress and coping,
personal control, helplessness and disease, social support and health, reactivity to stress, behavior and hypertension, coronary heart disease, infectious diseases and immune function, and the effectiveness of behavioral interventions in health. Special permission of instructor required.

85-444  Interpersonal Relationships
Fall:  9 units
The focus on this class will be on theories and studies of attraction and of relationship functioning. Definitions of attraction and of relationships, classical reinforcement theories of attraction, attribution and cognitive consistency theories of attraction, misattribution theories, self-evaluation maintenance theory, attachment theory and several other theoretical approaches to understanding attraction and relationships will be covered. Classes will consist of a combination of lectures, discussion and debate. You will be expected to: a) read original research articles and chapters, b) regularly turn in comments about those readings, c) participate regularly and actively in class discussions, and d) write four papers (to be handed in at the end of approximately every 3-4 weeks).
Prerequisites: (85241 and 85340) or (85251 and 85340)

85-446  Psychology of Gender
Spring:  9 units
This course is devoted to the investigation of psychological gender rather than biological sex. That is, sex differences will be explored from a social psychological (e.g., socialization) perspective. Implications of both male gender role and female gender role in the areas of relationships and health will be the course focus.
Prerequisites: 85241 or 85251

85-449  Emotion and Social Behavior
Spring:  9 units
This is an advanced seminar on emotion and social behavior. The course is new and the exact contents are still being developed. Examples of questions likely to be addressed are: What is an emotion? How might one differentiate such things as emotions, moods, and temperaments? What are the physiological, cognitive, and behavioral determinants of emotions? What are the physiological, cognitive and behavioral consequences of emotions? How do individuals’ emotional lives differ (e.g., men’s versus women’s; secure versus insecure individuals; people in stable relationships versus those in unstable relationships)? How does relationship context influence emotion and how does emotion influence relationships?
Prerequisites: (85241 or 85251) and 85340

85-451  Psychology of Purpose
Fall:  9 units
This course explores a number of issues and questions involving human motivation. The course begins by helping people identify goals to work toward, and how people keep themselves on track as they work to achieve the goals they have set. An even larger part of the course is devoted to examining the causes and consequences of motivational failure, a consideration of what happens when people are having difficulty in attaining the goals they value. Discussion surrounding motivational failure centers largely on how people adjust to being diagnosed and treated for chronic physical disease. This is an advanced seminar, and active participation in class is expected.
Prerequisites: (85241 or 85251) and (85310 or 85320 or 85340)

85-455  The Discovery of Spoken Language
Spring:  9 units
This course will explore an extraordinary feat - the acquisition of spoken language. We will focus on the very early cognitive skills that infants develop in acquiring speech perception and production. In our explorations of the discovery of spoken language, we will explore language and speech as domains of empirical study, we will examine prenatal and postnatal development of the skills that support the discovery of spoken language, we will survey commonly used methods and we will examine the important perceptual and cognitive skills infants develop in acquiring spoken language. Throughout the course, there will be emphasis on critical evaluation of theoretical interpretations. The course will be reading-intensive with evaluation based on written and oral presentation and argument. Senior or Junior class standing or permission of instructor.

85-465  Cognitive Neuroscience
Intermittent:  9 units
This course will cover fundamental findings and approaches in cognitive neuroscience, with the goal of providing an overview of the field at an advanced level. Topics will include high-level vision, spatial cognition, working memory, long-term memory, learning, language, executive control, and emotion. Each topic will be approached from a variety of methodological directions, for example, computational modeling, cognitive assessment in brain-damaged humans, non-invasive brain monitoring in humans, and single-neuron recording in animals. Lectures will alternate with sessions in seminar format. Graduate standing or two upper-level psychology courses from the areas of developmental, cognitive, computational modeling of intelligence, neuropsychology or neuroscience. Permission of instructor required.

85-480  Internship in Clinical Psychology
All Semesters:  6-12 units
This course is a cooperative effort by Carnegie Mellon University and a number of community and hospital-affiliated professionals. Through participation in this course, students will be exposed to didactic instruction and hands-on experience relevant to mental health treatment and applied clinical research.
Prerequisites: 85251 or 85261 or 85281

85-482  Internship in Psychology
Fall and Spring:  3-12 units
The Internship in Psychology is designed to enable students to gain experience in professional settings related to their studies in Psychology and earn credit for the intellectual work involved. It is the students responsibility to locate an internship site and on-site

85-484  Practicum in Child Development
Fall and Spring:  9 units
This guided field experience is designed to help students deepen their understanding of developmental psychology by assisting in a preschool or kindergarten classroom and discussing the ways that their experiences relate to the theories they have learned previously and to new readings. Each student will individually schedule a consistent 6 hours per week helping in a Children’s School classroom (preferably 2 or 3 chunks of time). Classroom duties will include working one-on-one and with small groups of students as they do puzzles, arts projects, dramatic play, etc., as well as helping with snack, playground supervision, classroom cleanup, and storytime. Each student will be expected to keep a journal 1) relating general experiences to developmental theories and 2) documenting the development of a particular child during the semester. All students will meet for a 1 hour weekly discussion with the director. Discussion topics and related readings will be selected collaboratively, based on issues/questions raised by the group’s observations and discussions.
Prerequisites: 85221

85-490  Seminar on Implicit and Explicit Memory
Intermittent:  9 units
This seminar will discuss current topics in human memory as well as go over some of the basic conceptualizations of the functionality of memory and information processing. Most weeks, the instructor will review an aspect of human memory or the literature relevant to the evening’s topic. In addition, we will discuss one or two journal articles. Students in the course will be responsible for reading all the articles but responsibility for leading the discussion will rotate. The course will require each student to either conduct an experiment relevant to a topic discussed or do a literature review relevant to one of the topics under discussion. Interested students must have taken a basic course in Cognitive Psychology to enroll.
Prerequisites: 85211 or 85213

85-501  Stress, Coping and Well-Being
Intermittent:  9 units
This course will examine the relationship of stress and coping to psychological and physical well-being. Discussions will be centered on readings from current theoretical and empirical articles. Anticipated discussions include the definitions of stress
and coping from multiple theoretical perspectives, issues relevant to the measurement of stress and coping, the psychological and physical consequences of stress, the time course of assessing well-being, and “adaptive” vs. “maladaptive” coping responses. This class is a small, upper level seminar that will consist of minimal lecture and a majority of class discussion. Active class participation is required.
Prerequisites: (85241 and 85340) or (85251 and 85340)

85-505  Readings In Psychology
All Semesters: 3-12 units
As the name implies, the emphasis in the Reading course is on reading articles and books in some specified area. The students work in the course must lead to the production of a written paper which will be read by the instructor directing the readings. Often the reading is related to a research project which the student may wish to conduct. Readings courses have also been used to give students an opportunity to receive instruction in areas which are not included elsewhere in our course listing. The course may be taken for any number of units up to 9, depending upon the amount of work to be done.

85-507  Research in Psychology
Fall: 3-12 units
This course may include field study, applied work, or laboratory research. The student should have previous training in the basic research skills that will be used in his/her project, especially statistical methods and experimental design. Independent Research Projects will be supervised by a faculty member and must result in a written paper. It is the students responsibility to make arrangements for independent study courses with individual faculty members. This should be done the semester before a student wishes to register for one of these courses. The course may be taken for any number of units up to 9, depending upon the amount of work to be done.

85-508  Research in Psychology
Spring: 3-18 units
This course may include field study, applied work, or laboratory research. The student should have previous training in the basic research skills that will be used in his/her project, especially statistical methods and experimental design. Independent Research Projects will be supervised by a faculty member and must result in a written paper. It is the students responsibility to make arrangements for independent study courses with individual faculty members. This should be done the semester before a student wishes to register for one of these courses. The course may be taken for any number of units up to 9, depending upon the amount of work to be done.

85-601  Senior Thesis
Fall: 9 units
This course is intended for senior Psychology or Cognitive Science majors who wish to conduct a research project under the direction of a faculty advisor. The project topic is to be selected jointly by the student and the advisor. The project will culminate in a senior paper which will be presented to the Department Head at the end of Fall Semester. Prerequisite: Grade of B or better in a previous research course required to enter, grade of B or better in first semester of senior thesis course required to complete, and permission of instructor. A formal proposal is required in the first semester. This course differs from the Honors Thesis sequence (85-611,612) in that it does not require Honors standing in HSS (i.e., there are no QPA requirements). This course differs from Problems in Psychology (85-507,508) in that the student’s original contribution to the research is expected to be more substantial, and in that a final written report of the project is to be presented to the Department.

85-602  Senior Thesis
Spring: 9 units
This course is intended for senior Psychology or Cognitive Science majors who wish to conduct a research project under the direction of a faculty advisor. The project topic is to be selected jointly by the student and the advisor. The project will culminate in a senior paper which will be presented to the Department Head at the end of Fall Semester. Prerequisite: Grade of B or better in a previous research course required to enter, grade of B or better in first semester of senior thesis course required to complete, and permission of instructor. A formal proposal is required in the first
Course Descriptions

Social & Decision Sciences
Undergraduate Courses

88-104 Decision Processes in American Political Institutions
Fall and Spring: 9 units
This is an interdisciplinary introduction to the study of politics and government, drawing mostly on political science, but also on economics. It familiarizes the student with the basic structures and processes of American government. The main theoretical tools are spatial models of political decision making, and models of collective action problems. The course focuses on politics and government in the United States, but explicit comparisons are made with politics in other countries. Grading is usually based on two midterm exams and a final exam, as well as a short writing assignment, several quizzes and homework.

88-110 Experiments with Economic Principles
Fall: 9 units
This course is designed to teach the basic principles of economics through the use of weekly experiments. In each experiment, you will be an active participant attempting to make deals with other traders in the market. At the end of the experiment it is time to really economics to the test—can economic theory really explain the complex interactions of the participants in your experiment? One nice feature of these experiments is that you can be both a participant and an observer, and you often will learn nearly as much about economic principles from your experience as a participant as you will from the analysis of the experiment as an observer. Topics covered include basic market behavior, auctions, rent control, pollution, network externalities, information economics, and international trade.

88-111 SDS Freshman Seminar: Human Rights and Global Politics
Spring: 9 units
The purpose of the seminar is to study human rights from different dimensions. First, we will examine the meaning of the term and the issues associated with defining the human rights field. What are these rights? What is their origin? Second, we will examine which rights/issues have been raised in the contemporary international political system and the responses from major international actors such as the United States, the Western European countries, International Organizations, and the NGO’s such as Amnesty International. The central issue here is one of answers and policies toward human rights abuses/issues. Finally, we will analyze a number of case studies. Some case studies will be presented in the lectures, some will be discussed by the students. Students will be asked to do research and report on a case of human rights abuses looking not only at the issue or conflict that has led to those abuses, but also international responses to the issue.

88-113 Self Presentation, Particularly in Political Contexts
Fall: 9 units
Whether used as a deliberate strategy or based on an intuitive understanding of impression formation, people who wish others to view them favorably often convey favorable characteristics. Moreover, people who wish another to view them favorably often (but not always) attempt to project characteristics that have nothing to do with the content of what they do or say. For example, positivity, optimism, self-confidence — and even narcissism — can create favorability. Making a positive impression is particularly important to political candidates seeking votes on the basis of televised appearances, or advertisements. Moreover, there are characteristics that convey an unfavorable impression. For example, discussing personal or political “malaise” — no matter how openly and honestly — can alienate the observer. In fact, there is evidence that expressing any negativity at all, even when directed against targets deserving bad evaluations, tends to tarnish the image of the person expressing it. This seminar will use as texts Erving Goffman’s The Presentation of Self in Everyday Life and Robyn Dawes’ Why We Often Admire the Wrong People (And Vote for Them). In addition, all students will be asked to observe televised political appeals in the 2004 election, to rate on prespecified scales their emotional responses to these appeals, and to write brief descriptions of their reactions to both these appeals’ content and “feeling.” After the second week of class, students must bring these descriptions to each meeting, and a number will be chosen at random for presentation and discussion. Finally, each student must choose a particular characteristic of self-presentation as a basis for a term paper that covers how this characteristic is conveyed (or manipulated) in both political appeals and in their own experience in everyday life.

88-114 SDS Freshman Seminar: Everyday Irrationality
Fall: 9 units
This seminar will cover the historical progression from belief in hot irrationality—i.e., emotional interference with an otherwise pristine intellect (Plato, Freud) through cold irrationality—i.e., clear thought stymied by common cognitive biases and heuristics (Tversky and Kahneman)—through a possible integration of hot and cold approaches—e.g. resulting from attentional mechanisms (Simon, Loewenstein, Lerner). Then the professor and students will discuss belief in ESP, alternative medicines, faith healing and Nazism in terms of the principles discussed. During the last half of the semester, students will choose a particular irrational belief to study and will both present to other students and write a term paper describing its acceptance (by at least some people) and possible reasons for such acceptance. The major text will be Dawes’ new book “Everyday Irrationality: How Pseudo-Scientists, Lunatics, and the Rest of Us Systematically Fail to Think Rationally.” This book will be supplemented by selected readings from Plato, Freud, Hines’s book on “Pseudoscience and the Paranormal,” Gilovich’s book of “How We Know What Isn’t So,” a book of first-hand accounts by the perpetrators of the Holocaust entitled “Death Dealers,” and finally Browning’s book of “Ordinary Men.”

88-115 Risk Communications for Health Decisions
Fall: 9 units
This seminar will explore how people make decisions about risk behaviors in various contexts relating to their health, including diet and exercise, sexual behavior, smoking, drinking, drug use, etc. The main focus of the course will be looking at efforts to improve health by educating people to make better decisions about reducing their own health risks. Students will participate in active class discussion, debating the benefits of different approaches to public health. The mid-term project will include basic research and data collection on a health behavior. The final project will include the production and planned evaluation of a public service announcement, aimed at improving health decisions and behaviors. Readings will include book chapters and original research articles relating to the psychology behind such behaviors and trade-offs.

88-120 Reason, Passion and Cognition
Spring: 9 units
This course will introduce students to major concepts and theories in social cognition. In particular, we will focus on how social and emotional factors shape judgment and choice. Class meetings will include a mixture of lecture and discussion. We will address such questions as: In what ways do specific emotions influence judgments and choices? What are some common mistakes in judgment and decision making? How do attitudes form and change? Can information shape our choices even if we do not consciously recognize the information? Throughout the course, the emphasis will be on understanding: (1) basic theories and research findings of decision science and psychology, and (2) the relevance of research findings to everyday life.

88-181 Topics in Law: 1st Amendment
Fall: Mini Session - 6 units
In their firm desire to perfect the new Constitution, which defined and limited the powers and roles of their new government, the founding fathers insisted on explicit statements that would protect the rights of the new nation’s citizens. Indeed, the protection of these essential rights in many ways drove and defined their successful rebellion from Britain. This impulse
resulted in ten amendments to the Constitution, which we have come to know as the Bill of Rights. The very first (and arguably considered at the time as the most essential) of these was the First Amendment, which we sometimes call the "free speech" amendment to the Constitution. This amendment guarantees every U.S. citizen five freedoms: freedom of religion, speech, press, peaceable assembly, and the freedom to petition the government for redress of grievances. This course examines the historical and philosophical roots of this key constitutional amendment, how it has been fleshed out and defined over time through case law, and the bases of some more recent critics of this amendments and current interpretations.

88-184 Topics of Law: The Bill of Rights
Spring: 9 units
This course examines the history and place of the Bill of Rights in our nation's constitutional framework. It focuses on the historical origins of the U.S. Constitution, of each of the first ten amendments to the Constitution (that we refer to as the "Bill of Rights"), how the meanings and interpretations of these have evolved over time, and what they mean to us today. Each article of the Bill of Rights is examined in terms of its original intentions, and then through cases that have challenged and been interpreted through the Bill's articles.

88-198 Research Training: Social and Decision Sciences
All Semesters: 6.9 units
This course is part of a set of 100-level courses offered by H&SS departments as independent studies for second-semester freshmen, and first- or second-semester sophomores, in the College. In general, these courses are designed to give students some real research experience through work on a faculty project or lab in ways that might stimulate and nurture subsequent interest in research participation. Faculty and students devise a personal and regularized meeting and task schedule. Each Research Training course is worth 9 units, which generally means a minimum for students of about 9 work-hours per week. These courses are offered only as electives; i.e., they cannot be applied toward a college or major requirement, although the units do count toward graduation as elective units. Additional details (including a roster and descriptions of Research Training Courses available in any given semester) are available in the H&SS Academic Advisory Center. Prerequisites/ restrictions: for H&SS students only; only for second-semester freshmen, or first- or second-semester sophomores; minimum cumulative GPA of 3.0 (at the time of registration) required for approved entry; additional prerequisites (e.g., language proficiency) may arise out of the particular demands of the research project in question.

88-205 Comparative Politics
Fall: 9 units
The aim of the course is to discuss, analyze and compare democratic, totalitarian and authoritarian regimes. Each of the models will be analyzed both from a theoretical and a practical perspective emphasizing the rights and obligations of the individual, the form in which the government functions and the process through which countries arrive at a particular form of government. The course will focus on British democracy, Nazi Germany, and Chile’s authoritarianism. The course will conclude with an analysis of current processes of democratization and transition to capitalism. No prerequisites. This course fulfills DCR2 of the H&SS General Education Program.

88-220 Policy Analysis I
Fall: 9 units
This course presents the basic ideas of microeconomic analysis, providing an introduction to issues in policy analysis and management. The first part of the course consists of a positive analysis of private markets, examining consumer choice, the supply and demand of factors and produced goods, and general and partial equilibrium. The second part of the course consists of a normative analysis of markets. This begins with an examination of the conditions necessary for markets to be economically efficient. This is followed by a detailed analysis of market failure, when private markets are not efficient. The strengths and weaknesses of markets are then examined in a broader framework encompassing concerns with information decentralization, incentive compatibility, transactions costs, and non-efficiency criteria such as equity and fairness. Markets are compared in this light with organizational, governmental, and other modes of resource allocation. Grading will be based mainly on 3 exams. Homework assignments and/or quizzes will comprise a smaller part of the grade. Priority access is given to SDS junior and senior students.

88-221 Policy Analysis II
Spring: 9 units
This course is an extension of Policy Analysis I and focuses on a normative analysis of government action. The course begins by considering justifications for government action drawing on work in political philosophy. It then compares different institutional approaches governments may adopt in attempting to correct market failures and in pursuing objectives other than efficiency. The basic concepts and tools of cost benefit analysis are then presented. Students are involved in individual and group projects applying the class material to specific policy issues. Prerequisites: 73250 or 73251 or 88220

88-222 Policy Analysis III
Fall and Spring: 12 units
Students in this course apply the research and analytical methods learned in their other courses to a real-world problem. Students decide how to structure the problem, divide into teams responsible for its different parts, identify and analyze relevant literature, collect data, synthesize their results, and present their conclusions in oral and written form to a review panel of individuals concerned with the problem. Faculty members help them along the way. Performance is based on students' contribution to the process and substance of the class, as observed by the faculty and by their fellow students. One or two such projects is offered every term. A complete list of previous topics is available from the department. Prerequisites:

88-223 Decision Analysis and Decision Support Systems
Spring: 9 units
This course emphasizes explicit procedures for analyzing complex decisions. The topics covered include: decision trees and other models of decisions involving uncertainty; methods for quantifying preferences and expert opinion; risk analysis; and the development and use of computerized decision aids ranging from spreadsheet programs to highly specialized decision support models. Prerequisites: 36201 or 36211 or 36217 or 36220 or 36225 or 36247 or 70207 or 36207

88-251 Empirical Research Methods
Spring: 9 units
This course teaches students how to evaluate and conduct original research regarding human behavior, whether it be in economic, social, or political settings. The course gives students practical experience in many of the most commonly used research techniques, including surveys, experiments, and quasi-experimental analysis. Although the course focuses primarily on the relationship between formulating research questions and implementing the appropriate methods to answer them, students can expect regularly to apply the statistical techniques learned in the course prerequisites, including regression.

88-260 Organizations
Fall: 9 units
Organizations are people acting upon a particular context. The context is shaped by a structure, technology, procedures, history, and environment. This course considers alternative theories of organizations that shed light on these elements and the determinants of organizational behavior. Thus, the course tries to consider how organizations actually behave and why. The course
is divided into several parts. The first two parts examine individuals in organizations. We discuss such questions as how individuals make decisions and how these can influence organizational success or failure. In the third section, we examine various models of organizational behavior. Here, we emphasize the influence of the nature of information processing on organizational behavior and performance. The fourth part presents economic approaches to understanding organizations. The fifth part of the course considers the importance of the environment for organizational behavior.

88-301 Intermediate Macroeconomics
Fall: 9 units
The 1960s was the golden age for macroeconomists. There existed an almost universal consensus on how the macroeconomy worked, government policy makers and academics saw the world in the same way, and when governments put the academic theories into practice it seemed to work. Beginning in 1970 or so, this consensus began to fall apart. Mathematical advances opened new methodological avenues, and some of these avenues led down markedly divergent paths. After thirty years of innovation, no merged to the contrary, distinct schools think very differently about the right way to do macroeconomic theory and conduct policy. To make sense of these competing frameworks, this course takes a historical approach to the development of theory. Doing so allows us to examine the practical contributions of each development in academia, while making clear the limitations of each. New theories are clearly seen to arise in response to the limitations of existing ideas, as well as to the economic events that preceded them. The course is cross listed with 73-301.
Prerequisites: 73250 or 73251 or 88220

88-302 Behavioral Decision Making
Fall: 9 units
Behavioral decision making is the study of how people make decisions, in terms that can eventually help them to make better decisions. It draws together research from psychology, economics, political science, and management, among other fields. It has applications that range from managing potentially hazardous technologies, to involving patients more fully in the choice of medical procedures, to the design of computer interactive systems. The course covers behavioral theories of probabilistic inference, intuitive prediction, preference, and decision making. Topics include heuristics and biases in inference and prediction, risk perceptions and attitudes, strategies for combining information from different sources and dealing with conflicting objectives, and the roles of group and emotional processes in decision making. The course emphasizes the mutually reinforcing relationship between theory and application.
Prerequisites: 36201 or 36207 or 36211 or 36217 or 36220 or 36225 or 36247 or 70207

88-305 Philosophy of Social Science
Intermittent: 9 units
This course asks whether we can use the scientific method to understand social phenomena like war and religion in the same way that we use it to understand natural phenomena like lasers and microchips. For example, humans possess free will and act with intentions while light rays do not; does this mean we must use different species of explanations in the two cases? Do simple social "laws" exist which explain basic social norms like cooperation? Do social norms evolve in the same way as do biological species? Whereas natural scientists often actively conduct experiments, social scientists can often only collect statistical data. Does this difference prevent social scientists from inferring causal relations? Is our understanding of social phenomena always value laden?

88-314 Politics through Film
Summer: 9 units
In this course we will use films, readings and discussions to enhance our ability to analyze, understand, and explain politics. The course is about political power, authority, leadership, ideologies, war, nationalism and resistance to authority. We will use major commercial films to explore some fundamental political problems regarding governments and societies. The central themes to be discussed in both the readings and the films will be tyranny and its impact on the people, resistance to tyranny and authority, and nationalism and war. The question of tyranny will be analyzed in the context of a variety of historical experiences, including Nazi Germany, Stalin’s regime, Latin American experiences, and racial problems in the U.S. To analyze the problem of nationalism and war, we will use material dealing with World Wars I and II and Vietnam.

88-324 Electoral Systems and Processes
Spring: 9 units
Elections provide the commonest means of aggregating the preferences of individuals into societal outcomes. However, Arrow's Impossibility Theorem tells us that every electoral system must fail to satisfy one or more criteria of fairness or sensibility. This course broadly explores the political consequences of electoral rules. It will cover elections in both governmental and non-governmental organizations, as well as the role of elections in modern political, social, and economic processes. Specific topics will include proportional representation versus first-past-the-post, at-large versus district elections, redistricting, Arrow’s Theorem, Duverger’s Law, and Black’s Median Voting Theorem. Grading will be based on a combination of written assignments and in-class exams.

88-326 Theories of International Relations
Fall and Spring: 9 units
This course has three major dimensions. Assumptions and propositions of the leading theories of international relations will be reviewed. This course also seeks to ensure that students clearly understand how newer theoretical approaches to the study of international relations build upon or depart from classical theories. Finally, theories will be tested against the historical record by examining major policy decisions and events such as the Cuban missile crisis, the Vietnam War, the Soviet invasion of Afghanistan, the Persian Gulf War, and the current war against global terror.

88-327 Politics of Economic Development
Intermittent: 9 units
This course will focus on the dual processes of political and economic development. It will address intellectual issues which at least go back to the time of Adam Smith: What policies favor and which retard economic development? Are different political regimes a consequence of or a cause of economic development? The course will examine development from three perspectives: local, national, and international. From a political perspective the course will consider questions of democracy and possible transitions to democracy, including issues of stability in authoritarian and totalitarian regimes.
Prerequisites: 73250 or 73251 or 88220

88-329 American Foreign Policy: 1945-Present
Fall and Spring: 9 units
This course provides an introduction to the study of U.S. foreign policy. Its main focus will be on problems and possibilities confronting the world during the Cold War as well as global political changes in the post-Cold War era and since 9/11. Important foreign policy strategies which will be discussed include the strategy of containment, NSC-68, the Eisenhower-Dulles “New Look,” the Kennedy-Johnson “Flexible Response,” “détente,” the democratic peace, and contemporary approaches to combating global terror. Theoretical readings in history and political science will be used as analytic filters to assess both scholarly evaluations of American foreign policy and key historical episodes.

88-330 Political Economy of Inequality and Redistribution
Spring: 9 units
Societies use welfare policies, social insurance, public employment, private charity, and of course, private labor markets to distribute the economic resources that they produce. The mixture of these programs varies tremendously across countries and over time. We will investigate the causes and consequences
of the rich variety of strategies that have been used in industrialized democracies to address the problems of economic inequality and poverty. We will also investigate important economic challenges and debates in these countries. For example, we will study recent welfare reforms and tax cuts in the United States as well as current debates over the future of social security. We will also study the possible effects of globalization on domestic well-being and social policy. Throughout the course we will ask how political values and institutions might affect the choices made concerning these issues and challenges. Prerequisites: (21111 or 21121 or 21115 or 21116) and (73260 or 36201 or 36207 or 36220 or 36225 or 36247 or 70207)

88-338 American Politics
Spring: 9 units
This course will provide an in-depth look at one or more different aspects of American politics. It will focus on how decisions are made in government. Particular topics may include Congress and the legislative process, the courts and juries, interest groups and representation, and voting and elections. Source material will be drawn from a combination of scholarly articles and textbooks. Prerequisite: 88-104, or the permission of the instructor. Prerequisites: 88104

88-340 The Economics of Entrepreneurship in High-tech Industries
Spring: 9 units
This course considers theories and evidence from the economics, business strategy and related literatures (including psychology and organizational behavior) that allow some understanding of the conditions affecting entry and performance of new firms in high technology industries. The course will be taught from an academic rather than practitioner perspective. Nonetheless, it should provide prospective entrepreneurs with information, tools and frameworks for thinking about the prospects for successful start-ups in selected industries. The course will cover the concept of barriers to entry, the advantages and disadvantages of small firm size for technological competition, the implications of the evolutionary stage of industries for entry, the role of patents in providing the basis for successful entry, venture capital, commercial applications of university research, the decision making biases that can characterize the behavior of both entrepreneurs and the venture capitalists who finance them, and the impact of small firms on rates of technical advance. Prerequisites: 73250 or 73251 or 88220

88-341 Organizational Communication
Fall: 9 units
Much of the work in groups and organizations consists of communication. You communicate to get information that will be the basis of decisions, to provide a vision for the people who work for and with you, to coordinate activity, and to sell yourself and your work. The goal of this course is to identify sources of communication problems within an organization and ways to overcome them. To do this requires that we know how communication normally works, what parts are difficult, and how to fix it when it goes wrong. The focus of this course is on providing you with a broad understanding of the way communication operates within dyads, work groups, and organizations. This course is not a practicum in public speaking or writing, although you will get some experience writing, speaking, and managing impressions. Rather the intent is to give you theoretical and empirical underpinnings for the communication you will undoubtedly do when you return to work. Readings come from both the research and the managerial literatures. Among the topics considered are managerial communication, persuasion and conformity, self presentation and person perception, social networks. Cases and group projects give you the opportunity to apply what you've learned in the classroom. Prerequisites: 36201 or 36207 or 36217 or 36220 or 36225 or 36247 or 70207

88-343 Economics of Technological Change
Fall: 9 units
This course will consider the determination of innovative activity and performance, and the effect of innovation on productivity, economic growth, and social welfare. We will focus particularly on the characteristics of markets and firms that influence industrial innovation. Such characteristics include, for example, market concentration, firm size, the strength of patent protection, and the vitality of the basic science and technology underlying innovation in a given industry. We will also study the economics of the adoption and diffusion of innovation. In addition to drawing on economic theory, the course will emphasize empirical studies of innovation and technological change, and will selectively exploit case study and institutional studies. Prerequisites: 73250 or 73251 or 88220

88-344 Organizational Intelligence in the Information Age
Spring: 9 units
Across all organizations people find that the actions they take are affected, and are affected by, the business now dominate R&D in the United States, or does "the little guy" still play an important role in technological innovation? What about the role of universities? How has R&D been "managed"? With the globalization of business, is R&D also being globalized, and if so, how? Why did the last decade of the 20th century see the decline or disappearance of numerous prestigious industrial research organizations? What is the future of industrial R&D in the 21st century? These are some of the questions explored in this seminar, which is open to students from all colleges.

88-345 The Rise of Industrial Research and Development
Intermittent: 9 units
The electric light, nylon, the atomic bomb, the transistor and integrated circuits, Post-it notes, Teflon, Silly Putty, and biopharmaceuticals are all products that emerged from organized research and development (R&D) programs. What factors caused modern R&D? When and why did industrial R&D laboratories appear in the United States and other industrialized nations? Did their creation change the character of science, technology, and business? How has the institutionalization of R&D affected the work of the individual inventor and scientist? Does big business now dominate R&D in the United States, or does "the little guy" still play an important role in technological innovation? What about the role of universities? How has R&D been "managed"? With the globalization of business, is R&D also being globalized, and if so, how? Why did the last decade of the 20th century see the decline or disappearance of numerous prestigious industrial research organizations? What is the future of industrial R&D in the 21st century? These are some of the questions explored in this seminar, which is open to students from all colleges.

88-347 Complex Technological Systems: Past, Present, and Future
Intermittent: 9 units
The Internet is only the latest example of a complex technological system that fundamentally alters the way that we act in and think about our world. During the last two centuries such complex technological systems have emerged, ranging from transportation systems such as the railroad and mass-produced automobiles running on paved roads and superhighways to networked information systems including the telegraph, the telephone, and radio and television. What are the common features of these complex technological systems? When do they emerge? How far reaching are their consequences in society, business, and in other complex technological systems? Can they be predicted? Can they be controlled? Can such complex technological systems be fully comprehended and modeled? These are some of the questions this course will tackle using cases from the past, the present, and the future. Prerequisites: junior or senior standing.

88-351 Mass Political Behavior: Issues, Elections and Public Opinion
Fall: 9 units
Political behavior is a multifaceted topic, encompassing such issues as voting, protest, running for political office, lobbying, and campaign contributions. This course will cover each of these issues with an emphasis on understanding the scientific study of political behavior, beginning with the development of theories of
individual behavior, aggregating the predictions of such theories to yield predictions about aggregate behavior (including election outcomes), and finally testing these predictions using real world data derived from surveys, election returns, and observed public policy outcomes. Students will be required to write several short papers, complete three exams based on the course readings and lectures, and participate in class discussion of both current and historical examples of political behavior.

Prerequisites: 88104

88-352 International Environmental Law and Policy
Fall: 9 units
Global environmental problems-climate change, stratospheric ozone destruction, species extinction and loss of biodiversity, and the contamination of air, land, and water-affect the lives of every person on earth today as well as of future generations. For the first time in history, human economic activity, and our ever-increasing population and consumption, threaten to surpass the ecological limits of the earth. This course examines the range of global and multinational environmental problems, and the international treaties and agreements, institutions, mechanisms and policies developed to address them. This takes into account the socio-economic and geopolitical contexts and overarching issues such as the balance between environmental protection and economic development, and between international regulation and national sovereignty. Topics to be covered include the 1972 Stockholm Conference on the Human Environment and the 1992 Rio Conference on Environment and Development; Agenda 21 and sustainable development; ozone depletion and the Vienna Convention and the Montreal and subse-quent protocols to the convention; transboundary air pollution and water pollution; marine pollution; the conservation of living marine resources and the UN Law of the Sea Convention; global warming and the 1992 Framework Convention on Climate Change; the 1997 Kyoto Protocol, and the Fourth and Fifth Conferences of the Parties to the Climate Change Convention, held in Buenos Aires in 1998 and Bonn in 1999 respectively; access to fresh water; Toxic and Hazardous Substances and the Basel Convention; chemical pollutants; nuclear weapons, waste disposal and power plant safety and environmental damage and the Convention on Nuclear Safety and other instruments; protection of wildlife and biodiversity, including the Conventions on Biodiversity, Wildlife Conservation, and Trade in Endangered Species; habitat protection, including forests, wetland, a

88-353 Human Judgment
Intermittent: 9 units
This advanced undergraduate course will examine social psychological perspectives on human judgment. The course focuses on ten selected topics in human judgment, each of which elucidates a classic or contemporary debate in the field. Seminar participants will gain in-depth knowledge of these topics, rather than surface knowledge of the field as a whole. One sample topic is the effect that being in power has on how much effort one puts into thinking. Throughout the course, the primary goals are to: (a) Learn about the academic field of human judgment, its major theories, results, and debates. (b) Become a critical consumer of research findings by learning to apply the methodological standards for evaluating the soundness of research. (c) Consider the applicability of research results to every day problems. Because this is an advanced seminar, students will be expected to: (a) read original research articles and chapters on the selected topics, (b) regularly turn in comments and questions about the readings, (c) participate regularly and actively in class discussions, and (d) write several essays. The majority of class time will consist of discussion and debate. Students who have taken Social Psychology (85-241) or Reason, Passion, & Social Cognition (88-120) will be especially well-prepared for this course. However, the course has no formal prerequisites.

88-354 Economics and Psychology of Organizational Communications
Fall: 9 units
An important issue faced by organizations is how to handle information and communication within the organization. This course will examine the importance of principles from economics and psychology for this issue. The main goal is to provide an understanding of basic processes underlying individual and group behavior likely to affect the effectiveness of communica-tion. The topics covered will include: the relationship between organizational form and effectiveness of communication, cognitive biases affecting communication, the importance of social groups and shared knowledge, information and common knowledge in game theory, and the effects of different forms of communication. Experiments and applications to actual organizations will be part of the course.

Prerequisites: 73250 or 73251 or 88220

88-355 Political Economy
Intermittent: 9 units
Theories derived from economics have enhanced many areas of the study of politics. This course deals with theories of political behavior and public policymaking that have been influenced by economic thinking. Topics to be considered may vary from semester to semester. They will include models of individual political behavior, such as voting and legislative behavior; models of aggregation of preferences in electoral, legislative and bureaucratic institutions; and models of policymaking in macroeconomics, international trade and in economic growth and development. Theories of market failure and government failure will be an underlying theme.

88-356 Rational Choice
Fall: 9 units
This course will focus on selected topics in decision theory, game theory, and social choice theory. Some of the specific topics we will address will include: (a) cardinal utility and subjective probability, (b) paradoxes of alternative voting systems, (c) the impossibility theorems of Arrow and Gibbard and Satterwaite, (d) the extensive and the strategic form of noncooperative games, (e) rationalizability and the Nash and correlated equilibrium concepts, (f) the equilibrium selection problem, and (g) public goods and the Prisoners Dilemma. The topics covered in this course constitute part of the branch of social science sometimes called formal theory. To learn this material, we will need to work through a substantial amount of ‘definition-theorem-proof’ style presentations given in our primary texts. We will also pay special attention to the significance of these topics in formal theory for social philosophy and political science. The course will be run in lecture format, with discussion of assigned readings at each class meeting. No prerequisites, but previous coursework in mathematics and philosophy is recommended.

88-357 Comparative Foreign Policy: China, Russia, and the US
Spring: 9 units
The purpose of this course is to compare and analyze the Foreign Policies of China, the United States and the former Soviet Union. The first section of the course will be geared to analyzing the foreign policies of the three major powers since World War II until today. The second section will be devoted to analyzing major foreign policy problems and the position that China, the US, and the former Soviet Union had, or have, in relation to those problems. Among the issues discussed will be the Arms Race, Nuclear Proliferation, the conflicts in the Middle East, the end of communism, and the new war in Afghanistan.

88-358 Policy Making Institutions
Fall: 9 units
This course examines the institutions of governance in democratic societies. Modern democracies are governed by both elected and unelected officials. Therefore, this course focuses on three equally important roles of democratic governance: legislative, executive/administrative, and judicial. The course is designed to provide a theoretical and applied understanding of how public policies are designed, implemented, and evaluated. Throughout the semester, current topics of political and economic interest will be examined as they relate to, are caused by, and affect public policy.

Prerequisites: 88104

88-359 Globalization
Spring: 9 units
Globalization entails an erosion of the national borders and the expansion of trade and technology. In this course we will analyze the political and economic implications of the process of globalization and its impact on Developed and Less Developed Countries. Among the issues discussed will be the increased power of Transnational Corporations and Nongovernmental organizations as well as the power of International Organizations such as the World Bank and the IMF. The course will also focus on the impact of globalization on poverty and wealth across the world.

88-373 Mental Health Ideologies in the US: From Psychoanalysis to Prozac
Spring: 9 units
Both beliefs about the nature of psychological distress and its treatment have changed radically in the last 100 years, particularly in the United States. Insurance policies and the government are now paying—at considerable expense—for the treatment of many forms of "mental illness" on the understanding that it "helps." Many people with depression or anxiety may get better, but there is no evidence that the problem is any better. This class will combine an historical survey of the degree to which we have become what one author characterizes as a "therapeutic society," together with a critical analysis of whether the claims made to support such a society have scientific validity, or valid support of any sort. Students will be assigned to one of two discussion sections. Grading will be on the basis of brief written critical analyses of material covered in sections, a mid-term, and a final. The course is only open to sophomore or higher standing.

88-374 Government Response to Market Failures
Spring: 9 units
A leading rationale for government is to do things that private markets fail to do. National defense, the Clean Air Act, the Sherman Antitrust Act, the Pure Food and Drug Act, and the Social Security Act are government responses to five classic market failures. Sometimes government intervention can make things worse than the problem was originally, leading to unanticipated consequences and "government failure." This course will be a research course in which students work in groups of five classic market failures and investigate the processes that led to major legislation, and the consequences of such legislation.

88-378 International Economics
Fall: 9 units
This course analyses the causes and effects of commercial and financial transactions between nations and the major policy issues raised by these transactions. The first half focuses on international trade and commercial policy using the tools of microeconomic analysis. The second half deals with balance of payments and exchange rate issues with emphasis on problems of macroeconomic policy in open economies.

88-379 Social Cognition
Intermittent: 9 units
Social cognition research identifies the social factors that shape cognitive processes. This seminar focuses on ten selected topics in social cognition. Each of these topics elucidates a classic or contemporary theoretical argument in the field. Seminar participants will gain in-depth knowledge of these topics, rather than superficial knowledge of the field as a whole. We will begin the seminar with topics revolving around the individual level of analysis (i.e., interpersonal processes). We will progress to interpersonal processes, and end with the group level of analysis. Seminar participants will include weekly participation in discussion of assigned readings, presentations of assigned readings, and two open-note exams.

88-382 Climate Change, Energy Policy and Environmental Protection
Spring: 9 units
Early in 2001 the Intergovernmental Panel on Climate Change will issue its Third Assessment Report on the state of the world's climate. A summary of the report was recently released to governments in advance of the November, 2000 COP-6 meeting of the parties to the 1992 Framework Convention on Climate Change (FCCC) and its 1997 Kyoto Protocol, the key international instruments dealing with the problem. The IPCC's 3rd assessment report paints a considerably bleaker picture of global warming than its 2nd report issued in 1995, which predicted an increase of between 1.8 and 6.3 degrees Fahrenheit in the earth's average surface air temperature due to anthropogenic emissions of greenhouse gases (GHGs) if mitigation measures were not taken. The new report predicts an increase of no less than 11 degrees fahrenheit by the end of this century, and confirms that "there is stronger evidence of human influence on climate. Significantly, much of the increase is attributed to a decline in sulfate emissions resulting from air quality control measures implemented by many industrialized nations and hence a decline in the cooling effect of these sulfates, a classic example of the interrelated nature of air and atmosphere related environmental problems. The goal of the COP-6 negotiations is to work out the details of the methods and mechanisms by which states parties may implement the commitments made in the Protocol. These include direct domestic reductions in emissions of six GHGs, and the use of "sinks" to increase carbon absorption, as well as Joint Implementation (JI) programs with other states, Emissions Trading and the Clean Development Mechanism (CDM). This course will examine the problem of climate change and energy policy, and the interconnectedness with national energy policies, laws, and regulations and the energy-related environmental impacts and policy.

88-385 Managerial Decision Making
Intermittent: 9 units
People in organizations make decisions, with important consequences, every day. Therefore, an understanding of decision-making is important in any education in management or economics. However, while a large number of courses in these curricula expose students to how decisions should be made, very few focus on how people actually make choices. This course addresses this topic by focusing on how decisions made by real people - and in particular decisions in business contexts - differ from the theoretical predictions of rational decision-making. We specifically focus on common areas of biased decision-making, their basis, and how they might be corrected. The focus of the course is on both individual and competitive decision-making. Prerequisites: 73250 or 73251 or 88220. Students conduct research or other independent academic study under the supervision of a Social & Decision Sciences faculty member. Students who wish to engage in research should seek out a faculty member whose interests are appropriate to the topic. Prerequisite: Permission of a faculty sponsor.

88-421 Advanced Topics in Emotion and Decision Making
Intermittent: 9 units
This advanced seminar will examine important theoretical and empirical perspectives on emotions and decision making. The course will begin with consideration of foundational issues, such as: (a) how to define emotion, (b) physiological causes and consequences of emotion, (c) cognitive causes and consequences of emotion, and (d) distinguishing different kinds of emotional phenomena, such as moods, temperaments, etc. The course will progress on to consider different theories of emotion and decision making. Depending on class interests, a few special topics in emotion and decision making may receive extra emphasis: health (especially anger and anxiety), gender, and adolescence. Throughout the course, the primary goals are to: (a) Learn about the academic field of emotion and decision making, its major theories, results, and debates. (b) Become a critical consumer of research findings by learning to apply the methodological standards for evaluating the soundness of research. (c) Consider the applicability of research results to every day problems. This is an advanced seminar in which you will be expected to: (a) read original research articles and chapters on the selected topics, (b) regularly turn in comments.
and questions about the readings, (c) participate regularly and actively in class discussions, and (d) write several papers. The majority of class time will consist of discussion and debate. At key points, the instructor will give focused lectures.

Prerequisites: 85449 or 88120

88-425 Politics of Economic De Regulation
Intermittent: 9 units
This course examines formulation and implementation of regulatory policy in the United States. Among the general issues we will consider are the role of ideas and interests in public policy, tensions between expertise and democracy, differences in the way governments and private industries regulate, economic and social activity, and differences in the politics of regulation and deregulation. Specific topics include the evolution of intellectual rationales for regulation and deregulation. The course is organized around several industries where the choice of the industries to be studied depends upon student interest. The railroads are always included because this industry is among the first to be deregulated. Usually, environmental regulation is included because of the importance of this topic. Others can include air transportation, telecommunications, electric utilities, etc.

Prerequisites: (88104) and (36202 or 36208 or 36217 or 36221 or 36226 or 70208)

88-430 Epistemology of Behavioral Decision Research
Intermittent: 9 units
The course will look at the mutual implications of behavioral decision making and the philosophy of science (from the perspective of the role played by criticism in the growth of knowledge). It will consider the limits to decision making, as these emerge in empirical studies, in terms of their implications for normative accounts (regarding how decisions should be made). It will consider the cognitive plausibility and advisability of philosophical accounts of how science should proceed, in the light of these studies. It will consider the tension between psychology and economics in terms of general tensions in the development of the sciences. The readings will be drawn from philosophy and behavioral decision making, in order to provide essential background in each. Nonetheless, the course will be most valuable to students who know one perspective reasonably well. Grades will be based on class participation and either three 10-page research papers or one report on an empirical study.

88-441 Formal Models of Political Economics
Intermittent: 9 units
This course is intended to introduce students to the modern theory of political economy. The course has two goals: providing a basic training in theoretical methods (including game theory, equilibrium analysis, constrained optimization, and social choice) and serving as an introduction to both classic and current theoretical research in political economy. In addition to showing proficiency in the methods learned in class through exams and homework, students will be expected to produce a final paper with an eye towards eventual publication. No prerequisites, but previous coursework in calculus and real analysis will be very helpful.

88-444 Public Policy and Regulation
Intermittent: 9 units
Regulations are a significant policy tool of government. How society and the economy will react to new regulations can be hard to predict. Unintended side effects sometimes occur resulting in costs exceeding estimates and/or benefits never being realized. This course will review the basics of regulatory policy and use historical examples, will explore the reasons why past regulations have succeeded and failed. The second half of the course will involve 2-3 detailed case studies. Quantitative methods will be used to evaluate several pending regulations for real-world clients from both government and industry perspectives.

88-501 SDS Senior Honors Thesis I
Fall: 9 units
Majors in the Social and Decision Sciences Department with outstanding academic records and intellectual promise will be given the opportunity to undertake original research under the direction of individual faculty members. Research topics are selected by students and faculty. Prerequisites: Senior standing; a 3.5 QPA in one of the Departments majors; a 3.25 QPA overall; permission of the Departments faculty; and approved entry into the Colleges Honors Program.

88-502 SDS Senior Honors Thesis II
Spring: 9 units
Majors in the Social and Decision Sciences Department with outstanding academic records and intellectual promise will be given the opportunity to undertake original research under the direction of individual faculty members.

Prerequisites: 88501

University Wide Courses

Courses that do not belong to a specific department and interdisciplinary courses that are not easily classified as belonging to one specific department are referred to as "University-Wide" courses. There are two sets of University-Wide courses:

99-xxx courses are those of university wide interest. Examples are 99-101 and 99-102, Computing Skills Workshop, a requirement for all Carnegie Mellon students. and 99-250, Seminar for Peer Tutors, that may be of interest to all students.

98-xxx courses are student led courses, and are part of the Student College ("StuCo") program. These courses offer 3 units, and a student may count at most three such courses toward graduation, contingent upon approval from his/her major department. The advisors for StuCo are Mark Stehlik, Associate Dean of Computer Science, and Janet Stocks, Assistant Vice Provost for Education. StuCo courses are not listed in the catalog because they vary each semester. For additional details and a current course listing, visit www.cmu.edu/stuco.

99-101 Computing Skills Workshop
Fall and Spring: Mini Session - 3 units
Computing Skills Workshop (CSW) is a 3-unit required class that ALL incoming undergraduate students take when they arrive on campus. The course is comprised of mostly Carnegie Mellon specific information and helps students understand what resources are available to them and what responsibilities they have as a user in our computing community. Class is held twice/week for 50 min for 1/2 of the semester. There is very little work required outside of class, so students are expected to attend all classes. This course is only offered during the Fall and Spring semesters. There are no test-out opportunities or summer programs. Advanced Placement Computing Courses cannot be credited/substituted for this requirement.

99-102 Computing Skills Workshop
Fall and Spring: Mini Session - 3 units
Computing Skills Workshop (CSW) is a 3-unit required class that ALL incoming undergraduate students take when they arrive on campus. The course is comprised of mostly Carnegie Mellon specific information and helps students understand what resources are available to them and what responsibilities they have as a user in our computing community. Class is held twice/week for 50 min for 1/2 of the semester. There is very little work required outside of class, so students are expected to attend all classes. This course is only offered during the Fall and Spring semesters. There are no test-out opportunities or summer programs. Advanced Placement Computing Courses cannot be credited/substituted for this requirement.
Course Descriptions

99-103  Computing Skills Workshop  
Fall and Spring: Mini Session - 3 units
Computing Skills Workshop (CSW) is a 3-unit required class that ALL incoming undergraduate students take when they arrive on campus. The course is comprised of mostly Carnegie Mellon specific information and helps students understand what resources are available to them and what responsibilities they have as a user in our computing community. Class is held twice/week for 50 min for 1/2 of the semester. There is very little work required outside of class, so students are expected to attend all classes. This course is only offered during the Fall and Spring semesters. There are no test-out opportunities or summer programs. Advanced Placement Computing Courses cannot be credited/substituted for this requirement.

99-200  Tutoring, Mentoring and Role Modeling—A Community Service Course  
Spring: 6 units
This course has service, intellectual, and personal goals. Its service goal is to provide effective tutors, mentors, and role models to local public school children. Students meet for class once/week and tutor 2 hours per week, in a time slot of your choosing, usually through the East End Tutoring Program (http://www.andrew.cmu.edu/~eastend/). To promote your effectiveness, the course covers topics of tutoring (making tutoring interesting and creative, focusing on meta-learning strategies and study skills); mentoring (exploring multiple mentoring models and the mutual benefits of a mentoring relationship); and informed citizenship (gaining a broader understanding of the issues that urban kids face, exploring how public policies affect the disparities between urban and suburban school student performance). Tutors learn that they can be effective in helping younger students, and that it is personally rewarding to do so. Tutors also often express that it is refreshing to step outside the grind of Carnegie Mellon life and do something worthwhile in the community.

99-250  Seminar for Peer Tutors  
Fall and Spring: 4.5 units
The purpose of this training course is to provide undergraduates with the knowledge and skills necessary to become peer tutors. Students will be exposed to the goals and objectives of the program and will gain the knowledge and experience necessary to become an effective peer tutor. Peer helpers will gain experience in group dynamics, communication skills, study strategies, referral resources, leadership, and creating a supportive learning environment. Teaching practice is an integral part of the training program. Students must complete an application in person or electronically (http://acad-dev.mac.cc.cmu.edu/acad-dev/jobs.htm) and then be interviewed by the instructor(s) to determine if the student possesses the basic qualifications.

99-251  Seminar for Supplemental Instruction  
Fall and Spring: 4.5 units
The purpose of this training course is to provide undergraduates with the knowledge and skills necessary to become supplemental instruction (SI) leaders. Students will be exposed to the goals and objectives of the program and will gain the knowledge and experience necessary to become an effective SI leader. SI leaders will gain experience in group dynamics, communication skills, study strategies, referral resources, leadership, and creating a supportive learning environment. Teaching practice is an integral part of the training program. Students must complete an application in person or electronically (http://acad-dev.mac.cc.cmu.edu/acad-dev/jobs.htm) and then be interviewed by the instructor(s) to determine if the student possesses the basic qualifications.

99-252  Seminar for Academic Counseling  
Fall and Spring: 4.5 units
The purpose of this training course is to provide undergraduates with the knowledge and skills necessary to become peer academic counselors. AC's will gain experience in group dynamics, communication skills, study strategies, referral resources, leadership, and creating a supportive learning environment. Teaching practice is an integral part of the training program. Students must complete an application in person or electronically (http://acad-dev.mac.cc.cmu.edu/acad-dev/jobs.htm) and then be interviewed by the instructor(s) to determine if the student possesses the basic qualifications.
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# 2004-2005 Academic Calendar

- **Fall 2004 Semester**
  - Semester: (M-14, T-15, W-14, Th-14, F-13) Total=70
  - Mini-1: (M-7, T-7, W-7, Th-7, F-7) Total=15
  - Mini-2: (M-7, T-7, W-6, Th-6, F-6) Total=12

### Date | Day | Notes
--- | --- | ---
August 23 | M | Fall Semester Payment Due
August 30 | M | Semester & Mini-1 Classes Begin
September 3 | F | Mini-1 Course Add Deadline without Dean's Permission (except TSB & HNZ/ISM)
September 3 | F | Mini-1 Course Audit Grade Option Deadline (except TSB & HNZ/ISM)
September 3 | F | Mini-1 Course Drop Deadline to Receive Tuition Adjustment (except TSB & HNZ/ISM)\(^a\)
September 6 | M | Labor Day; No Classes
September 13 | M | Semester Course Add Deadline without Dean's Permission
September 13 | M | Semester Course Audit Grade Option Deadline
September 13 | M | Semester Course Drop Deadline to Receive Tuition Adjustment\(^a\)
September 13 | M | Mini-1 Course Add Deadline without Dean's Permission
September 13 | M | Mini-1 Course Audit Grade Option Deadline (HNZ/ISM only)
September 14 | M | Mini-1 Course Drop Deadline to Receive Tuition Adjustment (TSB only)
September 14 | M | Mini-1 Course Drop Deadline to Receive Tuition Adjustment (TSB only)\(^a\)
September 29 | W | Mini-1 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date\(^a\)
October 11-18 | M-F | Mini-1 Faculty Course Evaluations
October 18 | M | Mini-1 Last Day of Class
October 18 | M | Mini-1 Course Drop Deadline to Receive a Withdrawal Grade
October 19 | T | No Undergraduate Mini-1 Course Meetings (Reading Day)
October 19-21 | T-Th | No Undergraduate Mini-1 Course Meetings (Reading Period)
October 20-23 | W-Sa | Graduate Mini-1 Exam Days
October 22 | F | Undergraduate Mini-1 Exam Day
October 22 | F | Mid-Semester Break; No Classes (Mini-1 exams will take place)
October 25 | M | Semester Mid-Term & Mini-1 Final Grades Due by 9 p.m.
October 25 | M | Semester & Mini-2 Classes Begin
October 29 | W | Mini-2 Classes Begin (TSB only)
October 29 | F | Mini-2 Course Add Deadline without Dean's Permission (except TSB & HNZ/ISM)
October 29 | F | Mini-2 Course Audit Grade Option Deadline (except TSB & HNZ/ISM)
October 29 | F | Mini-2 Course Drop Deadline to Receive Tuition Adjustment (except TSB & HNZ/ISM)\(^a\)
November 5 | F | Mini-2 Course Add Deadline without Dean's Permission (HNZ/ISM only)
November 5 | F | Mini-2 Course Audit Grade Option Deadline (HNZ/ISM only)
November 5 | F | Mini-2 Course Drop Deadline to Receive Tuition Adjustment (except TSB & HNZ/ISM)\(^a\)
November 8 | M | Semester Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course
November 10 | W | Mini-2 Course Add Deadline without Dean's Permission (TSB only)
November 10 | W | Mini-2 Course Audit Grade Option Deadline (TSB only)
November 10 | W | Mini-2 Course Drop Deadline to Receive Tuition Adjustment (TSB only)\(^a\)
November 24-26 | W-F | Thanksgiving Holiday; No Classes
November 29 | M | Mini-2 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Droping After This Date
December 2 | W | Mini-2 Last Day of Class (except TSB)
December 10 | F | Semester & Mini-2 Course Drop Deadline to Receive a Withdrawal Grade (except TSB)\(^b\)
December 13-14 | M-T | Final Examinations (except TSB)
December 15 | W | Reading Day (except TSB & HNZ/ISM)
December 16-17 | Th-F | Final Examinations for graduating students due by 6 p.m.
December 17 | F | Semester & Mini-2 Last Day of Classes
December 17 | F | Semester & Mini-2 Course Drop Deadline to Receive a Withdrawal Grade (except TSB)\(^b\)
December 18-22 | Sa-W | Final Examinations (TSB only)
December 20-21 | M-T | Final Examinations (except HNZ/ISM)
December 23 | Th | Final Grades Due by 6 p.m.

- **Spring 2005 Semester**
  - Semester: (M-13.5, T-15, W-14, Th-14, F-13) Total=70.5
  - Mini-2: (M-6.5, T-7, W-7, Th-7, F-7) Total=34.5
  - Mini-4: (M-7, T-7, W-6, Th-6, F-6) Total=33

### Date | Day | Notes
--- | --- | ---
January 3 | M | Spring Semester Payment Due
January 10 | M | Semester & Mini-3 Classes Begin
January 14 | F | Mini-3 Course Add Deadline without Dean's Permission (except TSB & HNZ/ISM)
January 14 | F | Mini-3 Course Audit Option Deadline (except TSB & HNZ/ISM)
January 14 | F | Mini-3 Course Drop Deadline to Receive Tuition Adjustment (except TSB & HNZ/ISM)\(^a\)
January 17 | M | Martin Luther King Day; No Classes after 12:30 p.m. (all colleges; all courses; including evening classes)
January 21 | F | Semester Course Add Deadline without Dean's Permission
January 21 | F | Semester Course Audit Grade Option Deadline
January 21 | F | Semester Course Drop Deadline to Receive Tuition Adjustment\(^a\)
January 21 | F | Mini-3 Course Add Deadline without Dean's Permission (TSB & HNZ/ISM only)
January 21 | F | Mini-3 Course Audit Option Deadline (TSB & HNZ/ISM only)
January 21 | F | Mini-3 Course Drop Deadline to Receive Tuition Adjustment (TSB & HNZ/ISM only)\(^a\)
February 7 | M | Mid-Min Break; No Classes
February 8 | F | Mini-3 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date\(^a\)
February 21-28 | T-F | Mini-3 Faculty Course Evaluations
February 25 | F | Mini-3 Last Day of Class (TSB only)
February 25 | F | Mini-3 Course Drop Deadline to Receive a Withdrawal Grade (TSB only)\(^a\)
February 28 | M | No Undergraduate Mini-3 Course Meetings (Reading Day)
February 28 | M | No Undergraduate Mini-3 Course Meetings (Reading Period)

### Notes:
1. Students dropping a course while maintaining enrollment will receive a tuition adjustment only if they drop by this date. Students taking a Leave of Absence should consult the official Tuition Adjustment Policy.
2. Not Applicable for Graduate Students except graduate students in MCS & TSB.

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*Exceptions for TSB refer only to graduate programs.*

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**Mini-3:** (M-7, T-7, W-7, Th-7, F-7) Total=34.5

**Mini-4:** (M-7, T-7, W-6, Th-6, F-6) Total=33
## 2005-2006 Academic Calendar

### Fall 2005 Semester
- **Semester:** (M-14, T-15, W-14, Th-14, F-13) Total=70
- **Mini-1:** (M-7, T-7, W-7, Th-7, F-7) Total=35
- **Mini-2:** (M-7, T-7, W-6, Th-6, F-6) Total=32

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 22</td>
<td>M</td>
<td>Fall Payment Due</td>
</tr>
<tr>
<td>September 2</td>
<td>F</td>
<td>Mini-1 Course Add Deadline without Dean's Permission (except TSB)</td>
</tr>
<tr>
<td>September 2</td>
<td>F</td>
<td>Mini-1 Course Audit Grade Option Deadline</td>
</tr>
<tr>
<td>September 2</td>
<td>F</td>
<td>Mini-1 Course Drop Deadline to Receive Tuition Adjustment (except TSB)</td>
</tr>
<tr>
<td>September 5</td>
<td>M</td>
<td>Labor Day; No Classes</td>
</tr>
<tr>
<td>September 12</td>
<td>M</td>
<td>Semester Course Add Deadline without Dean's Permission</td>
</tr>
<tr>
<td>September 12</td>
<td>M</td>
<td>Semester Course Audit Grade Option Deadline</td>
</tr>
<tr>
<td>September 12</td>
<td>M</td>
<td>Semester Course Drop Deadline to Receive Tuition Adjustment^</td>
</tr>
<tr>
<td>September 12</td>
<td>M</td>
<td>Mini-1 Course Add Deadline without Dean's Permission (TSB only)</td>
</tr>
<tr>
<td>September 12</td>
<td>M</td>
<td>Mini-1 Course Audit Grade Option Deadline (TSB only)</td>
</tr>
<tr>
<td>September 12</td>
<td>M</td>
<td>Mini-1 Course Drop Deadline to Receive Tuition Adjustment (TSB only)</td>
</tr>
<tr>
<td>September 28</td>
<td>W</td>
<td>Mini-1 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date^</td>
</tr>
<tr>
<td>October 10-14</td>
<td>M-F</td>
<td>Mini-1 Faculty Course Evaluations</td>
</tr>
<tr>
<td>October 17</td>
<td>M</td>
<td>Mini-1 Last Day of Classes</td>
</tr>
<tr>
<td>October 17</td>
<td>M</td>
<td>Mini-1 Course Drop Deadline to Receive a Withdrawal Grade^</td>
</tr>
<tr>
<td>October 18</td>
<td>T</td>
<td>No Graduate Mini-1 Course Meetings (Reading Day)</td>
</tr>
<tr>
<td>October 18-20</td>
<td>T-Th</td>
<td>No Undergraduate Mini-1 Course Meetings (Reading Period)</td>
</tr>
<tr>
<td>October 19-22</td>
<td>W-Sa</td>
<td>Graduate Mini-1 Exam Days</td>
</tr>
<tr>
<td>October 21</td>
<td>F</td>
<td>Undergraduate Mini-1 Exam Day</td>
</tr>
<tr>
<td>October 21</td>
<td>F</td>
<td>Mid-Semester Break; No Classes (Mini-1 exams will take place)</td>
</tr>
<tr>
<td>October 24</td>
<td>M</td>
<td>Semester Mid-Term &amp; Mini-1 Final Grades Due by 9 p.m.</td>
</tr>
<tr>
<td>October 24</td>
<td>M</td>
<td>Mini-2 Classes Begin</td>
</tr>
<tr>
<td>October 28</td>
<td>F</td>
<td>Mini-2 Course Add Deadline without Dean's Permission (except TSB)</td>
</tr>
<tr>
<td>October 28</td>
<td>F</td>
<td>Mini-2 Course Audit Grade Option Deadline (except TSB)</td>
</tr>
<tr>
<td>October 28</td>
<td>F</td>
<td>Mini-2 Course Drop Deadline to Receive Tuition Adjustment (except TSB)</td>
</tr>
<tr>
<td>November 4</td>
<td>F</td>
<td>Mini-2 Course Add Deadline without Dean's Permission (TSB only)</td>
</tr>
<tr>
<td>November 4</td>
<td>F</td>
<td>Mini-2 Course Audit Grade Option Deadline (TSB only)</td>
</tr>
<tr>
<td>November 4</td>
<td>F</td>
<td>Mini-2 Course Drop Deadline to Receive Tuition Adjustment (TSB only)</td>
</tr>
<tr>
<td>November 7</td>
<td>M</td>
<td>Semester Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date^</td>
</tr>
<tr>
<td>November 21</td>
<td>M</td>
<td>Mini-2 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date^</td>
</tr>
<tr>
<td>November 21</td>
<td>M</td>
<td>Semester &amp; Mini-2 Last Day of Classes (except TSB)</td>
</tr>
<tr>
<td>November 9</td>
<td>F</td>
<td>Semester &amp; Mini-2 Last Day of Classes (except TSB)</td>
</tr>
<tr>
<td>December 9</td>
<td>F</td>
<td>Semester &amp; Mini-2 Course Drop Deadline to Receive a Withdrawal Grade (except TSB)</td>
</tr>
<tr>
<td>December 12-13</td>
<td>M-T</td>
<td>Final Examinations (except TSB)</td>
</tr>
<tr>
<td>December 14</td>
<td>W</td>
<td>TSB Semester &amp; Mini-2 Last Day of Classes</td>
</tr>
<tr>
<td>December 14</td>
<td>W</td>
<td>TSB Semester &amp; Mini-2 Course Drop Deadline to Receive a Withdrawal Grade (except TSB)</td>
</tr>
<tr>
<td>December 15-16</td>
<td>Th-F</td>
<td>Final Examinations (except TSB)</td>
</tr>
<tr>
<td>December 19-20</td>
<td>M-T</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>December 22</td>
<td>Th</td>
<td>Final Grades Due by 6 p.m.</td>
</tr>
</tbody>
</table>

### Spring 2006 Semester
- **Semester:** (M-13.5, T-15, W-15, Th-14, F-13) Total=70.5
- **Mini-3:** (M-6.5, T-7, W-7, Th-7, F-7) Total=34.5
- **Mini-4:** (M-7, T-7, W-6, Th-6, F-6) Total=33

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 9</td>
<td>M</td>
<td>Spring Payment Due</td>
</tr>
<tr>
<td>January 16</td>
<td>M</td>
<td>Semester &amp; Mini-3 Classes Begin</td>
</tr>
<tr>
<td>January 16</td>
<td>M</td>
<td>Martin Luther King Day; No Classes after 12:30 p.m. (all colleges, all courses; including evening classes)</td>
</tr>
<tr>
<td>January 20</td>
<td>F</td>
<td>Mini-3 Course Add Deadline without Dean's Permission (except TSB)</td>
</tr>
<tr>
<td>January 20</td>
<td>F</td>
<td>Mini-3 Course Audit Option Deadline (except TSB)</td>
</tr>
<tr>
<td>January 20</td>
<td>F</td>
<td>Mini-3 Course Drop Deadline to Receive Tuition Adjustment (except TSB)</td>
</tr>
<tr>
<td>January 27</td>
<td>F</td>
<td>Semester Course Add Deadline without Dean's Permission</td>
</tr>
<tr>
<td>January 27</td>
<td>F</td>
<td>Semester Course Audit Grade Option Deadline</td>
</tr>
<tr>
<td>January 27</td>
<td>F</td>
<td>Semester Course Drop Deadline to Receive Tuition Adjustment^</td>
</tr>
<tr>
<td>January 27</td>
<td>F</td>
<td>Mini-3 Course Add Deadline without Dean's Permission (TSB only)</td>
</tr>
<tr>
<td>January 27</td>
<td>F</td>
<td>Mini-3 Course Audit Grade Option Deadline (TSB only)</td>
</tr>
<tr>
<td>January 27</td>
<td>F</td>
<td>Mini-3 Course Drop Deadline to Receive Tuition Adjustment (TSB only)</td>
</tr>
<tr>
<td>February 13-17</td>
<td>M-F</td>
<td>Spring Break; No Classes</td>
</tr>
<tr>
<td>March 6</td>
<td>M</td>
<td>Mini-3 Last Day of Classes</td>
</tr>
<tr>
<td>March 6</td>
<td>M</td>
<td>Mini-3 Course Drop Deadline to Receive a Withdrawal Grade^</td>
</tr>
<tr>
<td>March 9</td>
<td>M-F</td>
<td>Graduate Mini-3 Exam Days</td>
</tr>
<tr>
<td>March 10</td>
<td>F</td>
<td>Undergraduate Mini-3 Exam Day</td>
</tr>
<tr>
<td>March 10</td>
<td>F</td>
<td>Mid-Semester Break; No Classes (Mini-3 exams will take place)</td>
</tr>
<tr>
<td>March 13</td>
<td>M</td>
<td>Semester Mid-Term &amp; Mini-3 Final Grades Due by 9 p.m.</td>
</tr>
<tr>
<td>March 20</td>
<td>M</td>
<td>Mini-4 Classes Begin</td>
</tr>
<tr>
<td>March 24</td>
<td>F</td>
<td>Mini-4 Course Add Deadline without Dean's Permission (except TSB)</td>
</tr>
<tr>
<td>March 24</td>
<td>F</td>
<td>Mini-4 Course Audit Option Deadline (except TSB)</td>
</tr>
<tr>
<td>March 24</td>
<td>F</td>
<td>Mini-4 Course Drop Deadline to Receive Tuition Adjustment (except TSB)</td>
</tr>
<tr>
<td>April 3</td>
<td>M</td>
<td>Semester Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date^</td>
</tr>
<tr>
<td>March 17</td>
<td>M</td>
<td>Fall 2006 Registration Week</td>
</tr>
<tr>
<td>April 18</td>
<td>T</td>
<td>Mini-4 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date^</td>
</tr>
<tr>
<td>April 28-29</td>
<td>F-Sa</td>
<td>Spring Carnival; No Classes (except TSB)</td>
</tr>
<tr>
<td>May 1-5</td>
<td>M-F</td>
<td>Semester &amp; Mini-4 Faculty Course Evaluations</td>
</tr>
<tr>
<td>May 5</td>
<td>F</td>
<td>Semester &amp; Mini-4 Last Day of Classes</td>
</tr>
<tr>
<td>May 5</td>
<td>F</td>
<td>Semester &amp; Mini-4 Course Drop Deadline to Receive a Withdrawal Grade (except TSB)</td>
</tr>
<tr>
<td>May 6</td>
<td>Sa</td>
<td>TSB Semester &amp; Mini-4 Final Examinations</td>
</tr>
<tr>
<td>May 6</td>
<td>Sa</td>
<td>TSB Reading Day (except TSB)</td>
</tr>
<tr>
<td>May 8-9</td>
<td>M-T</td>
<td>Final Examinations (except TSB)</td>
</tr>
<tr>
<td>May 8-9-10</td>
<td>M-T-W</td>
<td>TSB Semester &amp; Mini-4 Final Examinations</td>
</tr>
<tr>
<td>May 10</td>
<td>W</td>
<td>TSB Reading Day (except TSB)</td>
</tr>
<tr>
<td>May 11-12</td>
<td>Th-F</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>May 15-16</td>
<td>M-T</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>May 18</td>
<td>T</td>
<td>Final Grades for graduating students due by 6 p.m.</td>
</tr>
<tr>
<td>May 21</td>
<td>Su</td>
<td>Commencement</td>
</tr>
<tr>
<td>May 23</td>
<td>T</td>
<td>Final Grades for non-graduating students due by 4 p.m.</td>
</tr>
</tbody>
</table>

**Notes:**
- ^ Exceptions for TSB refer only to graduate programs.
- 1. Students dropping a course while maintaining enrollment will receive a tuition adjustment only if they drop by this date. Students taking a Leave of Absence or Withdrawal from the University should consult the official Tuition Adjustment Policy.
- 2. Not Applicable for Graduate Students except graduate students in MCS & TSB.
Addendum

The addendum to this catalog will be published in the summer of 2005 and bound to the back of books distributed after August of that year. Separate copies of the addendum will be available to undergraduate students and will be distributed to faculty and administration during the fall by way of campus mail. Additional copies may be purchased at the bookstore.