Carnegie Mellon University

Undergraduate Catalog 2002 - 2004
Carnegie Institute of Technology
The College of Fine Arts
The College of Humanities and Social Sciences
The Graduate School of Industrial Administration
  William Larimer Mellon, Founder
The H. John Heinz III School of Public Policy and Management
Mellon College of Science
The School of Computer Science
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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 [http://www.cmu.edu/security/stats.html](http://www.cmu.edu/security/stats.html)

**Obtain general information about Carnegie Mellon University by calling (412) 268-2000.**

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Carnegie Mellon University reserves the right to change its programs, policies and procedures without notice.
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 2003. 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 2002 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 2004.

William F. Elliott, Editor and Publisher, 2002 - 2004 Undergraduate Catalog; Vice President for Enrollment

Karen J. Marron, Copy Editor
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Contents

Look at Carnegie Mellon ................................................................. 8
A Background Based on Achievement ........................................ 8
A Special Educational Experience ............................................... 8
The World of Carnegie Mellon .................................................... 9
Carnegie Mellon Affects the World Beyond Campus .................. 9
Mission ..................................................................................... 9
Degrees Offered ........................................................................ 10
Admission ................................................................................ 13
Undergraduate Admission .......................................................... 14
Application as a Freshman ......................................................... 14
Freshman of Application Instructions ........................................ 15
Application Plans .................................................................... 15
Secondary School Preparation and Required Tests .................... 16
Transfer Application Instructions .............................................. 17
Application as an International Student ..................................... 18
Intercollege Degree Programs ................................................... 18
Requirements for the College Of Fine Arts ............................... 18
Exploring Carnegie Mellon ....................................................... 23
Summer Opportunities .............................................................. 24
Enrollment Services ................................................................ 28
Undergraduate Enrollment ....................................................... 28
Advising and Registration ........................................................ 28
Auditing .................................................................................. 29
Pass/Fail Option ....................................................................... 29
Change in Schedule (Add/Drop) ............................................... 30
Enrollment Services - The HUB ............................................... 30
PCHE (Pittsburgh Council on Higher Education) Guidelines .... 30
Finances ................................................................................ 31
Financial Aid .......................................................................... 31
Financial Aid Policy Statement ................................................. 31
Student Leave Policy .............................................................. 31
Student Return Policy ............................................................ 31
Tuition .................................................................................... 31
Tuition Refund Policy ............................................................. 31
University Policies .................................................................. 36
Policy on Cheating and Plagiarism ............................................ 36
Computing and Information Resources Code of Ethics ............ 36
Carnegie Mellon University Policy on Final Examinations ....... 36
Free Speech and Assembly and Controversial Speakers .......... 37
Human Subjects in Research at Carnegie Mellon University ... 37
Intellectual Property Policy ..................................................... 37
Policy on Student Privacy Rights .......................................... 38
Policy on Restricted Research ................................................. 39
Statement of Assurance .......................................................... 40
Student Activities Fee ............................................................ 40
Policy on Temporary Emergency Closing of the University ....... 40
Undergraduate Academic Regulations ..................................... 46
Availability of Required Courses ............................................. 46
Conduct of Classes ................................................................ 46
Degree Requirements ............................................................. 46
Grading Policies .................................................................... 46
Overloads .............................................................................. 48
Procedure for the Appeal of Grades & Academic Actions ........ 48
Residence Requirements ......................................................... 48
Retention of Student Work ...................................................... 48
Standard Degree Terminology ................................................. 48
Status, Class Standing ............................................................ 49
Statute of Limitations ............................................................. 50
Student Suspension/Required Withdrawal Policy .................... 50
Transfer Credit Evaluation and Assignment Policy .................... 51
Undergraduate Course Meetings .............................................. 51
Units and Quality Points ......................................................... 52
Withdrawal of a Degree ........................................................ 52
University Services ................................................................. 54
Assistance for Individuals with Disabilities ............................. 54
Carnegie Mellon Action Project .............................................. 54
Computing Services ............................................................... 55
Dining Services ...................................................................... 56
Division of Student Affairs ....................................................... 56
Fellowship Resource Advising Center ..................................... 60
Honor Societies ................................................................... 60
Intercultural Communication Center ....................................... 60
Undergraduate Research Initiative .......................................... 60
University Center .................................................................. 61
University Libraries .............................................................. 61
University Police ................................................................. 62
Undergraduate Options ........................................................... 64
Additional Majors/Dual Degrees ............................................. 64
Five-Year Bachelor's/Master's Programs ................................. 64
Health Professions Program ............................................... 64
Minors ................................................................................ 65
Pre-Law Advising Program .................................................... 66
Study Abroad ....................................................................... 66
University Student-Defined Major ......................................... 67
University Summer Sessions .................................................. 67
Department of Athletics & Physical Education ......................... 68
Reserve Officers' Training Corps (ROTC) ................................. 70
Department of Aerospace Studies (Air Force ROTC) .............. 70
Department of Military Science (Army ROTC) ......................... 70
Department of Naval Science (Naval ROTC) ....................... 71
Intercollege Programs ............................................................ 74
Bachelor of Humanities and Arts Degree Program .................. 74
Bachelor of Science and Arts Degree Program ...................... 77
Bachelor of Science in Computational Finance ....................... 81
Minor in Computational Finance ............................................ 81
Science and Humanities Scholars Program ............................ 82
The Undergraduate Additional Major in Human-Computer Interaction .... 84
The Minor in Arts in Society (AIS) ......................................... 86
The Minor in Health Care Policy and Management .................. 87
Carnegie Institute of Technology .............................................. 90
First Year for Engineering Students ....................................... 90
General Education Program for CIT Students ......................... 91
Designated Minors Offered by CIT ......................................... 91
Biomedical Engineering Minor .............................................. 92
Engineering Studies Minor .................................................... 92
Technology and Policy Minor ................................................. 92
Robotics Minor .................................................................. 93
Academic Standards ............................................................ 93
Academic Actions ................................................................. 93
Undergraduate Designated Minors in Carnegie Institute of Technology ......................................................... 95
Automation and Control Engineering Designated Minor ........ 95
Biomedical Engineering Designated Minor ......................... 95
Colloids, Polymers and Surfaces ............................................. 96
Data Storage Systems Technology Designated Minor ............. 96
Electronic Materials Designated Minor .................................. 97
Engineering Design Designated Minor .................................. 98
Environmental Engineering Designated Minor ....................... 98
Manufacturing Engineering Designated Minor ....................... 99
Materials Science and Engineering Designated Minor .......... 100
Mechanical Behavior of Materials Designated Minor ............ 100
Department of Biomedical Engineering ................................. 101
Suggested Tracks and courses: .............................................. 102
Course Requirements: ........................................................ 102
Biomedical Engineering Minor .............................................. 102
Chemical Engineering - Biomedical Engineering Double Major .... 104
Civil & Environmental - Biomedical Engineering Double Major .... 106
Electrical & Computer Engineering - Biomedical Engineering .... 107
Materials Science - Biomedical Engineering Double Major .......... 108
Mechanical Engineering - Biomedical Engineering Double Major .... 109
Department of Chemical Engineering ................................. 111
Curriculum: ................................................................. 111
Process Systems Track .......................................................... 112
Chemical Engineering Sciences Track .................................... 112
Minors with a B.S. in Chemical Engineering ......................... 113
International Chemical Engineering Exchange Programs ........................................ 113
Practical Internships for Senior Chemical Engineering Students (PISCES) ............... 113
Fifth Year Master of Chemical Engineering (MChE) ............................................. 113

Department of Civil and Environmental Engineering ........................................... 114
Curriculum ............................................. 115
Specialty Areas in Civil Engineering ................................................................. 115
Double Majors and Minors ................................................................................. 116
Co-Operative Education Program ................................................................. 116
Integrated B.S./M.S. Program ............................................................................. 116
Faculty .................................................... 116

Department of Electrical and Computer Engineering ........................................... 117
B.S. Curriculum ................................................................................................. 118
Notes on the Curriculum .................................................................................... 119
ECE Cooperative Education Program ............................................................... 120
Requirements for the Integrated M.S./B.S. Degrees Program ............................. 120
Area Course Lists ................................................................................................. 120
Faculty .................................................... 121

Department of Materials Science and Engineering ............................................ 123
Standard Program ............................................................................................ 124
Notes on the Curriculum .................................................................................... 124
Indoor Comfort and Design (Cooperative Education Program) ......................... 125
Integrated B.S.-M.S. Program ............................................................................. 125
Faculty .................................................... 126

Department of Mechanical Engineering ............................................................. 127
Curriculum ........................................................................................................ 128
Notes on the Curriculum .................................................................................... 128
Advising ............................................................................................................. 130
Accelerated Graduate Program .......................................................................... 130
Faculty .................................................... 130

Department of Engineering and Public Policy .................................................... 131
Double-Major Curricula ....................................................................................... 131
EPP Core courses ............................................................................................... 132
EPP Technical Electives ..................................................................................... 133
Social Analysis and Economics Requirements ................................................... 133
Decision Analysis and Economics Requirements ................................................. 133
Social Analysis Electives .................................................................................... 133
Interdisciplinary Problem-Solving Projects.......................................................... 135
Minor in Technology and Policy ......................................................................... 134
Chemical Engineering/Engineering and Public Policy ......................................... 135
Civil and Environmental Engineering / Engineering and Public Policy ................. 136
Computer Science ............................................................................................... 137
Computer Science/Engineering and Public Policy ............................................... 137
Electrical and Computer Engineering/Engineering and Public Policy .................... 138
Materials Science and Engineering/Engineering and Public Policy ...................... 139
Mechanical Engineering/Engineering and Public Policy ..................................... 140
Faculty .................................................... 142

The College of Fine Arts .................................................................................... 144
Academic Standards ............................................................................................ 145
Academic Actions ............................................................................................... 145

Minor Offered by the College of Fine Arts .......................................................... 147
Minor in Architecture .......................................................................................... 147
Minor in Architectural History ............................................................................ 147
Minor in Architectural Technology ..................................................................... 147
Minor in Building Science .................................................................................. 148
Minor in Art .......................................................................................................... 148
Minor in the History of Arts .................................................................................. 148
Minor in Interior Design ....................................................................................... 148
Minor in Drama .................................................................................................... 148
Minor in Jazz Performance ................................................................................. 148
Minor in Music Performance .............................................................................. 148
Minor in Music Technology ............................................................................... 148
Minor in Music Theory ....................................................................................... 149
Minor in Photography, Film and Digital Imaging ................................................ 150

School of Architecture ......................................................................................... 152
Bachelor of Architecture Program ...................................................................... 152
Curriculum ........................................................................................................... 154
Faculty .................................................... 155

School of Art ........................................................................................................ 156
Bachelor of Fine Arts (B.F.A.) Curriculum ......................................................... 157
Sophomore and Senior Year Reviews ............................................................... 157
Faculty .................................................... 158

School of Design .................................................................................................. 159
Design at Carnegie Mellon ................................................................................... 159
B.F.A. in Communication Design ......................................................................... 159
B.F.A. in Industrial Design .................................................................................... 159

School of Drama ................................................................................................... 163
Acting Option ....................................................................................................... 164
Music Theatre Option .......................................................................................... 164
Design Option ....................................................................................................... 165
Directing Option ................................................................................................... 166
Production Technology and Management Option ................................................ 166
Theatre Studies ..................................................................................................... 167
General Studies..................................................................................................... 167
Faculty .................................................... 167

School of Music ................................................................................................... 169
Performances and Activities of the School of Music .............................................. 170
Music Curriculum ............................................................................................... 170
Piano ...................................................................................................................... 170
Organ ..................................................................................................................... 170
Voice ..................................................................................................................... 171
Instrumental .......................................................................................................... 172
Composition ......................................................................................................... 172
Dalcroze Eurythmics Certificate .......................................................................... 173
Piano Pedagogy Certificate ................................................................................... 173
Minor in Accompanying for Piano Majors in the School of Music ......................... 173
Minor in Conducting for Students in the School of Music ...................................... 173
Minor in Jazz Performance for Students in the School of Music ............................. 173
Minor in Music for Students in the School of Music ............................................. 174
Minor in Music Technology for Students in the School of Music ......................... 174
Faculty .................................................... 174

The College of Humanities and Social Sciences ................................................. 177
Liberal/Professional Education .............................................................................. 178
Degree Options ..................................................................................................... 178
H&SS Majors ......................................................................................................... 179
Additional Majors ................................................................................................. 179
Minors .................................................................................................................... 179
Fifth-Year Graduate Degree Options ..................................................................... 179
Bachelor of Arts (B.A.) vs. Bachelor of Science (B.S.) ......................................... 179
H&SS General Education Program ...................................................................... 180
H&SS College-Wide Services, Programs and Research Centers ............................ 182
Academic Standards, Actions and Regulations ..................................................... 186
Academic Actions ................................................................................................. 186

H&SS Interdepartmental Majors .......................................................................... 189
Additional Major in Environmental Policy ............................................................ 189
The Major in Ethics, History, and Public Policy ..................................................... 190
The Major in European Studies ............................................................................ 191
The Major in Information Systems ....................................................................... 192
The Additional Major in International Relations ................................................... 192
The Major in Russian Studies ............................................................................... 196
Student-Defined Major Program ....................................................................... 197

H&SS Interdepartmental Minors .......................................................................... 198
The Minor in Environmental Studies ................................................................. 198
The Minor in European Studies .......................................................................... 199
The Minor in Film and Media Studies .................................................................. 199
The Minor in Gender Studies ............................................................................ 200
The Minor in Health Care Policy and Management .............................................. 200
The Minor in International Relations .................................................................. 200
The Minor in Linguistics ....................................................................................... 201
The Minor in Minority Studies ............................................................................ 202
The Minor in Multimedia Production .................................................................. 202
The Minor in Religious Studies ........................................................................... 203
The Minor in Russian Studies ............................................................................... 203
The Minor in Science, Technology and Society .................................................... 204
The Minor in Sociology ....................................................................................... 204

Department of Economics ................................................................................... 206
B.S. in Economics ............................................................................................... 206
Minor in Economics ............................................................................................ 207
B.S. in Managerial Economics ............................................................................. 207
Faculty .................................................... 208

Department of English ......................................................................................... 209
The B.A. in English .............................................................................................. 210
The B.A. in Creative Writing .................................................................................. 211
The B.A. in Professional Writing ........................................................................... 212
The B.S. in Technical Writing & Communication ................................................ 213
Minor in English .................................................................................................. 216
Faculty .................................................... 217

Department of History .......................................................................................... 218
The Majors in History .......................................................................................... 218
The Major in Anthropology and History .............................................................. 219
The Major in History and Policy ......................................................................... 220
The Major in Social and Cultural History ............................................................. 221
The Minor in History ........................................................................................... 221
Faculty .................................................... 222
Contents

Honors B.S./M.S. Program in Chemical Biology ...................................................... 282
B.S. in Chemistry/Computational Chemistry Track ................................................ 284
B.A. in Chemistry ..................................................................................................... 285
Requirements for a Minor in Chemistry .................................................................. 286
Faculty .................................................................................................................... 287

Department of Mathematical Sciences ................................................................. 288
Mathematics Concentration .................................................................................... 289
Operations Research Concentration ..................................................................... 289
Statistics Concentration .......................................................................................... 290
Discrete Mathematics and Logic Concentration .................................................... 291
Computational and Applied Mathematics Concentration .................................... 292
The Minor in Mathematical Sciences ..................................................................... 293
Minor in Discrete Mathematics and Logic .............................................................. 293
The Honors Degree Program .................................................................................. 293
Faculty .................................................................................................................... 294

Department of Physics .......................................................................................... 296
B.S. in Physics ........................................................................................................ 296
B.A. in Physics ........................................................................................................ 297
B.S. in Physics / Applied Physics Track ................................................................. 297
B.S. in Physics / Astrophysics Track ....................................................................... 298
B.S. in Physics / Biological Physics Track .............................................................. 298
B.S. in Physics / Chemical Physics Track ............................................................... 299
B.S. in Physics / Computational Physics Track ...................................................... 299
The Minor in Physics .............................................................................................. 299
Faculty .................................................................................................................... 300

School of Computer Science .................................................................................. 301
Curriculum — B.S. in Computer Science ................................................................ 302
Suggested Options .................................................................................................. 303
Computer Science as a Secondary Concentration ............................................... 304
Minor in Computer Science ................................................................................... 305
School of Computer Science (SCS) Academic Standards and Actions ................ 305
Research and Teaching Faculty .............................................................................. 305

Course Descriptions .............................................................................................. 309
Biological Sciences ................................................................................................ 310
Chemical Engineering ............................................................................................ 312
Chemistry ................................................................................................................ 314
Civil Environmental Engineering .......................................................................... 317
Computer Science ................................................................................................. 319
Robotics ................................................................................................................... 321
Electrical & Computer Engineering ....................................................................... 321
Engineering & Public Policy ................................................................................... 325
Mathematical Sciences .......................................................................................... 326
Mechanical Engineering ........................................................................................ 330
Materials Science & Engineering .......................................................................... 332
Military Science (Army ROTC) .............................................................................. 334
Aerospace Studies (Air Force ROTC) ....................................................................... 335
Naval Science (Navy ROTC) ................................................................................... 336
Physics .................................................................................................................... 336
Statistics ................................................................................................................ 340
MCS Interdisciplinary ............................................................................................. 341
CIT Interdisciplinary ................................................................................................ 341
Biomedical Engineering ......................................................................................... 341
Architecture ............................................................................................................ 342
Design .................................................................................................................... 346
Drama ..................................................................................................................... 350
Music ....................................................................................................................... 359
Art ............................................................................................................................ 365
CFA Interdisciplinary .............................................................................................. 368
H&SS Interdisciplinary ........................................................................................... 369
Physical Education .................................................................................................. 371
Business Administration ......................................................................................... 372
Economics ............................................................................................................... 376
English .................................................................................................................... 378
History ..................................................................................................................... 385
Philosophy ............................................................................................................. 389
Modern Languages ................................................................................................ 402
Psychology ............................................................................................................. 411
Social & Decision Sciences ..................................................................................... 414
University Studies ................................................................................................. 419

Appendix .................................................................................................................. 421
Administration, Board of Trustees and University Professors ......................... 422
Index ....................................................................................................................... 426
2002-2003 Academic Calendar .............................................................................. 430
2003-2004 Academic Calendar .............................................................................. 431
Addendum .............................................................................................................. 432
A Background Based on Achievement

A Community Striving Toward Excellence

Students come to Carnegie Mellon for a number of reasons. Some are excited by the richness of a university comprising seven different colleges and seek strong academic programs which allow them to focus on a program in one college while still exploring areas in others. Other students are stimulated by the presence of talented fellow students and faculty — by becoming part of a community where colleagues in the arts, business, humanities, engineering, science and public policy all strive to reach their full potential. Some value the close interaction with faculty who open their doors and their minds, and who include home phone numbers on a course syllabus. However, all students come to Carnegie Mellon with a common pursuit: excellence.

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 school was designed to train the sons and daughters of working class families. The original institute 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 be 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.

The Carnegie Mellon of more recent years is a far cry from the institution envisioned by its founder. In 1967, the trustees of the Mellon Institute and 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. They include the Graduate School of Industrial Administration, the H. John Heinz III 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.

Since the end of World War II, the Carnegie Institute of Technology has developed from a regional, technical college into a selective, international research university. Today Carnegie Mellon is made up of seven colleges. As undergraduates, students pursue majors through the Carnegie Institute of Technology (engineering), the College of Fine Arts, the Graduate School of Industrial Administration’s business administration program for undergraduates, the College of Humanities and Social Sciences, the Mellon College of Science, and the School of Computer Science.

A Special Educational Experience

Carnegie Mellon is a varied community. There are approximately 5,200undergraduates and 3,200 graduate students, with a total faculty of more than 1,200. A small student-to-faculty ratio provides an opportunity for close interaction between students and professors. There is also a strong sense of independence at Carnegie Mellon. Faculty who open their doors and their minds, and who include home phone numbers on a course syllabus. However, all students come to Carnegie Mellon with a common pursuit: excellence.

Strength in Research and Artistic Creation

Carnegie Mellon faculty carry out two overlapping responsibilities: teaching and research or artistic creation. The university is alive with new information that finds its way into the classroom. At Carnegie Mellon, instruction is provided by people who are creating new knowledge at the frontier of their disciplines. 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, the Psychology Department, in collaboration with the Center for the Study of Writing in
the English Department, recently received a $1.5 million grant from the Andrew W. Mellon Foundation for a Literacy in Science Center to improve the level of scientific knowledge in America. The engineering college is the only institution in the country with 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 in the School of Music have worked with the School of Computer Science to develop a program called PIANO. Faculty in the School of Music have worked with the School of Computer Science to develop a program called PIANO.

Exploring Research and Creative Projects

Undergraduates hear news of research developments and artistic creation through professors, read about them in papers and magazines, or see them in galleries or on stage. Students can also 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 are the stars of stage productions. Students can be assertive 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 Student Undergraduate Research Grant (SURG) program. The Initiative offers many other services to undergraduates in all departments at Carnegie Mellon. 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 community 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.

A Tough Competitor: Yourself

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. Instead, students are more in step with each other, sharing abilities and sometimes goals. Carnegie Mellon students are serious students who want to excel. Their own toughest competitors are often themselves, pushing to absorb knowledge and reaching out for excellence. The atmosphere is intense but rewarding. Carnegie Mellon graduates enter society as very specially educated people, prepared to assume even greater challenges and equipped with an awareness of their own strengths and abilities.

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 graduates 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. 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 values 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, identity sound solutions, 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 an engineering discipline and Biomedical Engineering
  - Ph.D. in an engineering discipline and Biomedical Engineering
  - M.S. in Bioengineering
  - Ph.D. in 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 Chemical 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 an engineering discipline and Engineering and Public Policy
  - Ph.D. in Engineering and Public Policy

- **Mechanical Engineering**
  - B.S. in Mechanical Engineering
  - M.S. in Mechanical Engineering
  - Ph.D. in Mechanical Engineering

- **Materials Science and Engineering**
  - B.S. 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 Building Performance and Diagnostics
  - M.S. in Computer Aided Design
  - M.S. in Sustainable Design
  - M.S. in Architecture Engineering and Construction Management
  - Master of Urban Design
  - Ph.D. in Building Performance and Diagnostics
  - Ph.D. in Computer Aided Design

- **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.Des. in Interaction Design
  - M.A. in Communication Planning and Design (joint with Department of English)

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

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

College of Humanities and Social Sciences

- **Interdepartmental**
  - B.A. in Ethics, History, and Public Policy*
  - B.S. in Ethics, History, and Public Policy*
  - B.A. in European Studies**
  - B.S. in Information Systems
  - B.A. in Russian Studies**
  - Environmental Policy (additional major only)
  - International Affairs (additional major only)

* jointly sponsored by the Philosophy and History departments
** jointly sponsored by the Modern Languages and History departments

- **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
  - Masters of Design
    - (with the Department of Design)
  - Ph.D. in Literary and Cultural Theory
  - 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
  - Ph.D. in History
  - Ph.D. in History and Policy

- **Modern Languages**
  - B.A. in French
  - B.A. in German
  - B.A. in Japanese
  - B.A. in Spanish
  - 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.S. in Logic and Computation
  B.A. in Philosophy
  M.S. in Logic and Computation
  M.A. in Philosophy
  Ph.D. in Pure and Applied Logic (with the Department of Mathematics and the School of Computer Science)

• Psychology
  B.S. in Cognitive Science
  B.A. in Psychology
  B.S. in Psychology
  Ph.D. in Psychology

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

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

Graduate School of Industrial Administration
• Business Administration
  B.S. in Business Administration
  M.S. in Industrial Administration
  M.S. in Civil Engineering and Management (jointly with Carnegie Institute of Technology)
  M.S. in Computational Finance (with the College of Humanities and Social Sciences, Mellon College of Science, and School of Computer Science)
  M.S. in Electronic Commerce (with the School of Computer Science)
  M.S. in Industrial Administration, minor in Public Management and Policy (with the H. John Heinz School of Public Policy and Management)
  M.S. in Information Networking (jointly with Carnegie Institute of Technology and the School of Computer Science)
  M.S. in Software Engineering and Business Management (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 Political Economy
  Ph.D. in Algorithms, Combinatorics, and Optimization (with the Department of Mathematics and the School of Computer Science)
  Ph.D. in Robotics (with the Robotics Institute)

The H. John Heinz III School of Public Policy and Management
• M.S. in Public Policy and Management
• M.S. in Public Policy and Management with a minor in Business Administration (jointly with the Graduate School of Industrial Administration)
• M.S. in Public Policy and Management and Juris Doctor (dual degree program with the University of Pittsburgh’s School of Law)
• Master of Arts Management (jointly with the College of Fine Arts)
• Master of Science in Educational Technology Management
• Master of Medical Management
• Master of Public Management
• Master of Science in Health Care Policy and Management
• Ph.D. in Public Policy and Management

Human Computer Interaction
Bachelor's degree in a discipline and Human Computer Interaction

Humanities and Arts
Bachelor of Humanities and Arts (jointly sponsored by the College of Humanities & Social Sciences, and the College of Fine Arts)

Information Systems
Master of Science in Information Technology
Master of Information Systems Management

Mellon College of Science
• Biological 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)
  B.A. in Biological Sciences (and a discipline in the humanities or social sciences)
  M.S. in Computational Biology
  Ph.D. in Biological Sciences
  Ph.D. in Biological Sciences/Biophysics and Biochemistry

• Chemistry
  B.S. in Chemistry
  B.S. in Chemistry/Computational Chemistry Track
  B.A. in Chemistry
  M.S. in Chemistry
  M.S. in Polymer Science
  M.S. in Polymers, and Surfaces
  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 Graduate School of Industrial Administration)
  M.S. in Mathematics
  M.S. in Applied Mathematics
  Ph.D. in Mathematics
  Ph.D. in Mathematics (Scientific Computing)
  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.S. in Physics
  B.A. in Physics
  M.S. in Physics
  M.S. in Colloids, Polymers, and Surfaces
  Ph.D. in Physics
  Ph.D. in Applied Physics
  Ph.D. in Physics/Biophysics and Biochemistry

School of Computer Science
B.S. in Computer Science
M.S. in Computer Science (5th Year Scholars Program only)
M.S. in Human-Computer Interaction
M.S. in Language Technology
M.S. in Robotics
M.S. in Software Engineering
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

The following Master’s degrees are offered in conjunction with other academic units:
M.S. in Computational Finance
M.S. in Electronic Commerce
M.S. in Entertainment Technology
M.S. in Information Technology

Science and Arts
Bachelor of Science and Arts (jointly sponsored by the College of Fine Arts and The Mellon College of Science)
Admission

Application as a Freshman ............................................................... 14
Freshman Application Instructions .................................................. 14
Transfer Application Instructions ..................................................... 17
Application as an International Student .......................................... 18
Requirements for the College Of Fine Arts ..................................... 18
Exploring Carnegie Mellon ............................................................... 23
Summer Opportunities ..................................................................... 24
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 selects the most qualified freshman class possible.
We treat every applicant as an individual. Knowing what students like to
do in their free time and 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 weighs 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 Sleeping Bag Weekends, 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 School of Industrial
Administration’s 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, standard-
ized 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
1. Apply for admission to the specific college(s) in which you are
interested.
   • Indicate college by checking proper box on application for
     admission
   • 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 application 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)
   School of Industrial Administration (SIA)
   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 $55 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
$40. Student should submit all fees with his/her application.

5. Plan to visit our campus or interview with a Carnegie Mellon
   alumnus, 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. 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 that 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) 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.

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 15 (November 1 for Early Decision).

10. You must sign 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, 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 decisions 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.

If financial assistance is a concern, or critical to your enrollment at Carnegie Mellon, early decision is perhaps not your best option. Early decision applicants are not informed of their financial aid eligibility before acceptance.

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

1. Check the appropriate box on the application.

2. If you 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 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 application 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 15 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>
</tr>
</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>
</tr>
<tr>
<td></td>
<td>1 year Chemistry</td>
<td>Math Level I, Ic or Iic</td>
</tr>
<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>
<td></td>
</tr>
<tr>
<td></td>
<td>2 years Foreign Language (preferred)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 electives</td>
<td></td>
</tr>
<tr>
<td>School of Industrial Administration</td>
<td>4 years English</td>
<td>SAT I or ACT</td>
</tr>
<tr>
<td></td>
<td>4 years Mathematics*</td>
<td>SAT II: Subject Tests(3)</td>
</tr>
<tr>
<td></td>
<td>1 year Biology</td>
<td>English Composition</td>
</tr>
<tr>
<td></td>
<td>1 year Chemistry</td>
<td>Math Level I, Ic or Iic</td>
</tr>
<tr>
<td></td>
<td>1 year Physics</td>
<td>any third test, Physics, Chemistry or Biology preferred</td>
</tr>
<tr>
<td></td>
<td>1 year Computer Science (preferred)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 years Foreign Language (preferred)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 electives</td>
<td></td>
</tr>
<tr>
<td>College of Humanities and Social Sciences</td>
<td>4 years English</td>
<td>SAT I or ACT</td>
</tr>
<tr>
<td>Information Systems</td>
<td>3 years Mathematics** - H&amp;SS applicants</td>
<td>SAT II: Subject Tests (3)</td>
</tr>
<tr>
<td></td>
<td>4 years Mathematics* - IS applicants</td>
<td>English Composition</td>
</tr>
<tr>
<td></td>
<td>1 year Science (2 or more years preferred)</td>
<td>Math Level I, Ic or Iic</td>
</tr>
<tr>
<td></td>
<td>2 years Foreign Language</td>
<td>One additional test selected by applicant</td>
</tr>
<tr>
<td></td>
<td>6 electives</td>
<td></td>
</tr>
<tr>
<td>School of Architecture</td>
<td>4 years English</td>
<td>SAT I or ACT</td>
</tr>
<tr>
<td></td>
<td>4 years Mathematics*</td>
<td>SAT II: Subject Tests (3)</td>
</tr>
<tr>
<td></td>
<td>1 year Physics</td>
<td>English Composition</td>
</tr>
<tr>
<td></td>
<td>2 years Foreign Language</td>
<td>Math Level I, Ic or Ic</td>
</tr>
<tr>
<td></td>
<td>5 electives</td>
<td>Physics or Chemistry</td>
</tr>
<tr>
<td>School of Art</td>
<td>4 years English</td>
<td>SAT I or ACT</td>
</tr>
<tr>
<td>School of Drama</td>
<td>2 years Foreign Language (preferred)</td>
<td></td>
</tr>
<tr>
<td>School of Music</td>
<td>10 electives***</td>
<td></td>
</tr>
<tr>
<td>School of Design</td>
<td>4 years English</td>
<td>SAT I or ACT</td>
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<tr>
<td></td>
<td>2 years Mathematics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 years Science</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 years Foreign Language (preferred)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 electives</td>
<td></td>
</tr>
</tbody>
</table>

* 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 solfège 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 School of Industrial Administration, 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 I 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 SIA:
   - fall transfer possible if space is available
   - spring transfer limited

   H&S:
   - fall and spring transfer available

   CFA:
   - fall transfer possible
   - no spring transfer opportunities (except for advanced students in the School of Music)

   BHA, BSA, IS:
   - no transfer available

2. Enclose a non-refundable fee of $55 (and audition fees if applicable). This application fee is required, except in extenuating 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 $40. 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 15.

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 15 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

   IMPORTANT: If you are applying for financial aid as a transfer student, you must send a Financial Aid transcript of aid applied for and/or received at all colleges previously attended. Even if you didn’t receive any aid, federal regulations require that the college(s) attended complete the form.

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

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&S, SCS or SIA 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 our 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, SIA, 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, SIA, 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) 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.

- 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 accomplishing 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 your 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 multidisciplinary goals in 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.

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. If an audition or portfolio review is necessary for your BHA/BSA Program focus in the College of Fine Arts, please indicate your preferences for dates on the application.

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

- Be sure to indicate your first and second choices for audition/portfolio review dates on the application for admission.
- Submit your application by December 15 (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 architecture program, 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 architecture program, 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 architecture program, 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 English, mathematics, physics and social science courses because they’re the best predictor of success in the program. In addition, high school experience with computers is valuable but not required. 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 their interest in the field. Full-time university professors teach all courses.

Transferring into 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 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, collage and other media
- sculpture in any medium or of 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 or performance (video documentation appropriate)
- documentation of any other experimental work or creative projects such as stage, scenery, murals, gardens, etc.

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 of any two- and three-dimensional work that is too large or too bulky to bring (such as sculpture or framed painting), or of work no longer owned by the artist.
- 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:
- Submit your application by November 1 (for early decision consideration) or by December 15 (for regular decision consideration)
- Indicate your first and second choices of portfolio review dates (on the application for admission)
- Expect a confirmation of review date and time two weeks before the event

Transfer into 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’ve found that successful design students maintain a balance among three areas, and we assess applicants by evaluating (in no particular order) the following factors:

- academics: high school transcript, class rank and SAT I or ACT scores
- visual and design ability: portfolio and/or Design Project (details below)
- interpersonal skills: interviews, extracurricular activities, letters of recommendation

In order to demonstrate your abilities in each of these areas, you must complete the application by December 15 (November 1 for early decision consideration) and fulfill the requirements outlined below. Preference may be given to those applicants showing a portfolio on campus.

Design requirements
Preferred application procedure (choose one):

- on-campus portfolio review and interview with Design faculty
- on-campus Design Project review and interview with Design faculty
Alternative application procedure (choose one):

- submit a slide portfolio for review by mail and interview with admission staff member or alumni interviewer
- submit a Design Project for review and interview with admission staff member or alumni interviewer

Design portfolio guidelines
The School of Design strongly recommends that the student have a portfolio review and a personal interview with their faculty on campus. The student should include the following in their portfolio:

- actual works rather than photographs of works
- attempt to limit your portfolio to 15 – 20 items (a sketch book is one item)
- we will also review work presented on video cassette and computer diskettes (indicate Macintosh-compatible software used). If you include video cassettes or computer diskettes in your portfolio, please plan to leave them (with a self-addressed stamped envelope) with the school, so that they may be reviewed more carefully at a later date.

Portfolio by mail
If the student would prefer to submit his/her portfolio by mail, he/she should:

- Follow the guidelines described above
- Submit the work in the form of 35mm slides in a standard 9x11" clear, plastic slide page

Do not mail original work or sketchbooks

- Include a key, including title (when appropriate), size, medium and objective of project
- Include a self-addressed, stamped envelope and a sheet of cardboard to prevent bending, so we can return the student’s slides

Mail your portfolio to the address below no later than January 15 (November 15 for early decision consideration):

Office of Admission  
Design Portfolio  
Carnegie Mellon University  
5000 Forbes Avenue  
Pittsburgh, PA 15213-3890

Design project procedure
If you choose to meet a portion of the admission requirements by completing the Design Project, check the appropriate box on the application form. When we receive your application, we will forward the project to you with instructions for completing it. Complete the project and bring it with you to the faculty interview or return it by mail before January 15 (November 15 for early decision consideration) to the address below:

Office of Admission  
Design Project  
Carnegie Mellon University  
5000 Forbes Avenue  
Pittsburgh, PA 15213-3890

On-campus Design interviews
The School of Design recommends that the student bring his/her Design project to his/her interview, so that they can discuss the student’s work. To arrange an on-campus interview and portfolio review the student should:

- Check the appropriate boxes on the application form, indicating first and second preferences of interview dates
- Expect a confirmation of the student’s review date and time two weeks before the event
- We will assign the student’s interview when he/she arrives on campus
- To arrange an interview without a portfolio or project review, students should call the School of Design at (412) 268-2822

Transfer into 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 application for admission 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:

- indicate on the application for admission the particular option you wish
- indicate first and second choices for audition/ portfolio review dates
- submit application by December 15 (no early decision consideration available for admission into Drama)
- enclose a fee of $40 to cover the audition/ portfolio review, in addition to the $55 application fee (make checks payable to Carnegie Mellon University)
- 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
- 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 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 use them. They include: Slow Dance on the Killing Ground, Hale Hamlet, Star Spangled Girl, Runaways, Nuts, A My Name is Alice, Talking With, Dentity 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 fifteen 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

Performance Technology & Management Option
If you are applying to the Performance Technology & Management Option, you should already have practical experience in the theater as well as some background in mathematics and physics.

We expect the student to submit:

• evidence of your ability in drawing, drafting or model making
• a letter describing your training, experience, and ambitions in theater
• 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
Performance Technology Management Option- Drama
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
Fax (412)268-7838

Directing Option
The Directing Option provides a solid grounding in theater arts if you are seeking a career in theater, film or if you have an interest in future graduate studies in production, directing or dramaturgy.

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 describing 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:

• indicate on the application for admission the particular option you want to pursue
• indicate first and second choices for audition review dates
• plan to audition in Pittsburgh if you live within 200 miles of the city (auditioning in Pittsburgh is recommended)
• submit the application by December 15 (November 1 for early decision consideration)
• Enclose a non-refundable fee of $40 to cover your audition, in addition to the $55 application fee (all checks payable to Carnegie Mellon University)
• 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 three 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. They must be prepared to sing two contrasting songs from the standard concert repertoire (i.e., Italian, French, German, or English art songs; operatic or oratorio arias, etc.)

Preparation of a song from the musical theater repertoire is optional. The songs may be sung in the original language or in English. At audition locations outside of Pittsburgh, you must bring your own accompanist; at auditions in Pittsburgh, an accompanist is provided.

Performance-Instrumental Options
Violin
1. Scales: any major or minor scale in three octaves as requested
2. One etude by Mazas, Kreutzer or Fiorillo
3. A 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 Bruni, Kreutzer, Campagnoli or Mazas’ Brilliant Studies
3. A movement, concerto or sonata by Bach or Telemann or a representative work of the romantic or contemporary period
Specific audition requirements in the various categories:

**Percussion Department.** Copies of prepared pieces must be provided and ear test. Memorization of a piece is optional. Sticks and mallets evaluated on the basis of techniques, a prepared piece, sight reading demonstrated. Auditions in all categories are not required. Auditionees will be demonstrated other rudiments upon request

**Flute requirements:**
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

**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 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**
1. Scales: any major or minor scale as requested
2. Chords: any major, minor or dominant seventh chord as requested
3. Any etude or equivalent technical exercise
4. Any composition by Carcassi, Sor, Tarrega, Ponce or Villa-Lobos
5. A solo work of the applicant’s choice

**Composition Option**
Applicants must submit manuscripts of original compositions in advance of the interview date to the head of the School of Music, Carnegie Mellon University, College of Fine Arts Room 105, 5000 Forbes Avenue, Pittsburgh, PA 15213.

**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 for completion.

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

- Submit your unedited work on cassette or VHS of good fidelity. You may submit an audiocassette 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
- 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 $40 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 15:

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

**Transfer into 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 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 January 1 and May 1, 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.

The specific dates and locations for Hometown Interviews are listed in the Carnegie Mellon 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 as interviews made by our Professional Admissions Counselors.

If you’re 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.

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, email cmsbw@andre.cmu.edu or call us at (412) 268-2082. If you do not receive an invitation, call (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.

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

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 Veteran’s 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 for approximately 1/2 mile
- 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
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 Minority Scholars. 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 Minority Scholars

African American, Hispanic American and Native American students entering their junior or senior year who are 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. Carnegie Mellon is always interested in academically talented high school juniors who have the academic ability to skip their senior year entirely to accept early admission to college. This is especially true for capable students whose academic and career goals are clear. Student 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, School of Industrial Administration (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.

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 and recommends concurrent registration in calculus; and that the chemistry and biology 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 important, 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, we engage in the privilege to 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/digital arts 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 freshmen 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, appliance, 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 a 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 musician to learn more about acoustics and discover new sounds. Music theory software developed at Carnegie Mellon enhances the curriculum, and the finest compositions 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 synthesizers. 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 recent cassette tape, representative of their level of performance, or copies of original compositions, with the application materials. A brief outline or resume of previous musical training is also required.

For more information
Requests for applications and further information should be addressed to:

Pre-College Programs
Office of Admission
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
(412) 268-2082
FAX: (412) 268-7838
Enrollment Services

Undergraduate Enrollment ............................................................... 28
Advising and Registration ................................................................. 28
Auditing ............................................................................................ 28
Pass/Fail Option ................................................................................ 28
Change in Schedule (Add/Drop) ....................................................... 29
Enrollment Services - The HUB ......................................................... 29
Cross-College and University Registration
PCHE (Pittsburgh Council on Higher Education) Guidelines .......... 29
Finances ............................................................................................. 30
Financial Aid ...................................................................................... 30
Financial Aid Policy Statement ......................................................... 33
Student Leave Policy ........................................................................ 33
Student Return Policy ...................................................................... 34
Tuition ................................................................................................. 34
Tuition Refund Policy ........................................................................ 34
Undergraduate Enrollment

Enrollment is the process whereby eligible students notify Enrollment Services that they will be attending the university by registering for courses and paying 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 the Monday before the first payment deadline will be assessed a Late Enrollment Fee of $150.

Instructions for enrollment are available on The HUB Website (www.cmu.edu/hub). 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 The Official Academic Calendar.

Advising and Registration

Advising and registration is the process of selecting courses for the upcoming semester and reviewing 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). If you do not know your advisor, OLR will identify him/her for you and facilitate contact with your advisor via e-mail as part of the automatic registration process.

Registration for 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. 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. A “Course Schedule” 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 availability of 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 College Council 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.

Undergraduates may seek to transfer from one academic department to another within the university. Information on procedures and criteria is available through the Associate Dean’s Office of CIT, MCS and H&SS, through each School’s office in the College of Fine Arts, and through the undergraduate departmental offices SCS and GSIA.

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

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.

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

A student may choose to receive a grade of pass or fail as opposed to receiving a grade through the standard grading system. A student who wishes to receive pass/fail grading must register for the course, get the permission of their advisor, complete and submit the Pass/Fail Form to The HUB by the last day to drop a course.

To receive pass/fail grading for a course, follow these three steps. You cannot choose to receive a pass/fail grade for the course after this deadline, even if you're already registered for the course:

1. Complete a Pass/Fail Approval Form, available from The HUB.
2. Have the course instructor sign the form.
3. Submit the Pass/Fail Approval Form to The HUB.

Once you submit the this form, you cannot receive a letter grade other than “P/N” for the course.

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. Changes after this period must be authorized by action of the College Council of the student's college.

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 should consult the Office of International Education.

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 (578-6084), Chatham College (365-1131), CCAC (237-2555), Duquesne University (396-6230), LaRoche College (387-9030), Pittsburgh Theological Seminary (362-5610), Point Park College (392-3861), Robert Morris College (262-8256), University of Pittsburgh (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.

Enrollment Services

Lower Level, Warner Hall
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
Phone (412) 268-8186
Fax (412) 268-8084
Email thehub@andrew.cmu.edu

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.

The tuition charged each student will be automatically adjusted on the 10th regularly scheduled class day (refer to the specific date noted in the 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 for 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.

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.

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.
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. This goal can be reached only if every family contributes as much support as it can reasonably afford. 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.
Financial aid awards 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. Our Office of Admission will provide prospective students with financial aid information as part of the admission application process. Returning student financial aid awards are renewed each year upon proper resubmission of application material by April 1, continued evidence of financial need, and satisfactory academic progress.

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](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.

• Your PIN serves as an electronic identifier and allows you to electronically sign and immediately transmit the FAFSA.

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


4. Submit a signed copy of your parent(s)’ Federal Income Tax Return or Certification of Non-Filing of Federal Income Tax Return or Foreign Income Tax Return, and W-2 Wage and Tax Statements. Also submit a signed copy of your Federal Income Tax Return or Certification of Non-Filing of Federal Income Tax Return or Foreign 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.

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.

What Is Financial Need?
Financial need is the difference between your cost of attendance and your parent(s)’ and your ability to contribute. Two elements must be considered:

1. The expense of the academic year.
2. The amount of money the student and parent(s) can reasonably expect to contribute toward an academic year.

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 annual 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).

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 GSIA and Heinz) must pass 80 percent of all cumulative units attempted at Carnegie Mellon and have a 2.00 cumulative QPA.

Financial Aid 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).

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.

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 board.

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 $5,000 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 $5,000 annually in outside grants/scholarships, your need-based Carnegie Mellon grants/scholarships will be reduced by one-half the value that exceeds $5,000.

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 2002-03 academic year is $4,000. 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
State grants are made available to residents of their state who demonstrate financial need.

If you are eligible for grant assistance from your state but 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 Pennsylvania 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 awarded to students when they enter as freshmen and are renewed annually if the student meets the cumulative 2.0 QPA 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 semesters of undergraduate education (ten semesters for Architecture students), provided satisfactory academic performance is maintained and you are assessed Carnegie Mellon tuition. Academic scholarships are only awarded to incoming freshmen during the admission process. These scholarships include: Judith Resnik Challenger Scholarship for Women, Andrew Carnegie Scholarship, Carnegie Mellon Scholarship and Presidential Scholarship. Recipients do not have to file a FAFSA to renew these scholarships unless they wish to apply for need-based financial aid. If your parent is a Carnegie Mellon employee who qualifies for tuition remission, you will not be eligible for a Carnegie Mellon Academic Scholarship.

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 must complete and submit the following: the Mellon Financial Aid Application. There is no separate application for this loan. Enrollment Services will automatically credit the loan to your student account (if you are a Carnegie Mellon employee who qualifies for tuition remission, you will not be eligible for a Carnegie Mellon Academic Scholarship).

If you are offered a Federal Perkins Loan, Enrollment Services will mail your 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: Federal Stafford Loan Entrance Counseling Form appearing in the browser, you will need to log into the server by entering your Andrew User ID and Password. Use Netscape Navigator version 4.0 or newer or Microsoft Internet Explorer 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. Your parent may obtain a Federal PLUS Loan application from the lender of his/her choice. 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

Insurance and guarantee fees (in the majority of cases 2 percent) are deducted from the loan proceeds each semester before being sent to Carnegie Mellon.

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 your FAFSA is 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 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.cm.edu/hub/exit.html. 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 User ID and Password. Use Netscape Navigator version 4.0 or newer or Microsoft Internet Explorer 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.
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.

Parents who have previously borrowed through the Federal PLUS Loan Program and wish to reapply must obtain a loan application from the same lender. Parents who have not previously borrowed a PLUS Loan may obtain an application from The HUB or directly from their lender of choice. Parents who are borrowing a PLUS Loan through a Pennsylvania/PHEAA lender, must mail a completed application to the address at the bottom of the loan application. All other applications should be mailed to Carnegie Mellon, Enrollment Services.

Carnegie Mellon Gate Student Loan
The Carnegie Mellon Gate Student Loan Program offers students a low interest rate, requires no payments during enrollment, and has a graduated repayment schedule. It is a supplemental student loan program. The student is the borrower and is not required to have a cosigner. A student may be eligible to borrow an annual maximum of $10,000. Information regarding the Carnegie Mellon Gate Student Loan Program is available on The HUB Website http://www.cmu.edu/hub. We encourage all students to investigate borrowing through the subsidized and unsubsidized Federal Stafford Loan Programs before considering the Carnegie Mellon Gate Student 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: http://www.studentaffairs.cmu.edu/career

All undergraduates who are employed by Carnegie Mellon complete timescards 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. The authorization form may be found at http://www.cmu.edu/bank/forms/payroll_forms.html

Reserve Officer Training Corps (ROTC) Scholarships
Air Force ROTC
Two- and three-year scholarships are available to qualified freshmen and sophomores who join the Air Force ROTC program. These scholarships cover a portion of tuition, books and academic fees. The scholarships range from $2,000 each year up to full tuition, depending on the student’s major and academic performance. Students on scholarship are required to attend AFROTC courses (for more information see page 76).

Army ROTC
Army ROTC offers four, three and two year scholarships of up to $16,000 per year with additional annual allowances of $450 for books and $1,500 for spending. 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 71).

Navy-Marine Corps ROTC
The NROTC offers four-, three- and two-year scholarships based on competitive national selection. The Navy pays for tuition, the cost of textbooks, fees and uniforms, and a subsistence allowance of $150 per month. In addition, NROTC midshipmen receive full active duty pay and benefits while on summer training cruises.

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 71 for more information.

Financial Aid Policy Statement
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 2.00 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 International Students
For purposes of undergraduate student financial aid, an International Student is defined as someone who is neither a U.S. citizen nor an eligible noncitizen. The U.S. Department of Education defines an eligible noncitizen as:

1. An individual who is a permanent resident of the United States (as evidenced by an I-151, I-551 or I-551C card); or
2. An individual who can provide documentation from the U.S. Immigration and Naturalization Service (INS) that s/he is in the United States for other than a temporary purpose with the intention of becoming a citizen or permanent resident of the United States.

An undergraduate, International Student is 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
http://www.cmu.edu/policies/documents/StLeave.html - revised policy

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 off 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 signed by the student's Dean. After the Application for Leave Form is received by Enrollment Services, it will be reviewed for appropriate tuition refunds (see Enrollment Services: Tuition Refund Policy) and grade implications.

Student recording of courses and grades for taking 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

[http://www.cmu.edu/policies/documents/StLeave.html](http://www.cmu.edu/policies/documents/StLeave.html) - revised policy

**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 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

The annual full time tuition charge for 2002-03 is $324,970 for undergraduate students who entered prior to Fall 2000 and $26,910 for students who entered after Fall 2000. A full-time student is one registered in a degree program and carrying a schedule of not less than 36 units per semester. An undergraduate student enrolled for 35 units or less per semester will be charged tuition on a unit basis of $347 per unit if they entered prior to Fall 2000 and $374 if they entered after Fall 2000. A student activities fee of $72 per semester (in addition to tuition) is charged to all students who enroll for 19 units or more. Degree-seeking students enrolled for at least one course will be assessed a $31 per semester Port Authority fee.

Exceptions to the above policy are undergraduate students enrolled in:

- off-campus work which has been scheduled for more than two semesters or
- both on-campus and off-campus work or
- the Washington Semester program.

These students are charged at the regular tuition rates.

Private music instruction is available and can be arranged for non-music majors through the Elective Studio program. This private instruction for non-music students is not included in the basic full-time tuition charge.

### Tuition Refund Policy

[http://www.cmu.edu/policies/documents/tuitionRefund.html](http://www.cmu.edu/policies/documents/tuitionRefund.html) - revised policy

**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:

- 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.

### 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. Dine Express and Campus Express are assessed based upon actual use.

There is no adjustment of the PAT bus 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.

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

Policy on Cheating and Plagiarism ...................................................... 36
Computing and Information Resources Code of Ethics ................... 36
Carnegie Mellon University Policy on Final Examinations ........... 36
Free Speech and Assembly and Controversial Speakers .............. 37
Human Subjects in Research at Carnegie Mellon University ...... 37
Intellectual Property Policy ............................................................... 38
Policy on Student Privacy Rights ...................................................... 41
Policy on Restricted Research .......................................................... 43
Statement of Assurance .................................................................... 44
Student Activities Fee ....................................................................... 44
Policy on Temporary Emergency Closing of the University ....... 44
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:

- Plagiarism, explained below.
- Submission of work that is not the student’s own for papers, assignments or exams.
- Submission or use of falsified data.
- Theft of or unauthorized access to an exam.
- Use of an alternate, stand-in or proxy during an examination.
- Supplying or communicating in any way unauthorized information to another student for the preparation of an assignment or during an examination.
- Use of unauthorized material including textbooks, notes or computer programs in the preparation of an assignment or during an examination.
- 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.
- 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:

- A phrase, written or musical.
- A graphic element.
- A proof.
- 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

- 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.

Carnegie Mellon University Policy on Final Examinations

Preamble

The Faculty Senate adopted the following policies on the administration of final 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 at the conclusion of each academic semester. There should be no expectation that the following points will cover every conceivable situation. The student should anticipate the demands of the end-of-semester 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.

Definitions

- 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 are those scheduled by Enrollment Services. 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 can either be comprehensive, covering all course materials, or non-comprehensive, covering only a part of the course.

Policies

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 72 hours before the final examination in the course. 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 periods and final examinations are not cumulative. Late arrivals will reduce the total time for the examination, 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 within four days of the final examination of the same course.

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 contact first the instructor of the course 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.

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 which 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 the 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 intent should be directed to the vice provost for education, x8-5865.

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 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 unthinkable and where every 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.

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 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.

Contact
Questions concerning this policy or its intent should be directed to: Susan Burkett, associate provost for academic administration and research, x-8746

**Intellectual Property Policy**

1. Purpose

The policy reflects the following goals:

- To create a university environment that encourages the generation of new knowledge by faculty, staff, and students.
- To facilitate wide transfer of useful inventions and writings to society.
- To motivate the development and dissemination of intellectual property by providing appropriate financial rewards to creators and the university, and administrative assistance to creators.
- To ensure that the financial return from the development of intellectual property does not distort decisions and operations of the university in a manner contrary to the mission of the university.

The policy is based upon the following principles relating the university to society:

- 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 copy-rightable 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 use of 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.

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 by external sponsorship agreements, 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 sponsorship agreements, 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 during 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, poetry, musical works, dramatic works including any accompanying music, pantomimes and choreographic works, pictorial, 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 coursework) 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 data bases 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 coursework 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 works, and 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 without 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 by 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 3-6-4-1 below.

Procedural Provisions: At the time the intellectual property is disclosed to the university's provost as required under Section 4-1, or at any time thereafter, the creator may request that the university decide whether it will commercially develop said property or execute an assignment of the intellectual property rights to the creator. Such a decision 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.

3-6-3-5. 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 shall make 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 of the work 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 its 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 for 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 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,
- 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 on the part 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, decision 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 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 so 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 students:

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 to 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 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 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 of $65.00 per semester (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 bulletin board cmu-news.

Contact
Questions concerning this policy or its intent should be directed to the Office of the President, extension 82200.
Undergraduate Academic Regulations

Availability of Required Courses ..................................................... 46
Conduct of Classes ........................................................................... 46
Degree Requirements ....................................................................... 46
Grading Policies ................................................................................ 46
Overloads ........................................................................................... 48
Procedure for the Appeal of Grades & Academic Actions ............ 48
Residency Requirement ................................................................. 48
Retention of Student Work ............................................................... 48
Standard Degree Terminology ......................................................... 48
Status, Class Standing ................................................................. 50
Statute of Limitations ........................................................................ 51
Student Suspension/Required Withdrawal Policy ......................... 51
Transfer Credit Evaluation and Assignment Policy ....................... 51
Undergraduate Course Meetings ..................................................... 52
Units and Quality Points ................................................................. 52
Withdrawal of a Degree ................................................................. 52
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 from class or making up late work is the responsibility 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.

Members of athletic teams and other student organizations are permitted to be absent from classes to participate in authorized contests and presentations, either at home or out of town, provided the following conditions are met:

- All work missed must be made up to the satisfaction of the instructor(s) concerned;
- No trip shall involve an absence of more than two days, excluding days when classes are not scheduled;
- The total number of days of absence shall not exceed six per sport or per organization annually;
- Each student will obtain an absence authorization signed by the director or sponsor of the organization involved and by the Dean of Student Affairs. The student will present this authorization to the instructor. This is not an excuse for work missed.

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.cm.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.

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/Withdraw 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.

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.

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

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 Service’s 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 GPA'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 Grade Option Request 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-semiter 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 GSIA and MCS.

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.

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 (as of Fall 1995):

<table>
<thead>
<tr>
<th>Grade</th>
<th>Quality Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>4.33</td>
</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>2.97</td>
</tr>
<tr>
<td>C+</td>
<td>2.33</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
</tr>
<tr>
<td>C-</td>
<td>1.67</td>
</tr>
<tr>
<td>D+</td>
<td>1.33</td>
</tr>
<tr>
<td>D</td>
<td>1.00</td>
</tr>
<tr>
<td>R</td>
<td>0.00</td>
</tr>
<tr>
<td>X</td>
<td>0.00</td>
</tr>
<tr>
<td>S</td>
<td>Non-factorable</td>
</tr>
<tr>
<td>P</td>
<td>Non-factorable</td>
</tr>
<tr>
<td>N</td>
<td>Non-factorable</td>
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<tr>
<td>O</td>
<td>Non-factorable</td>
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<tr>
<td>W</td>
<td>Non-factorable</td>
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<tr>
<td>I</td>
<td>Non-factorable</td>
</tr>
<tr>
<td>AD</td>
<td>Non-factorable</td>
</tr>
</tbody>
</table>

This grading standard is for all students classified as seeking an undergraduate degree and special students taking undergraduate courses. Special students taking graduate courses will be graded on the graduate grading scale (see below).

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 (as of Fall 1995):

<table>
<thead>
<tr>
<th>Grade</th>
<th>Quality Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>4.33</td>
</tr>
<tr>
<td>A</td>
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</tr>
<tr>
<td>B+</td>
<td>3.33</td>
</tr>
<tr>
<td>B</td>
<td>3.00</td>
</tr>
<tr>
<td>B-</td>
<td>2.97</td>
</tr>
<tr>
<td>C+</td>
<td>2.33</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
</tr>
<tr>
<td>C-</td>
<td>1.67</td>
</tr>
<tr>
<td>D+</td>
<td>1.33</td>
</tr>
<tr>
<td>D</td>
<td>1.00</td>
</tr>
<tr>
<td>R</td>
<td>0.00</td>
</tr>
<tr>
<td>S</td>
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<tr>
<td>P</td>
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<td>N</td>
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<td>O</td>
<td>Non-factorable</td>
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<tr>
<td>W</td>
<td>Non-factorable</td>
</tr>
<tr>
<td>I</td>
<td>Non-factorable</td>
</tr>
<tr>
<td>AD</td>
<td>Non-factorable</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 GPAs recalculated at the time of their return.

No A+ may be given in an H&SS or CIT course. No D or D+ may be given in a GSIA course. Pass/Fail policies for graduate students vary and students should be advised to check with their individual colleges/departments/programs for details. Only GSIA 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, and special students taking graduate courses.

Contact

Questions concerning this policy or its intent should be directed to Enrollment Services, x8-8186. 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.

Students who are awarded their degrees with University Honors will be listed as such in the Commencement program, and their diplomas will carry the distinction “With University Honors.”

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 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.
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 the student believes that Step 1 does not adequately resolve the grievance or if no decision has been rendered within the 30 days provided for in Step 2. The Dean of the college, 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 College Council’s decision.

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:

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 course-work. 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 course work. 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)

**Multiple Degrees**
More than one degree granted by the University, whether simultaneously or sequentially. While working towards more than one bachelor’s degree, one of the departments (and if necessary colleges) is to be designated as home unit. 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).

**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); BHA 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

**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**
Secondary field of study, generally represented by a set of department-determined courses of no less than 45 units.
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**
Definition: One diploma, stating the degree and the major field of study. Currently, the Statute of Limitations on earning an undergraduate degree is eight years (See p.).
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**
Definition: 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; Master of Science in the field of Physics

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 (cited on p. 51) 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 upon submission of the Graduate Student Data Sheet 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/Double Major**
Definition: One diploma/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)

Note: Non-CIT students cannot pursue (an) additional major(s) in CIT.

CIT students may pursue (an) additional major(s) in other colleges but are limited within CIT to a double major only in Engineering and Public Policy. Undergraduates can only double major in EPP — it is not offered to them as a major.

The Biomedical and Health Engineering option available to CIT students is now a minor.

Additional Majors / Triple Major

Definition: One diploma/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 Spanish. 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)

Note: Non-CIT students cannot triple major in CIT.

Minor

Definition: One diploma/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).

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 - Additional Major - Minor Declaration Process

Major

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 to The HUB on the Graduate Student Data Sheet.

Additional Majors/Minors

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 transfer this information to the Commencement System. This procedure ensures that when a student is expected to graduate, all degree/minor information is immediately accessible, the correct diploma is ordered and certification of the degree is simplified.

Transitional students: Policy and Practice:
The designation Transitional student 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. Being 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 admissibility 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. A student must obtain the permission of his/her home college Associate dean to initiate this option.

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 Associate Provost for Academic Affairs. 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 student 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: Course work 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 course work 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. 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. time period if they wish. Extra class time beyond that regularly scheduled must take place either before 4:30 p.m. or after 6:30 p.m.

**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:

- A (excellent) = 4
- B (good) = 3
- C (satisfactory) = 2
- D (passing) = 1
- R (failure) = 0

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>
<thead>
<tr>
<th>Subject</th>
<th>Units</th>
<th>Grade</th>
<th>Quality Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>11</td>
<td>A</td>
<td>44</td>
</tr>
<tr>
<td>Physics</td>
<td>10</td>
<td>R</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry</td>
<td>9</td>
<td>B</td>
<td>27</td>
</tr>
<tr>
<td>History</td>
<td>9</td>
<td>C</td>
<td>18</td>
</tr>
<tr>
<td>English</td>
<td>9</td>
<td>D</td>
<td>9</td>
</tr>
<tr>
<td>Total Units</td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Quality Points</td>
<td>98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
University Services

Assistance for Individuals with Disabilities ...................................54
Carnegie Mellon Action Project .......................................................54
Computing Services ..........................................................................55
Dining Services ..................................................................................56
Division of Student Affairs .................................................................56
Fellowship Resource Advising Center ............................................60
Honor Societies .................................................................................60
Intercultural Communication Center .................................................60
Undergraduate Research Initiative ..................................................60
University Center ...............................................................................61
University Libraries ..........................................................................61
University Police ..............................................................................56
University Services

Assistance for Individuals with Disabilities
Advocacy for Individuals with Disabilities: Equal Opportunity Services
143 North Craig Street (Whitfield Hall) x8-2102
Carnegie Mellon offers help to assist individuals with medical or learning disabilities. Both medical and learning disabilities take many forms. A medical disability can be defined as a permanent disorder of varying severity that may limit a student in a variety of ways. This includes visual, motor, hearing and speech impairment. Learning disabilities affect a student’s ability to receive, comprehend and express information.
Other forms of learning disabilities occur in listening, thinking, talking, reading, writing, spelling and mathematical computation disorders. Learning disabilities do not include problems due to developmental delay, visual motor or hearing impairment, mental retardation, emotional disturbance or environmental disadvantage.
Qualified students are entitled to reasonable accommodations under the guidelines of the Rehabilitation Act of 1973 and Americans with Disabilities Act (ADA). Examples of reasonable accommodations could include note-taking services, tutors, books on tape, or extended time exams. Accommodations are determined on a case-by-case basis and must be necessary to address the disability.
Verification of a disability is required to receive accommodations.

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 “cool out” and where the uniqueness of each student is the number one priority. CMAP is not just for “students who need help.” Rather, it is the university office of ethnic minority affairs and serves as a resource for underrepresented students.

Recruitment and Admission
All students are admitted through the Office of Admission. CMAP works in cooperation with them to identify talented African American, Hispanic and Native American students who wish to pursue degrees in any of the University’s disciplines. CMAP assists in the recruiting process by meeting with perspective students and parents, conducting information sessions and co-sponsoring campus visitation events.

Summer Academy for Minority Scholars (SAMS)
One of seven pre-college programs at Carnegie Mellon, SAMS is designed for African-American, Hispanic and Native American 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.

ORIGINS
This two-day, off campus, pre-orientation for African American, Hispanic and Native American first year students is intended to serve as a bridge for ethnic minority students as they transition from high school to college, and as an opportunity for community building among students with similar backgrounds.

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 assure that African American, Hispanic and Native American students do, in fact, graduate from Carnegie Mellon. Its primary purpose is 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 minority students as individuals with goals, talents and abilities . . . as individuals that can be successful at Carnegie Mellon.

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Vice Provost for Computing Services: Joel Smith
Cyert Hall

Computing Services develops, maintains and supports the computing and communications resources for the students, faculty and staff of Carnegie Mellon. Their services include networking that interconnects the central campus computers, Andrew file servers, and personal computers as well as Wireless Andrew, Carnegie Mellon’s 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. For more information on these services visit www.cmu.edu/computing/.

The campus-wide network, dubbed “Andrew” for benefactors Andrew Carnegie and Andrew Mellon, provides computing and communications capabilities to every office, classroom, and residence dormitory on campus. From off-campus locations, the network is accessible via modems and broadband connections such as DSL and cable modem. The network allows you to access electronic mail and bulletin boards, printers, Internet resources like the World Wide Web, the Library Information Systems (LIS), on-line help, and many other applications and services.

In June 2000, Carnegie Mellon became the first university campus to offer wireless networking in all administrative and academic buildings. In fall 2001, all campus residence halls were upgraded to wireless networking. Wireless Andrew is available to faculty, staff and students and offers data connection speeds up to 11mbps. For more information on Wireless Andrew, visit the web site at www.cmu.edu/computing/wireless/.

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 mail to advisor@andrew.cmu.edu.

The Help Center also handles computer accounts and user IDs on the university’s central computing systems. This work includes creating user accounts, setting disk quota, changing passwords, and billing. User IDs on the Andrew System are available to all members of the university community and remain active as long as you remain affiliated with the university. If you think you have an Andrew account, but don’t know what it is, visit the University Directory web page at www.cmu.edu/directory/.

Online Documentation and News
www.cmu.edu/computing/documentation
www.cmu.edu/computing/documentation/PreCursor

In an effort to help new students become oriented and connected to the campus network as quickly and easily as possible, Computing Services initiated the FreshStart program. Included in our FreshStart orientation offerings is the FreshStart web site that provides information on finding your userID, password, hardware requirements for computing on campus, and other related information. Visit the FreshStart web site at www.cmu.edu/computing/freshstart/.

The division also 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/.

Four times during the academic year, the division publishes the Computing Services newsletter PreCursor. Students can obtain free copies of PreCursor in the clusters. You can also read Cursor on line at www.cmu.edu/computing/cursor/.

Clusters
www.cmu.edu/computing/clusters/

Cluster Services provides 400 UNIX, Macintosh, and IBM-compatible computers in ten public computer labs known as “clusters”. Eight of the clusters offer desktop machines and two are “virtual” clusters where members of the campus community can borrow wireless laptops. Most clusters are open 24 hours per day when classes are in session and have a consultant on duty to answer common 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 to students, faculty, and staff including lines, equipment, maintenance, voicemail and long distance. Telecommunications manages the centrally-provided cabling facilities for voice, data, and video as well as 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 like Apple, IBM, Dell, Compaq and Sun, and education software are usually available for faculty, staff, and students with a valid Carnegie Mellon ID card. Peripherals and supplies such as disks, paper, magnetic tape, modems, and printers are also available. If an item is not in stock, the Computer Store can order it for you. You may pay for products by check, cash, departmental charge, MasterCard or 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, backing up hard drives, upgrades, equipment evaluation, and extended warranty contracts. You may pay for repairs by check, cash, departmental 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.

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 (including workstations) in various configurations. Some of the keys to this service include:

- A campus-wide Internet running TCP/IP.
- External Internet includes both commodity and research connectivity.
- A dialup modem pool comprised of V.90 modems that can be accessed by telephone and through a structured cabling system.
- Campus-wide wireless access

For more information about Computing Services, visit our web site at www.cmu.edu/computing/.
Dining Services
Neal Binstock, Assistant Vice President for Business Services
6555 Penn Avenue

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, Purnell Center lobby, Baker Hall annex): espresso, cappuccino, Italian pastries and focaccia bread
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
Barista Caffé (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 meals, soups, 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 campus ID card. For more information, please call x8-4180.

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
Warner Hall 19-C, x8-2064

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 placement 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, occupational 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, x8-2922
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, x8-2157
Health Services provides general medical care, gynecological care and contraception, allergy injections, first aid and on-site vaccinations. Appointments to see the physician, nurse practitioners and registered nurses can be scheduled by calling the office Monday through Friday 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 admissions packet. Immunization information must be completed on the back of the form. Proof of two vaccinations against measles or proof of having had the disease is required. If a student has a medical emergency when the office is closed, he/she can call campus security at x8-2323 for transport to an emergency room or call the Health Service to page the physician on call.

Health Insurance
The university offers health insurance plans for students who are not covered by their parent’s policy. The plans are designed to provide catastrophic, moderate and comprehensive levels of coverage depending on the plan chosen. All students, whether on one of these plans or not, need to inform Health Services of their insurance coverage. Students can enroll for insurance coverage and payroll deduction at Health Services.

Office of the Dean of Student Affairs
Michael Murphy, Dean of Student Affairs
Jennifer Church, Associate Dean of Student Affairs
Warner Hall 301, x8-2075
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 288-2075 and scheduling an appointment at your convenience.

Student Guidebooks
The Word/Student Handbook and the Graduate Student Guidebook are published each year by the division of student affairs to provide information about all aspects of student life including general university policies and regulations affecting academic, student and community life. The Word/Student Handbook is sent to entering students during the summer, and the Graduate Student Guidebook is distributed during Graduate Student Orientation or via the Graduate Coordinators in the individual academic departments.

Carnegie Mellon Interfaith Council
UC Box 5, 5000 Forbes Avenue
Interfaith-Council@andrew.cmu.edu
The Carnegie Mellon Interfaith Council is an organization of religious ministries. The university acknowledges the staff members of those ministries who are commissioned by their particular faith group to work within the campus community at Carnegie Mellon. Each chaplaincy has its own mission, objectives, and schedules, which are available through the individual faith groups.

Informational brochures about Interfaith Council are available at the University Center Information Desk, the Admission Office, Counseling and Psychological Service, the University Center Chapel, or by contacting one of the Council officers directly.

Information concerning other religious communities that are not members of the Interfaith Council but are present on the Carnegie Mellon campus or in the Greater Pittsburgh area can be obtained from members of the Interfaith Council.

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, x8-5231
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

OIE has a reference library of more than 3,000 available programs, as well as reference materials on funding study abroad programs are designed for students in their junior year, however, they can be done at other times. If you are interested in studying or working abroad, the study abroad advisor can help you find the appropriate program. OIE also offers orientations to help you with personal, academic, or acculturation issues, before and after your experience abroad.

Office of Orientation and First Year Programs

Anne R. Witchner, Assistant Dean of Student Affairs
Morewood Gardens 188, 8-4887

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, x-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 also formed 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, x-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, and one private sorority 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, x-2139

Housing Services provides a variety of accommodations for Carnegie Mellon students. Living arrangements include traditional single-gender residence halls, coeducational residence halls, suites, apartments, 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 DSL 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/DSL connection in each room, apartment, or house. Students pay separately for room and public area damages and for toll and long distance telephone usage. (Campus and local calls - within the immediate area - are free. Students pay for all other calls by using their personal authorization code provided by the AT&T ACUS program.)

Room Types

Residence hall rooms, apartments and houses are available through Housing Services and are priced according to these broad categories:

Residence Hall Rooms
- Grouped and priced by occupancy (# of students per room by design) and classification (standard, prime, suite)
- Singles, doubles, triples, and quads are available
preferences, but it is often difficult to accommodate everyone’s top

We give our best effort in fulfilling each student’s individual housing

Building and Room Preferences

Apartments

- No in-room cooking facilities
- Classification is primarily based on bathroom privacy, although other criteria may also be involved
- **Standard rooms** share a large, central bathroom facility
- **Prime rooms** generally share a private or semi-private bathroom with no more than five students
- **Suite-style rooms** share a semi-private bathroom, as well as a common living area

Houses

- Grouped and priced by occupancy, location, and number of bedrooms
- In-room cooking 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 the entire process that accompanies 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/](http://www.housing.cmu.edu/)

Housing Reservations

Returning Student Room Selection (Room Draw)

Each spring returning resident students will have an opportunity to reserve 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.

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.

Building and 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 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 advertises students, parents and guardians to read the agreement thoroughly before it 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 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.

Housing Charges: The housing room charge is billed in three separate amounts. After charging and crediting the housing deposit, the University bills students for the balance of their academic year housing charges in two separate amounts, one each 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 delinquent, the rent 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 [http://www.housing.cmu.edu/](http://www.housing.cmu.edu/)
Fellowship Resource Advising Center
Janet Stocks, Director
Fran Branzel, Scholarship Coordinator
Office: 429 Warner Hall
www.cmu.edu/adm/osf

Students at Carnegie Mellon are encouraged to apply and/or be nominated for a number of prestigious national and international fellowships which open the door to exciting opportunities for work or study during or after graduation, sometimes abroad. Each of these provides an opportunity to become part of a new community of scholars and opens doors throughout your career. These opportunities include: the Fulbright Scholarship, the Rhodes Scholarship, the Luce Scholars Program, the Hertz Foundation Scholarship among others.

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.

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 Philosophia 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 initials of its adopted motto: Philosophia Kratoito 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.

Intercultural Communication Center
Peggy Heidish, Director
Office: Warner Hall 418
www.cmu.edu/adm/apaa/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 in Presentation Skills, Reading Skills, Job Interviewing for Non-Native Speakers and International TA Skills.

• Diagnostic language testing in listening and speaking skills for all incoming students as part of the Freshmen Orientation.

• Screening Tests for prospective TAs (teaching assistants) who are non-native speakers of English.

Undergraduate Research Initiative
Janet E. Stocks, Ph.D., Director
Office: Warner Hall 401 and 404

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, get a feel for graduate school, and have some fun at the same time!

The Undergraduate Research Initiative supports students conducting independent research and creative projects in every field at the university. In addition to the programs listed, the Initiative provides one-on-one advising and information services, from help with locating faculty mentors to reviewing grant proposals and applying to professional conferences.

All undergraduate students conducting research 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 outside Warner Hall 404 and on the world wide web (www.cmu.edu/adm/uri).

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.

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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/adv/is) 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 new 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.

What can you do in the University Center?
- 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 jacuzzi’s to soothe those muscles.

Eating at the University Center
We’ve brought in several outside vendors to offer a variety of dining options:
- Barista Cafe
- CK Pretzeis – 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
- Pepperazzi
- 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 Entopy, a convenience store.

The building houses student organization offices and activity space and a gameroom. 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
University Librarian: Gloriana St. Clair
Office: Hunt Library / 412-268-2447 / gstclair@andrew.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). Interactive access to library resources is supported by the University Libraries’ home page at http://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, request interlibrary loan service 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 Ill 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.

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, and archives 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 the 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.
The University Police Department consists of 24 sworn Police Officers, 29 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 35 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 commission.

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, and sexual assault policies, and statistics about the number and type of crimes committed on campus during the preceding three years can be found at [http://www.cmu.edu/police](http://www.cmu.edu/police).
Undergraduate Options

Additional Majors/Dual Degrees ...................................................... 64
Five-Year Bachelor's/Master's Programs ........................................ 64
Health Professions Program ........................................................... 64
Minors ............................................................................................. 65
Pre-Law Advising Program ............................................................. 66
Study Abroad ................................................................................. 66
University Student-Defined Major ............................................... 67
University Summer Sessions ........................................................... 67
Department of Athletics & Physical Education ......................... 68
Department of Aerospace Studies (Air Force ROTC) ............... 70
Department of Military Science (Army ROTC) ......................... 70
Department of Naval Science (Naval ROTC) ............................. 71
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 advisors.

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 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. The Departments of Chemical Engineering and Mechanical Engineering also offer fifth year/Accelerated Masters programs.

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
Accelerated Masters Program and Master of Arts Management Program
The Heinz School’s Accelerated Masters program allows qualified undergraduate students 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.

Graduate School of Industrial Administration
3-2 Program
Students who are interested in business management may wish to consider the Graduate School of Industrial Administration’s 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, GSIA offers an accelerated B.S./M.S. program in Economics.

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.

Health Professions Program
Director: Amy L. Burkert, Ph.D.
Office: Doherty Hall 1325
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 pursues 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.

General Course Requirements for Medical School Admission
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:
   33-111/106 Physics I (for science or engineering students)
   33-112/107 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 81 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 obtain 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
- Gender Studies
- German
- 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
- Spanish
- Statistics
- Student Defined

**Graduate School of Industrial Administration:**
- 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 consciously 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 Prelaw 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’s School of Law. Requirements and procedures vary for each option. Interested students should meet with the University prelaw adviser before the end of their junior year.

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.

Switzerland: EPFL/Exchange program with the Ecole Polytechnique Federale de Lausanne. This full year program is open to third year engineering and science majors (not biology) and fourth year architecture majors. Prior French study is preferred but not required. A three-month intensive French language program is included at no additional tuition cost. Students who are fluent in French may opt to participate in an internship at EPFL instead of the language program. Students must apply to the program in November of the year before they plan to attend. Up to twelve Carnegie Mellon students may participate each year.

Mexico: ITESM/Exchange program with Instituto Tecnologico y de Estudios Superiores de Monterrey. This semester or full year program is open to all Carnegie Mellon undergraduates. Students must have completed two years of college level Spanish or the equivalent to participate. A six week long intensive Spanish language program is included at no additional tuition cost. Students must apply to the program in the semester before they plan to attend. Up to two Carnegie Mellon students may participate each semester.

Japan: KEIO/Exchange program with Keio University in Tokyo. This one-year program is open to all Carnegie Mellon undergraduates. Students must consider that they will only study Japanese language and culture and may lose track for graduation. Prior Japanese study is preferred. Students must apply to the program in November of the year before they plan to attend. Up to two Carnegie Mellon students may participate per year.

Singapore: NUS/Exchange with the National University of Singapore. This semester or full year program is open to undergraduates in architecture, engineering (except materials science), humanities and social science, and computer science. The language of instruction at NUS is English. Students must apply to the program in the semester before they plan to attend. Up to two Carnegie Mellon students may participate each semester.

Chile: PUC/Exchange with the Catholic University of Chile. This semester or full year program is open to all Carnegie Mellon undergraduates. Students must have completed two years of college level Spanish or the equivalent to participate. An intensive language program is included at no additional tuition cost. Students must apply to the program in the semester before they plan to attend. Up to two Carnegie Mellon students may participate each semester.

Israel: Exchange with Technion University of Technology in Haifa. This semester or full year program is open to undergraduates in computer science, engineering, sciences, humanities, performing arts and architecture. The language of instruction at Technion is mostly Hebrew, however texts are in English and work can be submitted in English. Intensive Hebrew learning Ulpanas are available. One Carnegie Mellon student can attend Technion each semester.

China(Hong Kong): Exchange with City University of Hong Kong. This semester or full year program is open to students in business, engineering, sciences and humanities. The language of instruction at CityU is English. Up to two Carnegie Mellon students can attend each semester.

Sponsored Study Abroad
The university has designated a few study abroad programs administered by other organization 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

Departmental Exchanges
There are departmental exchange programs in Art, Design, Chemical Engineering, Materials Science and Engineering, and business (under GSIA). 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.
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: the Computer Center, the Health Center, the Counseling Center, the 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 (SIA).

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 applications and 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

Undergraduate Options
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 treated equally with regard to admission and financial aid policies. 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 appears 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 all 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:

**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
- Volleyball
- Bowling
- Racquetball
- Team Table Tennis
- Diasts
- 3-Person Volleyball
- Foosball
- Team Call Pool
- Floor Hockey
- Spades

### Spring

- Basketball
- Table Tennis-Singles
- Faculty/Grad. Volleyball
- Pinochle
- Individual Call Pool
- Swimming
- Indoor Soccer
- Softball
- Co-Rec Software
- 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. John H. Harvey, 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 cycling, 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. John H. Harvey, Head
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
DAVID BELOWICH, Head Men's/Women's Swim Coach/Instructor — Ph.D., Florida State University; Carnegie Mellon, 1996—.
TERRY BODNAR, Assistant Football Coach/Instructor — M.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 GAUDIOSO, Head Soccer Coach/Instructor — B.S., University of Maine; Carnegie Mellon, 1981—.
MIKE GRZYWINISKI, Assistant Intramural Director — B.S., Carnegie Mellon University; Carnegie Mellon, 1994—.
JOHN H. HARVEY, Director of Athletics and Physical Education — Ph.D., Boston College; Carnegie Mellon, 1989—.
HEATHER KENDRA, Head Women’s Soccer Coach/Instructor — M.A., University of North Carolina, 1998—.
RICHARD LACKNER, Head Football Coach/Instructor — B.A., Carnegie Mellon University; Carnegie Mellon, 1979—.
JOAN MASER, Associate Athletic Director/Instructor — M.S., University of Pittsburgh; Carnegie Mellon, 1981—.
MIKE MASTROIANNI, Director of Intramurals and Club Sports Coordinator/Instructor — M.S., Slippery Rock University of Pa.; Carnegie Mellon, 1986—.
MARK MILLER, Athletic Trainer/Instructor — M.S., North Carolina State University; Carnegie Mellon, 2001—.
DONNA MOROSKY, Director of Fitness and Health/Instructor — Post-Graduate Education, University of Pittsburgh; Carnegie Mellon, 1975—.
PETER MOSS, Head Men’s and Women’s Tennis Coach/Instructor — B.A., Allegheny College; Carnegie Mellon, 1990—.

DENNIS NESAW, Assistant Director of Fitness & Health/Instructor — M.S., Carnegie Mellon University; Carnegie Mellon, 1999—.
GERRIS SEIDL, Head Women’s Basketball Coach/Instructor — B.S., University of Pittsburgh; Carnegie Mellon, 1984—.
MELODY SRSIC, Director of Aquatic Activities/Instructor — M.S., University of Pittsburgh; Carnegie Mellon, 1997—.
JULIA WEBB, Head Volleyball Coach/Instructor — B.A., University of Vermont; Carnegie Mellon, 1996—.
TONY WINGEN, Head Men’s Basketball Coach/Assistant Athletic Director/Instructor — M.Ed., Springfield College; Carnegie Mellon, 1990—.
Reserve Officers' Training Corps (ROTC)

Department of Aerospace Studies  
(Air Force ROTC)

Alan E. Thompson, Colonel, U.S. Air Force  
Office: 2925 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 is under no 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 one and a half 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, incidental 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 at 4615 Forbes Avenue, or write to the Professor of Aerospace Studies, Air Force ROTC, Carnegie-Mellon University, Pittsburgh, PA 15231.

Faculty

SCOTT E. BOYD, Assistant Professor of Aerospace Studies — M.B.A., Wright State University, Carnegie Mellon 2001—.

SCOTT J. KOLAR, Assistant Professor of Aerospace Studies — M.P.A., Washington University, Carnegie Mellon 2001—.

BETH E. BRUKER WALOS, Assistant Professor of Aerospace Studies — M.A., George Washington University, Carnegie Mellon 2001—.

ALAN E. THOMPSON, Professor of Aerospace Studies — M.B.A., University of Phoenix, Carnegie Mellon 2000—.

Department of Military Science  
(Army ROTC)

John E. Richerson, Lieutenant Colonel, 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 National Advanced Leadership Course (NALC). Upon the 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 a student has 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 National Advanced Leadership Course during the summer months.

Curriculum

Freshman Year

30-101 Introduction to Military Leadership  
30-102 Foundations of Leadership

Sophomore Year

30-201 Leadership Dynamics & Application  
30-202 Applications in Leadership & Combat Power

Junior Year

30-301 Basic Leader Planning & Combat Operations  
30-302 Advanced Leader Planning & Combat Operations

Senior Year

30-401 Progressive Leadership Theory & Applications  
30-402 Transition to the Profession of Arms
Army ROTC Scholarships
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 up to $2,800 for spending. 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.

The Simultaneous Membership Program (SMP)
This program allows students to become members of the Army National Guard or the Army Reserves while enrolled in Army ROTC. Students in the Advanced Course who are SMP are paid for their Guard/Reserve training plus $2,400 allowance each year from ROTC. The benefit of this program is that students in the Advanced Course are able to act as Army officers in their National Guard or Reserve unit, receiving valuable leadership experience.

Summer Programs
National Advanced Leadership Course
This 35-day camp is a requirement for all contracted students. Students attend the summer between their junior and senior year. Students are placed in various leadership positions throughout Camp and their skills and abilities will be tested and evaluated in preparation of a commission in the United States Army. All expenses are paid by the Army. Students are paid while attending.

Leader’s Training Course
This 35-day camp is taken as a prerequisite for entry into the Advanced Course if the Basic Course cannot be fulfilled. It is taken the summer before the junior year. All expenses are paid by the Army. Students are paid while attending.

Army Adventure Training
ROTC students may participate in Airborne School, Air Assault School, Northern Warfare School and Mountain Warfare School the summer before the sophomore and junior year. These courses range from two to four weeks and students must arrive in top physical condition. All expenses are paid by the Army.

Extracurricular Activities
Rangers
Army ROTC students are eligible to participate in the Cadet Ranger Club. The Club conducts physically and mentally challenging extracurricular training to promote fitness, teamwork, self-confidence and fellowship. Training includes physical fitness, rappelling, rope bridging, tactics, hiking, climbing, weapons training and orienteering.

Scabbard & Blade
National Honor Society consisting of cadets/midshipman from Army, Air Force and Naval ROTC.

Rho Tau Chi
Military fraternity established for the members of the various branches of ROTC. Purpose is to draw together cadets to increase communication and feelings of goodwill between the Cadet Corps and the community. Cadets participate in a variety of community service projects.

Color Guard
Dedicated group of Army ROTC cadets who train and perform to present the American flag and Army colors at football and basketball games and various community events.

Faculty
RONALD A. BONOMO, Captain; Assistant Professor of Military Science – M.S., St. Mary’s University; Carnegie Mellon, 2000—.
KELLY R. BROOME, Captain; Assistant Professor of Military Science — B.S., Southwest Texas State University; Carnegie Mellon, 2000—.
MATTHEW N. GEBHARD, Captain, Assistant Professor of Military Science – M.S., Duquesne University; Carnegie Mellon, 2001—.
JEFFREY C. GUNN, Captain; Assistant Professor of Military Science – B.A., Iowa State University; Carnegie Mellon, 2001—.
MICHAEL L. HUMMEL, Major; Assistant Professor of Military Science – Ph.D., Columbia University; Carnegie Mellon, 2001—.
JOHN E. RICHERSON, Lieutenant Colonel, Professor of Military Science — M.S., Joint Military Intelligence College; Carnegie Mellon, 2001—.

Department of Naval Science (Naval ROTC)
Captain James R. Stapleford, USN
Office: 4615 Forbes Ave.

The Department of Naval Science was established 16 December 1987. Carnegie Mellon’s Naval Reserve Officers Training Corp (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.

Tweddale Scholarship Program
The three or two year scholarship programs 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 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**

JAMES R. STAPLEFORD, Professor of Naval Science — M.S., Salve Regina University; M.A., NWC; Carnegie Mellon, 2001—.

MARK J. CRAIG, Associate Professor of Naval Science — M.B.A., Troy University; Carnegie Mellon, 2001—.

MARVIN CUNNINGHAM, Assistant Professor of Naval Science — B.S., Oregon State University; Carnegie Mellon, 2000—.

JOED J. HADDAD, Assistant Professor of Naval Science — B.S., Carnegie Mellon University; Carnegie Mellon, 2000—.

MIKE KIBLER, Assistant Professor of Naval Science — B.A., Tufts University; Carnegie Mellon, 2000—.

### 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>
</tr>
</thead>
<tbody>
<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>Senior</td>
<td>Navy Option</td>
<td>9</td>
</tr>
<tr>
<td>32-401</td>
<td>Naval Ships Systems II (Weapons)</td>
<td>Senior</td>
<td>All</td>
<td>6</td>
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<tr>
<td>32-402</td>
<td>Leadership and Ethics</td>
<td>Senior</td>
<td>Marine Option</td>
<td>9</td>
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<tr>
<td>32-410</td>
<td>Amphibious Warfare</td>
<td>Senior</td>
<td>All</td>
<td>9</td>
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<tr>
<td>32-100-400</td>
<td>Naval Laboratory</td>
<td>All</td>
<td>All</td>
<td>3</td>
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</tbody>
</table>
Intercollege Programs

Bachelor of Humanities and Arts Degree Program ....................... 74
Bachelor of Science and Arts Degree Program ............................. 77
Bachelor of Science in Computational Finance ............................. 81
Minor in Computational Finance ...................................................... 81
Science and Humanities Scholars Program ................................... 82
The Undergraduate Additional Major in Human-Computer Interaction .............................................................. 84
The Minor in Arts in Society (AIS) .................................................... 86
The Minor in Health Care Policy and Management ....................... 87
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

Carnegie Mellon University offers an interdisciplinary degree that uniquely 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 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 or social sciences, and the director of the BHA & BSA Programs. Each BHA concentration is created and approved through consultation with the student’s advisors in the fine arts, the humanities and social studies. The program also provides enough flexibility to allow students to explore other areas of interest.

The BHA curriculum combines an eight-course version of the H&SS General Education Program with concentration areas in both the fine arts, and the humanities and social sciences. The concentration in the fine arts totals 108 units and the concentration in the humanities and social sciences totals 54 units. Students can choose their 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 may choose to complete their humanities and social sciences concentration through courses from existing H&SS majors and minors, or through an interdepartmental concentration. Each concentration is created and approved through consultation with the student’s advisors in the fine arts, the humanities and social sciences, and the director of the BHA & BSA Programs. Each BHA student receives extensive advising support from both CFA and H&SS.

The BHA Program is governed by faculty and administrators from both colleges, guided by the director of the BHA and BSA Programs. The director of the BHA and BSA Programs is the primary advisor and liaison between CFA and H&SS. Each student also 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 three advisors guides students 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, 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 them for this area. A student in the junior year may apply to the 3-1-1 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.

BHA Curriculum

246 units

A. General Education Program

75 units

The BHA General Education program is an abbreviated version of the H&SS General Education program. BHA students are required to fulfill the following H&SS General Education Program requirements. Complete one course from each CCR and DCR categories, two courses (minimum of 18 units) from BHAML, and one course from UR.

CCR1, World Cultures
36-201 Statistical Reasoning

(ccr1: world cultures)

9 units

This requirement seeks to recognize cultures that have shaped and continue to shape the human experience and analyze materials that provide clues as to how these cultures work.

79-104 Introduction to World History

Notes: This is the designated course for this requirement and is to be completed in the first year.

CCR2, Writing/Expression

37-104 Introduction to Literature

(ccr2: 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.

76-101 Interpretation and 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.

CCR3, Statistical Reasoning

36-201 Statistical Reasoning

(ccr3: statistical reasoning)

9 units

Numerical data surrounds us, from baseball box scores to the gross national product and from crime statistics to demographic trends. Statistical methodology and practice allow us to quantify data in order to draw conclusions. This requirement is designed to teach what types of data are quantifiable, how to gather data, what methods to use when evaluating data, and how to test hypotheses when using quantitative analysis.

Notes: This is the designated course for this requirement and is to be completed in the first year.
Distribution Course Requirements

DCR1, COGNITION, CHOICE, AND BEHAVIOR  9 units
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.

80-150 The Nature of Reason
80-180 The Nature of Language
80-181 Language and Thought
80-242 Conflict and Dispute Resolution
85-100 Intro. 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
88-120 Reason, Passion & Cognition

Notes: Complete one course.

DCR2, ECONOMIC, POLITICAL, & SOCIAL INSTITUTIONS  9 units
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
73-100 Principles of Economics
73/88-110 Experiments with Economic Principles
79-266 Times of Feast/Famine: Population and Family in History
80-135 Introduction to Political Philosophy
80-136 Social Structure, Public & Ethical Dilemmas
88-104 Decision Processes in American Political Institutions
88-205 Comparative Politics

Notes: Complete one course. The courses 73-110 and 88-110 are the same course, cross-listed in different departments.

DCR6, SCIENCE AND TECHNOLOGY (minimum)  9 units
This category introduces and provides an in-depth study of substance and methods in the natural and physical sciences, and the engineering technology and computer sciences.

Carnegie Institute of Technology
06-100 Introduction to Chemical Engineering
12-100 Introduction to Civil & Environmental Engineering
12-090 Technology and the Environment
18-100 Introduction to Electrical & Computer Engineering
19-101 Introduction to Engineering & Public Policy
24-101 Fundamentals of Mechanical Engineering
27-100 Materials in Engineering

Humanities and Social Sciences
66-210 Science, Technology and the Environment

Mellon College of Science
03-121 Modern Biology
03-122 Organismic Botany
03-130 Biology of Organisms
03-125 Evolution and the History of Life
03-240 Cell Biology
09-103 Atoms, Molecules and Chemical Change
09-104 Fund. Aspects of Organic Chemistry & Biochemistry
09-105 Introduction to Modern Chemistry I
09-106 Modern Chemistry II
33-102 Concepts of Modern Physics
33-111 Physics for Science Students I
33-112 Physics for Science Students II
33-114 Physics of Musical Sound (non-major)
33-115 Energy and Environmental Issues
33-124 Introduction to Astronomy

School of Computer Science
15-211 Fundamental Data Structures & Algorithms
15-212 Principles of Programming

Notes: Complete one course.

MODERN LANGUAGES REQUIREMENT (BHAML)  18 units
Complete two courses in the same language (minimum 18 units).

Chinese
Two courses taught entirely in Chinese by the Modern Languages Department (may be started at the elementary-level).

French
Two courses taught entirely in French by the Modern Languages Department, not including elementary-level French courses.

German
Two courses taught entirely in German by the Modern Languages Department, not including elementary-level German courses.

Italian
Complete 82-261, Intermediate Italian I (prereqs: 82-161, 82-162) and 82-262, Intermediate Italian II (prereqs: 82-161, 82-162, 82-261) - (may not include elementary-level Italian courses).

Japanese
Two courses taught entirely in Japanese by the Modern Languages Department (may be started at the elementary-level).

Russian
Two courses taught entirely in Russian by the Modern Languages Department (may be started at the elementary-level).

Spanish
Two courses taught entirely in Spanish by the Modern Languages Department, not including elementary-level Spanish courses.

UNIVERSITY REQUIREMENT (UR)  3 units
A 3 unit mini-course, pass/no credit, completed in the first semester.


B. BHA & BSA Integrative Seminar  9 units
62-190 BHA/BSA Integrative seminar (fall), or interdisciplinary course equivalent

C. Concentrations

1. College of Humanities and Social Sciences
Concentration (minimum)  54 units
Students may design the 54-unit H&SS concentration requirement based on individual H&SS majors and minors listed in the H&SS section of this catalog. Students may also choose to design an H&SS Interdepartmental Concentration. Please refer to the individual majors and minors in the H&SS section of this catalog.

2. College of Fine Arts Concentration (minimum)  108 units
Students select one of the following concentrations
Architecture Concentration  108 units
Art Concentration  108 units
Design Concentration  108 units
Drama Concentration  108 units
Music Concentration  108 units

Architecture Concentration (108 units minimum)

Required Courses (54 units)
48-100 Experiments in Building and Design  18 units
or 48-095 & 48-096Architecture for Non-Majors  18 units
48-140 Survey of World Architecture & Urbanism  9 units
48-3xx Architectural History Lecture (varying topics)  9 units
48-4xx Architectural History Lecture (varying topics)  9 units
48-035 Introduction to Architectural Drawing  9 units

Also complete one of the following Elective Focuses (54 units):

Elective Focus in General Education in Architecture (complete 54 units).
48-120 Computer Modeling  9 units
48-3xx Architectural History Lecture (varying topics)  9 units
48-4xx Architectural History (prerequisite: Two 48-3xx Arch. History)  9 units
48-4xx Departmental Elective (prerequisites vary)  9 units
48-210 Statics (prerequisite: 33-108)  9 units
48-215 Structures 1 (prerequisite: 48-210)  9 units
48-230 Perspective Drawing (prerequisite: 48-035)  9 units
48-310 Materials and Assemblies (prerequisite: 48-215)  9 units
48-315 Environmental Systems  9 units
48-321 Psychology of Habitation  9 units
48-420 Design Economics  9 units
In addition, students are encouraged to take 60-105 Pre-Industrial Visual Cultures (Spring) to complete the full three-semester historical sequence.

Design Concentration  
(108 units minimum)

**Design Required Courses**  81 units
51-121 Design Drawing I (Fall)  9 units
51-122 Design Drawing II (Spring)  9 units
51-132 Introduction to Photo Design (Spring)  9 units
51-171 Human Experience in Design (Fall)  9 units
51-174 History of Artifacts and Images (Spring)  9 units
51-222 Color and Communication - section B (Spring)  9 units
51-271 Design History I (Fall)  9 units
51-272 Design History II (Spring)  9 units
51-372 Contemporary Design (Spring)  9 units

(Complete two courses)  18 units
51-371-90 Topics in Design Studies (Fall + Spring)  9 units
51-471-90 Topics in Design Studies (Fall + Spring)  9 units

**Required Studio Option**  9 units
(Complete one course)
51-261 Communication Design Fundamentals (Fall)  9 units
51-263 Industrial Design Fundamentals (Fall)  9 units

Drama Concentration  
(108 units minimum)

The School of Drama requires an audition/interview for the directing option, and a portfolio review/interview for the design or production technology and management option.

The BHA candidate must choose from three options offered by The School of Drama and successfully pass the audition/interview for the directing option, or the portfolio review/interview for the design or production technology and management options. There is no BHA acting or musical theatre option. All BHA students are required to take courses #54-177 Text to Stage and 54-163 Introduction to Production in the freshman year, and course #54-259 Crew in both semesters of the sophomore year (4-6 weeks per term).

**Drama Required Courses**  30 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
54-107 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
54-123 Dance I (Fall) ~  3 units
54-124 Dance I (Spring) ~  3 units
54-131 Freshman Studio (Section B only; Fall) ~  6 units
54-132 Freshman Studio (Section B only; Spring) ~  6 units
54-151 Introduction to Lighting (Fall)  6 units
54-152 Introduction to Lighting (Spring) ~  6 units
54-173 Intro to Performance Tech. and Man. (Fall)  6 units
54-174 Intro to Performance Tech. and Man. (Spring) ~  6 units
54-187 Introduction to Playwriting (Fall)  6 units
54-188 Introduction to Playwriting (Spring)  6 units
54-189 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
54-231 Design for the Stage (Fall) ~  9 units
54-232 Design for the Stage (Spring) ~  9 units
54-237 Scene Painting I (Fall) ~  4 units
54-238 Scene Painting I (Spring) ~  4 units
54-243 History of Architecture and Decor (Fall)  6 units
54-244 History of Architecture and Decor (Spring)  6 units
54-246 History of Clothing (Fall and Spring)  6 units
54-283 Fundamentals of Directing (Fall) ~  4 units
54-284 Fundamentals of Directing (Spring) ~  4 units
54-341 Costume Design I (Fall) ~  9 units
54-342 Costume Design I (Spring) ~  9 units
54-409 Theatre Lab - New Play Workshop (Fall) ~  4 units
54-410 Theatre Lab - New Play Workshop (Spring) ~  4 units
54-103 Speech I ~  2 units
Bachelor of Science and Arts
Degree Program

Carnegie Mellon University recognizes that there are students who are naturally gifted in both the fine arts and the sciences. In order to accommodate students who want to pursue an education simultaneously in these areas, we offer a unique 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 an intense program that offers a unique group of qualified students the opportunity to develop their talents and interests in an area of the arts and an area of the natural sciences or mathematics.

The BSA curriculum is divided into three parts: BSA core requirements and two focused concentrations - one in CFA and one in MCS.

Students can choose their 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 can choose their science concentration from among the four departments in MCS: Biological Sciences, Chemistry, Mathematical Sciences, or Physics.

Each concentration is created and approved through consultation with the student’s advisors in the fine arts, the sciences and the director of the BHA & BSA Programs. Each BSA student receives extensive advising support from both CFA and MCS.

The BSA Program is governed by faculty and administrators from both colleges and led by the director of the BHA & BSA Programs. The director of the BHA & BSA Programs is the primary advisor and liaison between CFA and MCS. Each student also has two additional academic advisors: an advisor in the admitting school of CFA for their science concentration and an advisor in MCS for their art concentration. This network of three advisors guides students 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.

Curriculum

A. BSA Core Requirements 105 units

1. Writing/Expression: 9 units
   - 76-101 Interpretation & Argument

2. BHA & BSA Integrative Seminar 9 units
   - 62-190 BHA/BSA Integrative seminar (fall) or interdisciplinary course equivalent

3. Complete one course from the “Cultural Analysis” category 9 units

CULTURAL ANALYSIS

- 76-201 Cultural Practices and Literary Production
- 76-227 Comedy
- 76-240 What is Cultural Studies
- 79-104 Introduction to World History
- 79-110 Dynamics of Cultural Change
- 79-111 Cultural and Cross-Cultural Perspectives on the Environment
- 79-112 Race, Nationality, and the Development of American Cultures
- 79-113 Culture and Identity in American Social Life
- 79-116 Debates and Controversies: Cultural Differences in Action
- 79-206 Development of American Culture
- 79-309 Blacks, Women and Gays in the Military
- 79-368 Poverty, Charity and Welfare
- 79-320 Society and the Arts
- 80-100 What Philosophy Is
- 80-182 Language, Culture and Thought
- 82-107 Introduction to French Film
Students select one of the following concentrations

Architecture Concentration 108 units
Art Concentration 108 units
Design Concentration 108 units
Drama Concentration 108 units
Music Concentration 108 units

See following sections for curriculum requirements.
Prerequisite Courses (22 units):

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tr>
<td>21-115</td>
<td>Differential Calculus (Fall and Spring)</td>
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<tr>
<td>21-116</td>
<td>Integral Calculus (Fall and Spring)</td>
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<tr>
<td>33-106</td>
<td>Physics I for Engineering Students</td>
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Elective Courses (complete 32 units):

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<th>Course Code</th>
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<td>48-215</td>
<td>Structures (prerequisite: 48-210)</td>
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<tr>
<td>48-310</td>
<td>Materials and Assemblies (prerequisite: 48-215)</td>
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<tr>
<td>48-315</td>
<td>Environmental Systems (prerequisite: 48-310)</td>
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<tr>
<td>48-410</td>
<td>Advanced Building Systems (prerequisite: 48-315)</td>
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<td>48-415</td>
<td>Mechanical Equipment (prerequisite: 48-410)</td>
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<tr>
<td>48-4xx</td>
<td>Designated Departmental Technical Elective</td>
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</table>

Art Concentration (108 units minimum)

The School of Design requires a portfolio review for admission.

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>51-261</td>
<td>Industrial Design Fundamentals (Fall)</td>
<td>9</td>
</tr>
<tr>
<td>51-263</td>
<td>Industrial Design Fundamentals (Fall)</td>
<td>9</td>
</tr>
</tbody>
</table>

Design Required Courses (81 units)

The School of Design requires an audition/interview for the directing option, and a portfolio review for admission.

Drama Concentration (108 units minimum)

The School of Drama requires an audition/interview for the directing option, and a portfolio review/interview for the design or production technology and management option.

Drama Elective Courses (78 units)

The BHA candidate must choose from three options offered by The Drama School and successfully pass the audition/interview for the directing option, or the portfolio review/interview for the design or production technology and management options. There is no BHA acting or musical theatre option. All BHA students are required to take courses #54-177 Text to Stage and 54-163 Introduction to Production in the freshman year, and course #54-259 Crew in both semesters of the sophomore year (4-6 weeks per term).
Music Concentration  (108 units minimum)
The School of Music requires an audition for admission.

Required Academic Courses  48 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

Complete 24 units from the courses below:
57-151  Principles of 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

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

CFA Interdisciplinary Concentration
Students may propose a combination of courses from two or more schools within CFA to design a curriculum focused on an area of interest totaling 108 units.

2. MCS Concentration Requirements

Biological Sciences  120 units

Biological Sciences Core Requirements  102 units
03-240  Cell Biology  9 units
03-231/232  Biochemistry I  9 units
03-330  Genetics  9 units
03-xxx  Biology Laboratory  9 units
03-201/202  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
33-112  Physics for Science Students II  12 units

Biology Electives (2 courses)  18 units
Must be selected from 03-3xx, excluding 03-445

Chemistry  122 units

Chemistry Core Requirements  104 units
09-106  Modern Chemistry II  10 units
09-217  Organic Chemistry I  9 units
09-218  Organic Chemistry II  9 units
09-214/344/345  Physical Chemistry  9 units
09-348  Inorganic Chemistry  10 units
09-221  Lab I  12 units
09-222  Lab II  12 units
09-321  Lab III  12 units
09-204  Issues in Chemistry  3 units
09-201/202/301  Undergraduate Seminar  6 units
/402
33-112  Physics for Science Students II  12 units

Chemistry Elective (2 courses)  18 units
May be any upper level chemistry course, 09-3xx or higher, or Biochemistry, 03-231 or 03-232.
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.

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 the four calculus mini-courses 21-115 Differential Calculus, 21-116 Integral Calculus, 21-117 Integration and Differential Equations, and 21-118 Calculus of Approximation; and 10-150 Introductory/Intermediate Programming.

In addition, in the freshman year students should complete two of the following three courses:

- 33-111 Physics for Science Students I
- 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
- 73-250 Intermediate Microeconomics
- 73-300 Intermediate Macroeconomics

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 four 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
- 36-406 Statistics Topic
- 36-407 Topics in Statistics
- 36-408 Applied Multivariate Methods
- 36-495 Independent Study
- 73-372 International Money and Finance
- 73-392 Financial Economics
- 73-420 Monetary Theory and Policy
- 73-430 Topics in the Economics of Uncertainty
- 73-458 Money and Banking.

Detailed Curriculum

The detailed curriculum for the degree Bachelor of Science in Computational Finance is the following. The courses listed are required. The semesters in which the courses are to be taken are suggested.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
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<tbody>
<tr>
<td>Freshman Year</td>
<td>Fall</td>
<td>Introductory/Intermediate Programming</td>
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<td>21-115</td>
<td>Differential Calculus</td>
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<td>21-116</td>
<td>Integral Calculus</td>
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<td>76-101</td>
<td>Interpretation and Argument</td>
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<td>99-101</td>
<td>Computing Skills Workshop</td>
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<td>Spring</td>
<td>Advanced Programming/Practicum</td>
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<td>21-117</td>
<td>Integration and Differential Equations</td>
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<td>21-118</td>
<td>Calculus of Approximation</td>
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<td>73-100</td>
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<td>Sophomore Year</td>
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<td>Calculus in Three Dimensions</td>
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<td>21-295</td>
<td>Matrix Algebra</td>
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<td>36-225</td>
<td>Intro. to Probability and Statistics I</td>
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<td>Introduction to Accounting</td>
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<td>Spring</td>
<td>Introduction to Mathematical Finance</td>
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<td>21-270</td>
<td>Operations Research I</td>
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<td>21-260</td>
<td>Differential Equations</td>
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<td>36-226</td>
<td>Intro. to Probability and Statistics II</td>
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<td>73-250</td>
<td>Intermediate Microeconomics</td>
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<td>Junior Year</td>
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<td>Numerical Methods</td>
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<td>21-369</td>
<td>Discrete-Time Finance</td>
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<td>73-300</td>
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<td>Continuous-Time Finance</td>
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<td>36-410</td>
<td>Intro. to Probability Models</td>
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<td>Senior Year</td>
<td>Fall</td>
<td>Professional Writing</td>
<td>6</td>
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<td></td>
<td>90-717</td>
<td>Professional Speaking</td>
<td>6</td>
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<td></td>
<td>90-718</td>
<td>Depth Elective</td>
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<tr>
<td></td>
<td>xx-xxx</td>
<td>Humanities, Social Science or Fine Arts</td>
<td>9</td>
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<td></td>
<td>xx-xxx</td>
<td>Elective</td>
<td>9</td>
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<td></td>
<td>xx-xxx</td>
<td>Elective</td>
<td>6-9</td>
</tr>
<tr>
<td></td>
<td>Spring</td>
<td>Studies in Financial Engineering</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>46-816</td>
<td>Organizational Design and Implementation</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>90-729</td>
<td>Depth Elective</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>xx-xxx</td>
<td>Humanities, Social Science or Fine Arts</td>
<td>9</td>
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<td>xx-xxx</td>
<td>Elective</td>
<td>9</td>
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<td></td>
<td>xx-xxx</td>
<td>Elective</td>
<td>6-9</td>
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<td>45-48</td>
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</tbody>
</table>

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
- 21-256 Multivariate Analysis and Approximations
- 21-260 Differential Equations
- 21-370 Continuous-Time Finance

Students majoring in Mathematical Sciences are also required to take 46-816 Studies in Financial Engineering, due to double counting of courses.

Students minoring in Computational Finance are strongly encouraged to take one or two economics courses.

*Pre-requisite for 21-370 is a course in probability and either 21-257 or 21-292.
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 undergraduate curricular program which 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, and thereby 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. 21-115/116 Differential Calculus/Integral Calculus or 21-131 Analysis I
2. 21-117/118 Integration & Differential Equations/Calculus of 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 (5-10 units)
7. Choose from the following courses
   15-100 Introductory Intermediate Programming
   15-111 Intermediate Advanced Programming
   21-127 Concepts of Mathematics
   80-210 Introduction to Logic
   80-211 Arguments & Inquiry

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.
   03-121 Modern Biology
   03-130 Biology of Organisms
   09-105 Introduction to Modern Chemistry
   09-106 Modern Chemistry II
   33-111 Physics for Science Students I
   33-112 Physics for Science Students II

Distribution Requirements (36 units)
11-14. Choose a minimum of four courses, minimum 9 units per category, totaling at least 36 units.

Cognition, 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.
   80-150 The Nature of Reason
   80-180 The Nature of Language
   80-181 Language and Thought
   80-242 Conflict and Dispute Resolution
   85-100 Intro. 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
   88-120 Reason, Passion & Cognition

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.
   This category examine the ways in which institutions organize individual preferences and actions into collective outcomes using model-based reasoning.
   36-303 Sampling, Surveys, and Society
   73-100 Principles of Economics
   73/88-110 Experiments with Economic Principles
   79-266 Times of Feast/Famine: Population and Family in History
   80-135 Introduction to Political Philosophy
   80-136 Social Structure, Public & Ethical Dilemmas
   88-104 Decision Processes in American Political Institutions
   88-205 Comparative Politics

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.
   48-095 Architecture for Non-Majors I
   51-281 Communication Design Fundamentals
   51-283 Industrial Design Fundamentals
   51-285 Beginning Photography
   54-161/162 Production Preparation
   54-183/184 Fundamentals of Drama
   54-187/188 Introduction to Playwriting
   54-191/192 Acting for Non-Majors
   54-251/252 Introduction to Lighting Design (6 units)
   54-309/310 Theatre Lab (4 units)
   54-351/352 Lighting Design I
   57-117 Choral Ensemble for Non-Majors (6 units)
   57-118 Choral Ensemble for Non-Majors (6 units)
   57-328 Jazz Chamber Music (3 units)
   57-417 Major Choral Ensemble (6 units)
   57-418 Major Instrumental Ensemble (6 units)
   57-453/454 Jazz Improvisation I (3 units)
   57-455/456 Jazz Improvisation II (3 units)
   60-101 Concept Studio I
   60-110 Electronic Media Studio I
   60-130 3-D Media Studio I
   62-102/103 Modern Dance Workshop (6 units)
   62-299 CFA Interdisciplinary Workshop
   76-206 Introduction to Creative Writing
   80-120 Reflections on Science
   80-241 Ethical Judgments in Professional Life
   80-280 Philosophy and Art
   82-101 Elementary French I
   82-102 Elementary French II
   82-103 Elementary French I, On-Line
   82-104 Elementary French II, On-Line
   82-121 Elementary German I
   82-122 Elementary German II
### 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>76-201</td>
<td>Literature &amp; the Social</td>
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<tr>
<td>76-227</td>
<td>Comedy</td>
</tr>
<tr>
<td>79-113</td>
<td>Culture &amp; 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>The Development of European Culture</td>
</tr>
<tr>
<td>79-309</td>
<td>Who Shall Serve? Blacks, Women &amp; Gays in Military</td>
</tr>
<tr>
<td>79-368</td>
<td>Poverty, Charity &amp; Welfare</td>
</tr>
<tr>
<td>80-100</td>
<td>What Philosophy Is</td>
</tr>
<tr>
<td>80-250</td>
<td>Ancient Philosophy</td>
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<tr>
<td>80-251</td>
<td>Modern Philosophy</td>
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<tr>
<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>Aesthetics of Mass Art</td>
</tr>
<tr>
<td>82-304</td>
<td>Francophone World</td>
</tr>
<tr>
<td>82-415/416</td>
<td>Topics in French &amp; Francophone Studies</td>
</tr>
<tr>
<td>82-420</td>
<td>German Classical Literature</td>
</tr>
<tr>
<td>82-423</td>
<td>Postwar German Literature</td>
</tr>
<tr>
<td>82-426</td>
<td>Studies in German Literature</td>
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<tr>
<td>82-427</td>
<td>Nazi &amp; Resistance Culture</td>
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<tr>
<td>82-451</td>
<td>Studies in Latin American Literature &amp; Culture</td>
</tr>
<tr>
<td>82-455/456</td>
<td>Topics in Hispanic Studies</td>
</tr>
<tr>
<td>82-491</td>
<td>Literature, Politics &amp; Film in Russia Today</td>
</tr>
<tr>
<td>82-492</td>
<td>The Historical Imagination of 19th Century Russian Lit.</td>
</tr>
<tr>
<td>82-493</td>
<td>Joseph Brodsky in Context</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 Biological Sciences and Psychology, or Psychology and Biological Sciences (B.S.)
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 joint SHS program can complete the SHS educational core and choose either discipline order for their degree.

#### Specific Pre-Major Requirements
The double major specifies particular pre-major requirements in the areas of Mathematical Sciences and Statistics, 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. All other general education categories can be filled in any way that satisfies the requirements of the student’s college or the SHS program.

#### Mathematical Sciences/Statistics:
- 21-115/116 Differential Calculus and Integral Calculus
- 21-117/118 Integration & Differential Equations and Calculus of Approximations
- 36-247 Statistics for Laboratory Sciences*           
- 36-309 Experimental Design Statistics
- 36-202 can be used as an alternative but 36-247 is strongly recommended

#### Sciences:
- 09-105 Introduction to Modern Chemistry
- 09-106 Modern Chemistry II
- 33-111 Physics for Science Students I
- 09-217 Organic Chemistry I
- 09-218 Organic Chemistry II

#### Computational Reasoning:
- 99-xxx CSW
  - 15-100 Introductory/Intermediate Programming
  - 15-111 Intermediate/Advanced Programming

#### Discipline Core Requirements: 72 Units

<table>
<thead>
<tr>
<th>Category</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sciences</td>
<td>03-121 Modern Biology</td>
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<tr>
<td></td>
<td>03-231 or 232 Biochemistry</td>
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<tr>
<td></td>
<td>03-240 Cell Biology</td>
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<tr>
<td></td>
<td>03-330 Genetics</td>
</tr>
</tbody>
</table>

#### Psychology
- 85-102 Introduction to Psychology
- Complete three of the following 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

#### Laboratory/Research Methods Requirements: 52-55 Units
- 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:
- 85-310 Research Methods in Cognitive Psychology
- 85-320 Research Methods in Child Development
- 85-518 Research Methods in Social Psychology

#### Additional Laboratory Requirement:
Complete one additional laboratory experience either as an additional 85-3xx Research Methods course in Psychology or a second laboratory in Biological Sciences at the 300 level or above.

#### Advanced Biological Sciences/Psychology 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 (Research Recommended)

#### Additional comments:
If a student drops the double major program, the following additional courses would be required to complete the B.S. in Biological Sciences: 09-214 Physical Chemistry, 33-112 (or 33-107) Physics II and a second, 300-level Biology laboratory course. If a student drops the double major program, the following additional courses would be required to complete the B.S. in Psychology: a second Research Methods course.

This program does not satisfy requirements for a pre-medical preparation. Advising is suggested to determine the additional courses needed for that program (see Health Professions Program on page 64).

#### 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 acceptable for admission to both colleges.

#### Mathematical Sciences: 85 Units
- 21-115/116 Differential Calculus/Integral Calculus
- 21-117/118 Integration & Differential Equations/Calculus of 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
The Undergraduate Additional Major in Human-Computer Interaction

Richard Scheines, Undergraduate Advisor
Office: Baker Hall 135
For up to date information see: http://www.hcii.cs.cmu.edu/Academics/Undergrad/undergrad.html

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, internet connected personal digital assistants (PDAs) and interactive web-sites. 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
- Familiarity with standard programming languages - e.g., C++, Java
- Rapid prototyping skill (e.g., Visual Basic, Director)
- Computational literacy, i.e., knowledge sufficient for effective communication and decision making about:
  - interface construction tools and languages
  - multimedia authoring tools - e.g., Director, Premiere
  - 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 School of Industrial Administration).

Curriculum

Required Courses:
85-211 or 85-213 Cognitive Psychology
85-213 Human Information Processing and Artificial Intelligence
15-100 Introductory/Intermediate Programming
05-630 or 631 Interface Programming
51-261 Communication Design Fundamentals
51-421 Visual Interface Design
05-410 Introduction to Human-Computer Interaction Methods
09-571 Project Course

Free Electives: Enough to reach 360 Units

Sample Course Sequence: Math & Stat Sciences

Freshman Year: Fall
21-115 Differential Calculus
21-116 Integral Calculus
21-127 Concepts of Mathematics
76-101 Interpolation and Argument
33-111 Physics I for Science Students
99-101 Computer Skills Workshop

Sophomore Year: Fall
21-201 Undergraduate Colloquium
21-241 Matrix Algebra
36-309 Experimental Design
xx-xxx Cultural Analysis
xx-xxx Electives

Junior Year: Fall
21-355 Advanced Calculus I
36-325 Probability and Mathematical Statistics I
xx-xxx Cognition, Choice and Behavior
xx-xxx Electives

Senior Year: Fall
21-393 Operations Research II
36-401 Advanced Data Analysis I
36-461 Undergraduate Seminar
xx-xxx Electives

Spring
xx-xxx Electives
21-xxx Mathematical Science Elective
36-402 Advanced Data Analysis II
xx-xxx Electives
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 & Soc. 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 systmes
- 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
- 05-410 Computer Supported Cooperative Work
- 05-411 Cognitive Modeling
- 85-367 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, the senior project course in HCI (05-571), and an elective on the 400 level or above will be considered eligible for the Accelerated Masters program. These students, which include all undergraduates, 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. Applications are processed once a year, during Spring Break.
The Minor in Arts in Society (AIS)

Sponsored by:
The Center for the Arts in Society (CAS)
College of Humanities and Social Sciences
College of Fine Arts

Faculty Advisor: Judith Modell, Director
Center for the Arts in Society
Office: Baker Hall 242D

The Minor in Arts in Society (AIS) provides students with the opportunity to enter studio production as well as to critically reflect and analyze the role that creativity plays in the continuity and coherence of cultures. 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) 60 units
The AIS Minor requires six courses from the general themes outlined below, as well as meetings at the AIS Monthly Seminar.

I. Perspectives 24 units
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 the following lists of History and Context courses. Other courses may be substituted with the permission of the program advisor.

II. Project Courses 24 units
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 12 units
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.

AIS Monthly Seminar.
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.

History
48-340 The American Built Environment to 1860
48-440 The American Built Environment, 1850-Present
51-271 Design History I
51-272 Design History II
54-327/328 Music Theatre History
57-203 Medieval, Renaissance, and Baroque Music History
57-204 Eighteenth and Nineteenth Century Music History
60-105 Pre-Industrial Visual Cultures to 1789
60-205 Modern Visual Culture, 1789-1945
60-206 Contemporary Visual Culture, 1945 to the Present
60-350/79-323 Italian Renaissance Art
60-355/79-322 Michelangelo and the Italian Renaissance
60-356 Art from 1965 to the Present
60-357/79-321 Picasso and 20th Century Art
76-239 Introduction to Film Studies
79-227 History of World Architecture
79-238 Film and the Production of History
79-239 The Caribbean: Cultures and Histories
82-345 Hispanic Literary and Cultural Studies: Reflections in the Buried Mirror
82-407 The Arts in Society: French Modernism
82-428 History of German Film
82-457 Contemporary Latin American Texts: Back to the Future

Context
51-372 Contemporary Design
57-399 Music, Cinema, Culture
60-350 Italian Renaissance Art
60-351 Art and Religion
60-353 High Art; Low Art
60-354 Art, Aesthetics and Literature
60-372 Critical Theory
60-398 Contemporary Culture: Into the Public Realm
62-358/80-358 The Biology of Art, The Art of Biology
76-333 The Eighteenth Century London Stage
76-450 Literature And Psychoanalysis
79-210 Picturing Others: A Course on Ethnographic Film
79-229 History and Preservation
79-253 The Caribbean: Cultures and Histories
79-303 Visual Anthropology
82-183 Images of Memory In Modernity
82-345 Hispanic Literary and Cultural Studies: Reflections in the Buried Mirror
82-405 Images of Modernity: Baudelaire & the Painting of Modern Life
82-407 French Modernism: The Arts in Society
82-408 Matisse, Chagall, Picasso and Their Contemporaries: Art and Museums on the Riviera
82-427 Nazi and Resistance Culture
82-445 U.S. Latino Literature: Necessity is the Mother of all ‘Coyotes’
82-446 Political Drama of Spain
82-456 The “Other” in Latin American Literature and Film
82-457 Contemporary Latin American Texts: “Back to the Future”
82-491 Literature, Politics and Film in Russia and East Europe Today
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
Mark Wessel, 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 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.

The 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
90-650 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)
90-650 Introduction to Health Care Management
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
91-863 Health Care Guidelines and Outcomes

Humanities and Social Sciences Courses (9 units each)
73-328 Health Economics
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

John L. Anderson, Dean
Robert P. Kail, Associate Dean for Undergraduate Studies
Undergraduate Office: Scaife Hall 110

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, and 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 and health 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.

### Fall Semester

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Engineering Elective</td>
<td>12</td>
</tr>
<tr>
<td>Restricted Technical Elective</td>
<td>10-12</td>
</tr>
<tr>
<td>Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td>Integral Calculus</td>
<td>5</td>
</tr>
<tr>
<td>A Writing/Expression Course (General Education)</td>
<td>9</td>
</tr>
<tr>
<td>Computer Skills Workshop</td>
<td>3</td>
</tr>
</tbody>
</table>

### Spring Semester

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Engineering Elective</td>
<td>12</td>
</tr>
<tr>
<td>Restricted Technical Elective</td>
<td>10-12</td>
</tr>
<tr>
<td>Integration &amp; Differential Equations</td>
<td>5</td>
</tr>
<tr>
<td>Calculus of Approximation</td>
<td>5</td>
</tr>
<tr>
<td>A General Education Course</td>
<td>9</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:

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105 Modern Chemistry I</td>
<td>10</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>or 15-111 Intermediate/Advanced Programming</td>
<td>10</td>
</tr>
<tr>
<td>33-106 Physics for Engineering Students I</td>
<td>12</td>
</tr>
<tr>
<td>33-107 Physics for Engineering Students II</td>
<td>12</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomedical Engineering</td>
<td>09-105 or 33-106</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>09-105</td>
</tr>
<tr>
<td>Civil &amp; Environmental Engineering</td>
<td>33-106</td>
</tr>
<tr>
<td>Electrical &amp; Computer Engineering</td>
<td>15-100 or 15-111</td>
</tr>
<tr>
<td>Engineering &amp; Public Policy</td>
<td>33-106</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>33-106</td>
</tr>
<tr>
<td>Materials Science and Engineering</td>
<td>33-106</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-require) 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.

General Education Program for CIT Students

Breadth Requirement

Humanistic Studies 9 units
Either 79-104 (Introduction to World History) or one course from the “Cultural Analysis” category of the H&SS general education program. The list of acceptable courses is on file in the CIT Office of Undergraduate Studies and will be included in the CIT Registration Packet given to first year students.

Writing / Expression 9 units
76-101 Interpretation and Argument

Cognition and Institutions 9 units
One course from the Cognitions and Institutions category of the H&SS general education program. The list of acceptable courses is on file in the CIT Office of Undergraduate Studies and will be included in the CIT Registration Packet given to first year students.

Depth Sequence in Humanities, Social Science, or Fine Arts 27 units
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 or less 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 combination is not acceptable. A 6 unit, 3 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 or less 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 combination is not acceptable. A 6 unit, 3 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 and military science) may be taken as free electives in most CIT degree programs.

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 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 student should apply for the double major through the second department and coordinate requirements with both departments.

The double major is to be distinguished from a double degree program, which results in two separate bachelor’s degrees; for example, Bachelor of Science in Chemical Engineering and a Bachelor of Arts in English. The double degree, though, requires a minimum of 90 units of work in addition to the units required for the first degree. The second degree may be earned in Bachelor of Science or Bachelor of Arts degree programs.

Requirements for the Double Major Program in CIT
The student must satisfactorily pass requirements of the regular and complete program (with the permissible exceptions as noted below) 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 H&SS 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 pursue 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
* Manufacturing Engineering
* Material Science and Engineering
* Mechanical Behavior of Materials
* Robotics (described below)

Complete descriptions of the designated minors can be found on p. 89-92.
### 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 course 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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>124-124</td>
<td>Modern Biology</td>
</tr>
<tr>
<td>03-240</td>
<td>Cell Biology</td>
</tr>
<tr>
<td>03-310</td>
<td>Introduction to Computational Biology</td>
</tr>
<tr>
<td>03-311</td>
<td>Computational Molecular Biology</td>
</tr>
<tr>
<td>03-330</td>
<td>Genetics</td>
</tr>
<tr>
<td>03-343</td>
<td>Experimental Genetics and Molecular Biology</td>
</tr>
<tr>
<td>03-344</td>
<td>Experimental Biochemistry</td>
</tr>
<tr>
<td>03-345</td>
<td>Experimental Cell and Developmental Biology</td>
</tr>
<tr>
<td>03-350</td>
<td>Developmental Biology</td>
</tr>
<tr>
<td>03-438</td>
<td>Physical Biochemistry</td>
</tr>
<tr>
<td>03-439</td>
<td>Introduction to Biophysics</td>
</tr>
<tr>
<td>03-441</td>
<td>Molecular Biology of Prokaryotes</td>
</tr>
<tr>
<td>03-442</td>
<td>Molecular Biology of Eukaryotes</td>
</tr>
<tr>
<td>03-510</td>
<td>Computational Biology</td>
</tr>
<tr>
<td>03-533</td>
<td>NMR in Biomedical Sciences</td>
</tr>
<tr>
<td>534-534</td>
<td>Bio Imaging Fluorescence Spectroscopy</td>
</tr>
<tr>
<td>09-245</td>
<td>Physical Chemistry II</td>
</tr>
<tr>
<td>211-211</td>
<td>Fundamental Structures of Computer Science I</td>
</tr>
<tr>
<td>42-301</td>
<td>Physiology</td>
</tr>
<tr>
<td>42-377</td>
<td>Rehabilitation Engineering</td>
</tr>
<tr>
<td>42-501</td>
<td>Special Topics: Biomaterials I &amp; II</td>
</tr>
<tr>
<td>42-560</td>
<td>Research Project (at CMU or UPMC)</td>
</tr>
<tr>
<td>42-604</td>
<td>Biological Transport</td>
</tr>
<tr>
<td>42-621/06-621</td>
<td>Biotechnology &amp; Environmental Processes</td>
</tr>
<tr>
<td>42-622/06-622</td>
<td>Bio Process Design</td>
</tr>
<tr>
<td>42-644</td>
<td>Medical Devices</td>
</tr>
<tr>
<td>42-651/12-651</td>
<td>Air Quality Engineering</td>
</tr>
<tr>
<td>42-652</td>
<td>Introduction to Biomechanics</td>
</tr>
<tr>
<td>42-723/12-723</td>
<td>Biological Processes in Environmental Systems</td>
</tr>
</tbody>
</table>

### BME Electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-607</td>
<td>Phys Chem of Colloids and Surfaces</td>
</tr>
<tr>
<td>06-608/09-509</td>
<td>Physical Chemistry of Macromole 06-313</td>
</tr>
<tr>
<td>06-313</td>
<td>Exp Colloid Science</td>
</tr>
<tr>
<td>314-314</td>
<td>Exp Polymer Science</td>
</tr>
<tr>
<td>42-426</td>
<td>Experimental Colloid Surface Science</td>
</tr>
<tr>
<td>06-466</td>
<td>Experimental Polymer Science</td>
</tr>
<tr>
<td>18-3XX**</td>
<td>Special Topics in Biotechnology</td>
</tr>
<tr>
<td>19-607</td>
<td>General Robotics</td>
</tr>
<tr>
<td>24-254</td>
<td>General Systems and Control</td>
</tr>
<tr>
<td>27-432</td>
<td>Electrical, Magnetic, and Optical Properties of Materials</td>
</tr>
<tr>
<td>27-441</td>
<td>Deformation and Fracture of Materials</td>
</tr>
<tr>
<td>36-247</td>
<td>Introduction to Biophysics</td>
</tr>
<tr>
<td>39-319</td>
<td>Law and the Engineer</td>
</tr>
<tr>
<td>88-270</td>
<td>Networking; Organizations, Knowledge, and Technology</td>
</tr>
<tr>
<td>88-302</td>
<td>Behavioral Decision Making</td>
</tr>
<tr>
<td>340-340</td>
<td>Economics of Entrepreneurship in High Technology Industries</td>
</tr>
<tr>
<td>90-830</td>
<td>Financial Management of Health Systems</td>
</tr>
<tr>
<td>90-831</td>
<td>Health Management Systems</td>
</tr>
<tr>
<td>836-836</td>
<td>Legal Issues in Health Systems Management</td>
</tr>
<tr>
<td>90-837</td>
<td>Health Project Planning &amp; Management</td>
</tr>
<tr>
<td>90-853</td>
<td>Introduction to Health Care Management</td>
</tr>
<tr>
<td>90-861</td>
<td>Health Care Information Systems</td>
</tr>
</tbody>
</table>

*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.

### Engineering Studies Minor (for non-engineering students)

**Robert P. Kail, 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
   - 16-100 Introduction to Electrical & Computer Engineering
   - 19-101 Introduction to Engineering & Public Policy
   - 24-101 Introduction to Mechanical Engineering
   - 27-100 Materials in 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:

- 18-200/18-202 Math Foundations of Electrical Engineering  
- 19-319 Law and the Engineer  
- 19-321 Law and Technology  
- 24-160 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:

1. 19-102 EPP Sophomore Seminar (Fall)  3 units  
2. 19-451 or 452 EPP Project (Fall or Spring)  12 units  
3. 19-319 Law and the Engineer  3 units  
4. 19-321 Law and Technology  3 units  
5. 24-160 Engineering Graphics  3 units  
6. 42-500 Physiology  3 units  
7. 42-501 Physiology  3 units

Two EPP Technical Electives totaling 18 units  
Page 125 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)  9 units  
   - 88-302 Behavioral Decision Making (Fall)  9 units  
   - 19-426 Environmental Decision Making (Fall)  9 units  

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 24-248 Kinematics and Dynamics of Mechanisms

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

Academic Standards
Grading Practices
Undergraduate grading regulations are detailed on pages 46.

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 associate dean of CIT. Students admitted to CIT but excluded from certain departments must also consult with the associate 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 GPA or the cumulative GPA (excluding the first year) below 2.0 invokes an academic action.

Probation
The action of probation occurs in the following cases:
One semester GPA of the first year falls below 1.75.
The semester GPA 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 GPA 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 GPA AND cumulative GPA (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:

1. Receiving permission in writing from the associate dean for undergraduate studies.
2. Completing an Application for Readmission 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 even though academic credit earned will not transfer back to Carnegie Mellon.

Students who are suspended 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 28 for add/drop procedure information and page 47 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 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 design minor from the following list:

* Automation and Control
* Biomedical Engineering
* 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 (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 B22

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

**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:**

- 06-962 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
- 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
- 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.

**Course Requirements for Biomedical 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 Biomedical Engineering Minor are encouraged to look for applicable courses each semester in CIT, CS, and Robotics.

**One basic control course:**

- 06-962 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
- 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
- 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
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 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 advisors to approve final schedules. Following are advisors in departments:

Chemical Engineering: Dr. Todd Przybycien, Dr. Michael Domach, Dr. Lynne Walker
Civil & Environmental Engineering: Dr. Jean VanBriesen Walker
Electrical & Computer Engineering: Dr. Richard Stern, Dr. Chuck Neumann
Materials Science & Engineering: Dr. Lisa Porter; Dr. Henry Pfeifer
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 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
3-534 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
06-313 Exp Colloid Science
06-314 Exp Polymer Science
06-426 Experimental Colloid Surface Science
06-466 Experimental Polymer Science
18-3XX* Special Topics in Biotechnology
24-254 General Robotics
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: Scalfie 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 systems include computer storage design, computer organization, computer operating systems, computer architecture, computer networking, computer security, information retrieval, data storage, and database management systems.
storage technology are grouped in 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
- 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**

- 33-325 Quantum Physics and the Structure of Matter
- 33-448 Introduction to Solid State Physics
- 33-453 Intermediate Optics

A graduate course in quantum physics, magnetism, or optics

**Dynamics, Control and Signal Processing Concentration**

- 18-575 Control System Design OR
- 24-451 Feedback Control Systems
- 24-356 Engineering Vibrations
- 18-396 Signals and Systems
- 18-474 Computer Control Systems Design Laboratory

A graduate course in controls, dynamics, or signal processing

**Computer Systems Concentration**

- 19-412 Operating Systems
- 18-349 Introduction to Embedded Systems
- 18-549 Complex Embedded/Multimedia Computing

A graduate course in computer systems

**Circuit Design Concentration**

- 18-523 Analog Integrated Circuit Design
- 18-525 Integrated Circuit Design Project
- 18-545 Advanced Digital Design Project

A graduate course in circuit design

**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 B206
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-has 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 micromechanical 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 pursuing 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**

**Electrical and Computer Engineering - Stanley H. Charap, Michael Reed and T. E. Schlesinger**

**Engineering and Public Policy - M. Granger Morgan**

**Materials Science and Engineering - Marek Skowronski and Lloyd Bauer**

**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
- 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
- 27-533 Principles of Growth and Processing of Semiconductors
- 27-432 Electronic, Magnetic, and Optical Properties
- 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**

- 18-311 Semiconductor Devices I
- 18-512 Semiconductor Devices II
- 18-316 Introduction to Data Storage Systems Technology
- 18-715 Physics of Applied Magnetism
- 18-8XX An appropriate 800-level course (for example, 18-813, 18-815, 18-819).

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 and Environmental Engineering - Susan Finger and Jim Garrett
Electrical and Computer Engineering - Robert A. Ruttenbar and Daniel P. Siewiorek
Engineering and Public Policy - Kathleen Carley and Mark Kieler
Mechanical Engineering - Jonathan Cagan, Kenji Shimada and Tom Stahoovic
Materials Science and Engineering - Henry Piehler

Course Requirements for Engineering Design Minor

Required Courses:
Select at least two of the following courses.
39-245 Rapid Prototype Design
39-405 Engineering Design: Creation of Products and Processes
39-600 Integrated Product Development
39-655/660 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 45 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 Systems Design Project
18-523 Analog Integrated Circuit Design
18-525 Integrated 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 of Computer Systems
18-747 Superscalar Processor Design
18-778 Mechatronic Design
24-778 Mechatronic Design
24-781 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 - Spyros N. Pandis
Civil and Environmental Engineering - David A. Dzombak
Electrical and Computer Engineering - Sarosh Talukdar
Engineering and Public Policy - Mark Kieler and Edward S. Rubin
Mechanical Engineering - Allen L. Robinson
Materials Science and Engineering - Henry R. Piehler

Course Requirements for Environmental Engineering Minor

The requirements include two science-oriented courses, three engineering courses and two policy courses. Three of the five science and engineering courses must be from outside the student’s major department to ensure a diversity of exposure. The two policy courses are counted as part of the courses in the areas of humanities, social sciences, or fine arts required of all CIT students. The Environmental Engineering minor consists of seven courses, chosen from the list below.

A. Environmental Science Courses
Two from the following list of science-oriented courses:
03-121 Modern Biology
03-122 Organismic Biology
03-130 Biology of Organisms
03-231 Biochemistry
03-310 Introduction to Computational Biology; OR
03-310 Computational Biology
06-221 Thermodynamics; OR
24-221 Thermodynamics I; OR
27-215 Thermodynamics of Materials
06-426 Experimental Colloid and Surface Science
06-607 Physical Chemistry of Colloids and Surfaces
09-106 Modern Chemistry II
09-206 Physical Principles of Analytical Chemistry
09-214 Physical Chemistry
09-217 Organic Chemistry I
09-344 Physical Chemistry
09-441 Nuclear and Radiochemistry
09-510 Introduction to Green Chemistry
B. Environmental Engineering Courses:

Three from the following list of engineering-oriented courses:

06-630/19-630 Atmospheric Chemistry, Air Pollution, and Global Change
12-251 Introduction to Environmental Engineering [for non-CEE students only]
12-651 Air Quality Engineering
12-655 Water Quality Engineering
12-657 Water Resources Engineering
12-658 Hydraulic Structures Design
19-422 Radiation, Health and Policy
19-446 Quantitative Risk Assessment
19-450 Special Topics in Combustion and Air Pollution Control
19-650 Climate and Energy: Science, Economics and Public Policy
24-424/19-424 Energy and the Environment
27-322 Processing of Metals; OR
27-357 Selection and Performance of Materials
42-604 Biotechnological Transport
42-621 Biotechnology and Environmental Processes
48-315 Environment 1: Climate and Energy
48-416 Advanced Building

C. Environmental Policy Courses:

Two from the following list of humanities/social science-oriented courses:

19-319 Law and The Engineer
19-426 Environmental Decisionmaking
19-448 Science, Technology, and Ethics
48-425 Urban Design
48-567 Sustainable Design and Development
66-210 Science, Technology, and the Environment
70-332 Business and Society
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
79-343 Environmental Policy and Development in the Tropical World
79-345 American Environmental History
79-346 International Environmental Law and Policy
79-365 Climate Change, Energy Policy, and Environmental Protection
79-471 American Built Environment
79-475 Perspectives on the City and the Environment
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
88-340 Law and Public Policy
88-425 Politics of Economic Deregulation
90-745 Decision Support Systems for the Public Sector
90-747 Cost-Benefit Analysis
90-779 Design, Environment, and Economic Development
90-784 Geographic Information Systems
90-796 Environmental Policy and Regulation
99-231 Environmental Footprints: The Effects of Our Choices

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 and the Director for the Environmental Engineering Minor.

A list of relevant courses offered in particular semesters is provided at the Environmental Engineering Minor web site: [www.ce.cmu.edu/~dzombak/envminor.html](http://www.ce.cmu.edu/~dzombak/envminor.html)

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:

Chemical Engineering - Arthur Westerberg
Civil and Environmental Engineering - Susan Finger
Electrical and Computer Engineering - Bruce H. Krogh
Engineering and Public Policy –Mark Kieler
Materials Science and Engineering - Anthony D. Rollett
Mechanical Engineering – Kenji Shimada

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
27-622 Processing Methods
27-624 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
Marc De Graef, Director
Office: Roberts Engineering Hall 130

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, except MSE majors. All required and elective courses are taught within the MSE department.

Course requirements: the minor requires a minimum of 45 units, with three required courses.

Prerequisite: students who wish to take the MSE minor must have taken both a Thermodynamics and a Transport course in their own major.

Core Courses (27 units)
27-100 Materials in Engineering
27-211 Perfect Crystals
27-227 Phase Relations/Diagrams

Elective Courses:
The student must select a minimum of 18 units from the following list:

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

Course Requirements for
Mechanical Behavior of Materials Minor
The minor requires six courses: three solid mechanics courses and three materials science courses.

Core Courses:
Each student is required to take the three following courses.

27-201 Perfect Crystals
27-591 Mechanical Behavior of Materials
12-235 Statics
or
24-261 Statics of Deformable Solids

Group A: Materials Science
Each student is required to take one of the following courses.

27-217 Phase Relations
27-357 Introduction to Materials Selection
27-551 Properties of Ceramics and Glasses
27-530 Advanced Physical Metallurgy

Group B: Solid Mechanics
Each student is required to take two of the following courses.

12-231 Solid Mechanics
12-635 Structural Analysis
24-262 Stress Analysis
24-361 Intermediate Stress Analysis
24-751 Introduction to Solid Mechanics

In satisfying the above course requirements, each student must take three out-of-department courses.

1 Cannot be used by MSE students to satisfy requirements of minor.
2 Not available to MSE students.

Mechanical Behavior of Materials
Designated Minor
Warren Garrison, Director
Office: Wean Hall 3301

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
Civil and Environmental Engineering - Paul P. Christiano
Electrical and Computer Engineering - David W. Greve
Mechanical Engineering - Paul S. Steif
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 and clinical practice; 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 graduates also choose to pursue graduate studies or medical school. Our approach to biomedical engineering education reflects our belief that successful biomedical engineers in these sectors and settings will be deeply trained in both engineering and the life sciences.

Biomedical Engineering, as a collection of related fields, 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. We have granted graduate degrees and undergraduate minors in these programs since 1970.

The centerpiece of our undergraduate education program is our dual B.S. degree program in biomedical engineering. Carnegie Institute of Technology undergraduates may elect any one of these following majors jointly with Biomedical Engineering: Chemical Engineering, Biomedical 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 technology, 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 along with design students from the School of Design and business students from the Graduate School of Industrial Administration into design teams. The design teams 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. Sample curricula for each of the individual double major programs are given below.

The breadth of the BME domain courses currently offered as well as those in the planning stages 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 interdisciplinary 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 deep 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 biomedical engineering degree programs continues to grow, we expect that this differential, 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.

Double Major
The new double major Biomedical Engineering (BME) has the following broad 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, which can range from molecular phenomena to health care and delivery technology

Please Note: Keep in mind that the program described here is a double or auxiliary major. It is not possible to have a single major in Biomedical Engineering.
Suggested Tracks and courses:
Tracks 1, 2, and 3: All tracks must complete the Core Courses, Design course, and 5 Domain and Electives. Following are suggested Domain Courses for these tracks:

Track 1: Biotechnology Track
(primarily for Chemical and Civil & Environmental)
Any of the 03-xxxDomain Courses
42-604 Biological Transport
42-621 Biotechnology & Environmental Processes
42-622 Bioprocess Design
42-651/12-651 Air Quality Engineering
42-723 Biological Processes in Environmental Systems
42-560 U.G. Research Project

Track 2: Biomechanics Track
(primarily for Mechanical and Materials Science)
42-377 Rehabilitation Engineering
42-511/27-511 Biomechanics
42-510/27-510 Biomaterials II
42-644 Medical Devices
42-659 Intro. to Biomechanics
42-560 U.G. Research Project
42-560 U.G. Research Project

Track 3: Medical Imaging Track
(primarily for Electrical & Computer Engineers)
03-310 or 03-311 Computational Biology
42-377 Rehabilitation Engineering
42-644 Medical Devices
42-560 U.G. Research Project

Course Requirements:
The requirements are three core courses, one seminar, one merged (design) course, and five domain & policy related electives. The breakdown of the domain & elective courses is a minimum of three domain courses and two electives. Core courses will be taken by all students to insure that a basic foundation is acquired in science and vocabulary. A domain sequence will allow students to explore an area that complements their primary major. A merged course is a project course where students with some common background, yet different expertise, work on a substantial problem. The elective courses seek to compliment your biomedical engineering component. These requirements satisfy various categories of electives in your engineering curriculum and should not increase the total number of units/courses required for your primary degree. Below are the courses that fulfill the requirements.

Core (all required)
03-121 Modern Biology OR
03-231 Biochemistry OR
03-232 Biochemistry
42-101 Introduction to BME
42-201 Biomedical Engineering Seminar
42-301 Physiology

Domain (three courses from the following list are required)
03-124 Modern Biology/Laboratory
03-240 Cell Biology
03-310 Introduction to Computational Biology
of
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
03-380 Virology
03-388 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 Biological Imaging and Fluorescence Spectroscopy
03-824 Physical Chemistry II or an intermediate level physics course
42-377 Rehabilitation Engineering
42-510/27-510 Biomaterials I
42-511/27-511 Biomaterials II
42-604 Biomechanics
42-621/06-621 Biotechnology & Environmental Processes

For CIT students
General Requirements: (five courses, 48-51 units)
42-101 Introduction to BME
03-121 Modern Biology or 03-232 Biochemistry
BME Elective or Domain
BME Elective or Domain
BME Elective or Domain

For non-CIT students
General Requirements: (five courses, 51-57 units, plus pre- and co-requisite courses including 03-121 Modern Biology).
42-101 Introduction to BME
A second Introductory Engineering Course
BME Elective or Domain*
BME Elective or Domain **

* As long as it is not already 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)

Advising
One faculty member is assigned the advisor to each engineering department. Hilda Diamond, Associate Head, in Doherty Hall 2100 will also help with the 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 approve final schedules.

Following are advisors in departments:
Chemical Engineering: Dr. Todd Przybycien, Dr. Michael Domach, Dr. Lynne Walker
Civil & Environmental Engineering: Dr. Jean VanBriesen
Electrical & Computer Engineering: Dr. Richard Stern, Dr. Chuck Neumann
Materials Science & Engineering: Dr. Lisa Porter, Dr. Henry Piehler
Mechanical Engineering: Dr. Cristina Amon, Dr. Jon Cagan

Undergraduate Course Requirements for the Biomedical Engineering Minor

Merged (capstone, multidisciplinary project, required)
42-401 BME Design

Electives (two courses from the following list are required)
313-313 Experimental Colloid Science
313-314 Experimental Polymer Science
60-607 Physical Chemistry of Colloids and Surfaces
06-608/09-509 Physical Chemistry of Macromolecules
19-3XX As circuits and signals are integral to many medical technologies, most
24-354 General Robotics
36-247 Laboratory Science Statistics
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
90-650 Introduction to Health Care Management
90-853 Health Care Information Systems
90-861 Health Policy
90-862 Managed Care- Spring

The Heinz School (90-xxx) courses are appropriate for undergraduates, and may also be double counted as a General Education Course.
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.

*Capstone Design Courses: (The Capstone Design course also satisfies the BME Core requirement).
# Sample Curriculum for Biomedical Engineering

## Chemical Engineering Single Major - Option 1

(You can elect Option 1 or Option 2)

### First Year

<table>
<thead>
<tr>
<th>Fall Units</th>
<th>Spring Units</th>
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<tbody>
<tr>
<td>21-115 Differential Calculus</td>
<td>21-117 Integration &amp; Differential Eq.</td>
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<tr>
<td>21-116 Integral Calculus</td>
<td>21-118 Calculus of Approximation</td>
</tr>
<tr>
<td>21-116 Designated Writing Course</td>
<td>*42-101 Intro to Biomedical Engineering</td>
</tr>
<tr>
<td>99-101 Computing Skills Workshop</td>
<td>OR 09-106 General Education Course</td>
</tr>
<tr>
<td>06-100 Intro. to Chemical Engineering</td>
<td>xx-xxx General Education Course</td>
</tr>
<tr>
<td>09-105 Modern Chemistry</td>
<td><strong>Total:</strong> 44</td>
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| Total: 44 |

### Second Year

<table>
<thead>
<tr>
<th>Fall Units</th>
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<tbody>
<tr>
<td>06-222 Sophomore ChemE Seminar</td>
<td>06-261 Fluid Mechanics I</td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>06-262 Mathematical Methods of Chemical Engineering</td>
</tr>
<tr>
<td>06-221 Thermodynamics</td>
<td>09-221 Lab I: Introduction to Chemical Analysis</td>
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<tr>
<td>09-206 Physical Principles of Analytical Chem.</td>
<td>33-107 Physics for Engineering Students II</td>
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<tr>
<td>OR 09-106</td>
<td>xx-xxx General Education Course</td>
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<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td><strong>Total:</strong> 47</td>
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<tr>
<td>xx-xxx General Education Course</td>
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<th>Fall Units</th>
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</tr>
<tr>
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<td>06-362 Chemical Engineering Process Control</td>
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<tr>
<td>06-323 Heat and Mass Transfer</td>
<td>06-363 Transport Process Laboratory</td>
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<tr>
<td>08-217 Organic Chemistry I</td>
<td>03-232 Biochemistry</td>
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<td>09-347 Advanced Physical Chemistry</td>
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### Fourth Year

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<tr>
<td>06-421 Chemical Process System Design</td>
<td>06-461 Process Design Project</td>
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<tr>
<td>06-422 Chemical Reaction Engineering</td>
<td>06-462 Economics &amp; Optimization</td>
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<tr>
<td>06-423 Unit Operations Laboratory</td>
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<td>xx-xxx Elective</td>
<td>xx-xxx Elective</td>
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<tr>
<td>xx-xxx General Education Course</td>
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<td><strong>Total:</strong> 48</td>
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</tbody>
</table>

### If you choose Option 1, you do not have to overload any semester; however, this model makes for a challenging and loaded senior yr. - The Social and Decision Sciences (88-xxx) and Heinz School (90-xxx) courses may be counted as General Education, humanities in-depth sequence and BME Electives. Minimum no. units to graduate: 385

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## Biomedical Engineering & Chemical Engineering Double Major - Option 1

### First Year

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<thead>
<tr>
<th>Fall Units</th>
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<tr>
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### Chemical Engineering Single Major - Option 2

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<tr>
<td>or 09-106</td>
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<td>15-100</td>
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### Chemical Engineering & Biomedical Eng. Double Major - Option 2

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If you choose to use Option 2 of the CHE/BME schedule you will have to overload in the fall of your sophomore year. However, since you will take a BME Domain in the spring of your junior year, you will have a light spring semester in your senior year. - The Social and Decision Sciences (88-xxx) and Heinz School (90-xxx) courses may be counted as General Education, humanities in-depth sequence and BME Electives. Minimum no. units to graduate: 385
### Civil & Environmental Engineering
#### Single Major

**First Year**

<table>
<thead>
<tr>
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### Civil & Environmental Engineering with Double Major in Biomedical Engineering

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As a Freshman you should take 42-101 Intro to Biomedical Engineering and either 03-121 Modern Biology or 03-23x Biochemistry. Minimum number of units required for degree: 364
## Electrical & Computer Engineering – Single Major

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<td>Object-Based Programming I (mini 2)</td>
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<td>21-116</td>
<td>Integral Calculus</td>
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<td>Integration and Differential Equations</td>
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*As a Freshman you should take 42-101 Intro to Biomedical Engineering and either 03-121 Modern Biology or 231 or 232 Biochemistry. Also note that the Social & Decision Science courses (88-xxx or 90-xxx) may be counted as both General Education and as BHE Electives. See list of ECE courses: any 18-3XX course that focuses on signal processing can be counted as ELECTIVE courses in BHE.

*Minimum no. of units to graduate: 360 (an average of 45 units per semester)
**Materials Science & Engineering Single Major**

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* Suggested Depth Courses

As a Freshman you should take 42-101 Intro to Biomedical & Health Engineering and either 03-121 Modern Biology or 03-23X Biochemistry. - Also note that the Social & Decision Science courses may count as both General Education and as BME Electives. Minimum no. of units to graduate: 385

---

**Materials Science & Engineering and Biomedical Engineering Double Major**

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<td>BHE Domain Course</td>
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* Suggested Depth Courses

As a Freshman you should take 42-101 Intro to Biomedical & Health Engineering and either 03-121 Modern Biology or 03-23X Biochemistry. - Also note that the Social & Decision Science courses may count as both General Education and as BME Electives. Minimum no. of units to graduate: 385
## Mechanical Engineering - Single Major

### First Year

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<th>Spring</th>
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<td>Differential Calculus</td>
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<td>Integral Calculus</td>
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<td>21-118</td>
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<td>Fundamentals of Mechanical Eng.</td>
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<td>xx-xxx</td>
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<td>33-106</td>
<td>Physics for Engineering Students I</td>
<td>12</td>
<td>xx-xxx</td>
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<td>Calculus in Three Dimensions</td>
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<td>21-260</td>
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<td></td>
<td>24-221</td>
<td>Thermodynamics I</td>
<td>10</td>
<td>24-231</td>
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<td>24-261</td>
<td>Statistics of Deformable Solids</td>
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<td>Restricted Technical Elective</td>
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<td>General Education Course</td>
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### Third Year

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<td>Heat Transfer</td>
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<td>Dynamics</td>
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<td>or</td>
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<td>Engineering Design</td>
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## Mechanical Engineering & Biomedical Engineering Double Major

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<td>Integral Calculus</td>
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<td>Fundamentals of Mechanical Eng.</td>
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<td>42-301</td>
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<td>Physics for Engineering Students I</td>
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<td>Writing/Expression Course</td>
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### Second Year

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<th>Units</th>
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<tr>
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<td>21-260</td>
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### Third Year

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<th>Units</th>
<th>Spring</th>
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### Fourth Year

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<th>Spring</th>
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* Suggested Depth Courses

*As a Freshman you should take 42-101 Intro to Biomedical Engineering and either 03-121 Modern Biology or 03-231 or 03-232 Biochemistry. Social & Decision Science courses may be counted as both General Education and as BMES Electives. Minimum no. of units to graduate: 380
Faculty

Cristina Amon, Faculty of Biomedical Engineering; Professor of Mechanical Engineering; Director, Institute for Complex Engineered Systems — ScD 1988, Massachusetts Institute of Technology; Carnegie Mellon 1988—.

Bruce Armitage, Faculty, Biomedical Engineering; Assistant Professor of Chemistry, Mellon College of Science — PhD Chemistry, 1993, University of Arizona; Carnegie Mellon 1997—.

John Anderson, Dean, College of Engineering; University Professor of Chemical Engineering; Robert Mehrabian Professor; Faculty of Biomedical Engineering — PhD 1971, University of Illinois; Carnegie Mellon 1976—.

Amy Burkert, Faculty of Biomedical Engineering; Director of the Health Professions Program in Mellon College of Science; Associate Department Head for Undergraduate Affairs in the Department of Biological Sciences, Mellon College of Science — PhD Carnegie Mellon; Carnegie Mellon 1990—.

Jonathan Cagan, Faculty of Biomedical Engineering; Professor of Mechanical Engineering and Computer Science — PhD 1990, University of California at Berkeley; Carnegie Mellon 1990—.

Phil Campbell, Faculty of Biomedical Engineering; Visiting Senior Research Scientist, Institute for Complex Engineered Systems — PhD 1990, University of California at Berkeley; Carnegie Mellon 1990—.

Michael Domach, Faculty of Biomedical Engineering; Professor of Chemical Engineering — PhD 1983, Cornell University; Carnegie Mellon 1983—.

Charles Ettenson, Faculty of Biomedical Engineering; Associate Professor, Mellon College of Science — PhD, Yale University; Carnegie Mellon 1987—.

Omar Ghattas, Faculty of Biomedical Engineering; Associate Professor of Civil & Environmental Engineering — PhD 1988, Civil Engineering, Duke University; Carnegie Mellon 1989—.

Chien Ho, Faculty of Biomedical Engineering; Professor, Mellon College of Science — PhD 1961, Yale University; Carnegie Mellon 1979—.

Jeffrey Hollinger, Professor of Biomedical Engineering and Professor of Biological Sciences; Director, Bone Tissue Engineering Center — PhD University of Maryland, DDS Baltimore College of Dental Surgery; Carnegie Mellon 2000—.

Takeo Kanade, Faculty of Biomedical Engineering; U.A. and Helen Whitaker Professor of Computer Science and Robotics; Director of the Robotics Institute — PhD 1974, Electrical Engineering, Kyoto University, Japan; Carnegie Mellon 1980—.

Prashant Kumta, Faculty of Biomedical Engineering; Professor of Materials Science & Engineering; Advanced Ceramics Research Group — PhD 1990, University of Arizona; Carnegie Mellon 1990—.

Kacey Marra, Faculty of Biomedical Engineering; Research Scientist, Institute for Complex Engineered Systems (ICES) — PhD 1996, Organic Chemistry, University of Pittsburgh; Carnegie Mellon 1997—.

Robert Murphy, Faculty of Biomedical Engineering; Associate Professor, Mellon College of Science — PhD 1980, California Institute of Technology; Carnegie Mellon 1983—.

Henry Piehler, Faculty of Biomedical Engineering; Professor of Materials Science & Engineering and Public Policy — ScD 1967, Metallurgy, Massachusetts Institute of Technology; Carnegie Mellon 1967—.

Todd Przybyciien, Head of Biomedical Engineering; Associate Professor of Chemical Engineering — PhD 1989, California Institute of Technology; Carnegie Mellon 1995—.

Gordon Rule, Faculty of Biomedical Engineering; Associate Professor of Biology, Mellon College of Science — PhD, Carnegie Mellon University; Carnegie Mellon 95—.

Sunil Saigal, Faculty of Biomedical Engineering; Professor of Civil & Environmental Engineering — PhD 1985, Purdue University; Carnegie Mellon 1989—.

James Schneider, Faculty of Biomedical Engineering; Assistant Professor of Chemical Engineering — Ph.D. 1998, University of Minnesota; Carnegie Mellon 1999—.

Richard Stern, JR., Faculty of Biomedical Engineering; Professor of Electrical & Computer Engineering — PhD 1976, Massachusetts Institute of Technology; Carnegie Mellon 1977—.

Robert Tilton, Faculty of Biomedical Engineering; Associate Professor of Chemical Engineering — PhD 1991, Stanford University; Carnegie Mellon 1992—.

Jeanne Vanbiessem, Faculty of Biomedical Engineering; Assistant Professor of Civil & Environmental Engineering — Ph.D. 1998, Civil (Environmental) Engineering, Northwestern University; Carnegie Mellon 1999—.

Helmut Vogel, Faculty of Biomedical Engineering; Professor of Physics, Mellon College of Science — PhD Physics, University of Erlangen—Nuremberg, Germany; Carnegie Mellon 1983—.

Alan Waggoner, Faculty of Biomedical Engineering; Director, Science & Technology Center; Professor, Mellon College of Science – PhD University of Oregon; Carnegie Mellon University 1982—.

Lee Weiss, Faculty of Biomedical Engineering; Principal Research Scientist, The Robotics Institute – PhD 1984, Electrical & Computer Engineering, Carnegie Mellon University; Carnegie Mellon 1984—.
Chemical engineering is a broad discipline based on chemistry, mathematics, physics and biology that applies the principles of engineering science and computational tools in 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 transfer 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 electronics, pharmaceutical and biotechnology industries, including business consulting. 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). Moreover, exciting new opportunities exist in biotechnology, the computer industry, environmental firms, and consulting companies. For instance, the pharmaceutical industry recruits chemical engineers who possess expertise in both process engineering and biochemistry/molecular biology. 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 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 features state-of-the-art experiments that illustrate applications in safety, environment, product development, and computerized data acquisition and control.

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 majoring in Chemical Engineering 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 overloads, this degree could be awarded during the B.S. graduation, or after one additional semester.

### Curriculum

#### First Year

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<th>Units</th>
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<td>Integral Calculus</td>
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<td>76-xxx</td>
<td>Designated Writing/Expression Course</td>
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<td>09-101</td>
<td>Computing Skills Workshop</td>
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<td>Intro to Chemical Engineering</td>
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<td>Intro to Modern Chemistry</td>
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<td>Integration and Differential Equations</td>
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#### Second Year

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</table>

* Computer Science/Physics II: Students should complete 15-100(Introductory/Intermediate Programming) as well as 33-107 (Physics for Engineering Students II) by the end of the Sophomore year.

For those students who have not taken 06-100 as one of the two Introductory Engineering Electives, 06-100 should be taken in the Fall Semester of the Sophomore year. The General Education Course normally taken during that semester may be postponed until the Junior year. These students should consult with their faculty advisors as soon as possible.

At the end of the Sophomore year, a student should have completed the following required basic science and computer science courses.

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<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry</td>
</tr>
<tr>
<td>09-206</td>
<td>Physical Principles of Analytical Chemistry</td>
</tr>
<tr>
<td>(or 09-106)</td>
<td>Modern Chemistry II</td>
</tr>
<tr>
<td>09-221</td>
<td>Lab I: Introduction to Chemical Analysis</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
</tr>
<tr>
<td>33-106</td>
<td>Physics for Engineering Students I</td>
</tr>
<tr>
<td>33-107</td>
<td>Physics for Engineering Students II</td>
</tr>
<tr>
<td>99-101</td>
<td>Computing Skills Workshop</td>
</tr>
</tbody>
</table>
### Third Year

<table>
<thead>
<tr>
<th><strong>Fall</strong></th>
<th><strong>Units</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>06-321 Chemical Engineering Thermodynamics</td>
<td>9</td>
</tr>
<tr>
<td>06-322 Junior Chemical Engineering Seminar</td>
<td>2</td>
</tr>
<tr>
<td>06-323 Heat and Mass Transfer</td>
<td>9</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-347 Advanced Physical Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th><strong>Units</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
</tr>
<tr>
<td>06-361 Unit Operations of Chemical Engineering</td>
</tr>
<tr>
<td>06-362 Chemical Engineering Process Control</td>
</tr>
<tr>
<td>06-363 Transport Processes Laboratory</td>
</tr>
<tr>
<td>03-232 Biochemistry**</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Fourth Year</strong></th>
<th><strong>Fall</strong></th>
<th><strong>Units</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>06-421 Chemical Process Systems Design</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>06-423 Chemical Reaction Engineering</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>xx-xxx Unit Operations Laboratory</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th><strong>Units</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
</tr>
<tr>
<td>06-461 Process Design Project</td>
</tr>
<tr>
<td>06-462 Economics and Optimization</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
</tr>
</tbody>
</table>

**Notes:**
1. In addition to the graduation requirement of an overall QPA of 2.0 (not counting the First Year), the Department of Chemical Engineering requires a cumulative QPA of 2.0 in all chemical engineering courses (all those numbered 06-xxx).
2. Minimum number of units required for graduation: 385.
3. Electives: A total of 36-40 units is required for graduation. Students must select a minimum of 36 units from the following electives: Chemical Engineering Sciences (excluding Process Systems Track) and Chemical Engineering Process Systems. A maximum of 9 units of ROTC or Physical Education can be counted toward these electives. The other 27 units must be selected from the entire catalogue of graduate courses (all those numbered 600+).

### Process Systems Track

<table>
<thead>
<tr>
<th><strong>Units</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
</tr>
<tr>
<td>06-200, 300, or 400 Sophomore, Junior, or Senior Research Projects (or 39-500 CIT Honors Research)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Units</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>06-606 Computational Methods for Large Scale Process Design and Analysis</td>
</tr>
<tr>
<td>06-608 Safety Issues in Science and Engineering Practice</td>
</tr>
<tr>
<td>06-619 Semiconductor Processing Technology</td>
</tr>
<tr>
<td>06-630 Atmospheric Chemistry Air Pollution and Global Change</td>
</tr>
<tr>
<td>06-708 Advanced Process Dynamics and Control</td>
</tr>
<tr>
<td>06-713 Mathematical Techniques in Chemical Engineering</td>
</tr>
<tr>
<td>06-715 Advanced Process Synthesis</td>
</tr>
<tr>
<td>06-717 Biotechnology and Environmental Processes</td>
</tr>
<tr>
<td>06-720 Advanced Process Systems Engineering</td>
</tr>
<tr>
<td>06-721 Bio Process Design</td>
</tr>
<tr>
<td>12-271 Introduction to Computer Applications in Civil &amp; Environmental Engineering</td>
</tr>
<tr>
<td>12-411 Engineering Economics</td>
</tr>
<tr>
<td>12-651 Air Quality Engineering</td>
</tr>
<tr>
<td>12-655 Water Quality Engineering</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
</tr>
<tr>
<td>15-200 Data Structures</td>
</tr>
<tr>
<td>21-127 Introduction to Modern Mathematics</td>
</tr>
<tr>
<td>15-211 Fundamental Structures of Computer Science</td>
</tr>
<tr>
<td>18-370 Fundamentals of Control</td>
</tr>
<tr>
<td>19-420 Chemical Technologies the Environment and Society</td>
</tr>
<tr>
<td>19-424 Energy-Environment Systems</td>
</tr>
<tr>
<td>21-292 Introduction to Operations Research</td>
</tr>
<tr>
<td>24-451 Feedback Control Design</td>
</tr>
<tr>
<td>27-322 Processing Methods</td>
</tr>
<tr>
<td>36-220 Engineering Statistics and Quality Control</td>
</tr>
<tr>
<td>39-405 Engineering Design: Creation of Products and Processes</td>
</tr>
<tr>
<td>70-371 Production and Operations Management</td>
</tr>
<tr>
<td>70-391 Finance</td>
</tr>
</tbody>
</table>

### Chemical Engineering Sciences Track

<table>
<thead>
<tr>
<th><strong>Units</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
</tr>
<tr>
<td>06-200, 300, or 400 Sophomore, Junior, or Senior Research Projects (or 39-500 CIT Honors Research)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Units</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>06-607 Physical Chemistry of Colloids and Surfaces</td>
</tr>
<tr>
<td>06-608 Safety Issues in Science and Engineering Practice</td>
</tr>
<tr>
<td>06-426 Experimental Colloid and Surface Science</td>
</tr>
<tr>
<td>06-609/09-509 Physical Chemistry of Macromolecules</td>
</tr>
<tr>
<td>06-610/09-545 Rheology and Structure of Complex Fluids</td>
</tr>
<tr>
<td>06-640 Principles and Applications of Molecular Simulation</td>
</tr>
<tr>
<td>06-466 Experimental Polymer Science</td>
</tr>
<tr>
<td>06-619 Semiconductor Processing Technology</td>
</tr>
<tr>
<td>06-620 Global Atmospheric Chemistry: Fundamentals and Data Analysis Methods</td>
</tr>
<tr>
<td>06-702 Advanced Reaction Kinetics</td>
</tr>
<tr>
<td>06-703 Advanced Fluid Dynamics</td>
</tr>
<tr>
<td>06-704 Advanced Heat and Mass Transfer</td>
</tr>
<tr>
<td>06-705 Advanced Chemical Engineering Thermodynamics</td>
</tr>
<tr>
<td>06-712 Colloids and Dispersions</td>
</tr>
<tr>
<td>06-713 Mathematical Techniques in Chemical Engineering</td>
</tr>
<tr>
<td>06-714 Surfaces and Adsorption</td>
</tr>
<tr>
<td>06-716 Electrochemical Engineering</td>
</tr>
<tr>
<td>06-717 Biotechnology and Environmental Processes</td>
</tr>
<tr>
<td>06-721 Bio Process Design</td>
</tr>
<tr>
<td>03-231 Biochemistry I</td>
</tr>
<tr>
<td>03-240 Cell Biology</td>
</tr>
<tr>
<td>03-330 Genetics</td>
</tr>
<tr>
<td>03-380 Virology</td>
</tr>
<tr>
<td>03-438 Physical Biochemistry</td>
</tr>
<tr>
<td>03-441 Molecular Biology of Prokaryotes</td>
</tr>
<tr>
<td>03-442 Molecular Biology of Eukaryotes</td>
</tr>
<tr>
<td>09-248 Inorganic Chemistry</td>
</tr>
<tr>
<td>09-510 Introduction to Environmentally Benign Chemistry</td>
</tr>
<tr>
<td>12-651 Air Quality Engineering</td>
</tr>
<tr>
<td>12-655 Water Quality Engineering</td>
</tr>
<tr>
<td>21-372 Partial Differential Equations</td>
</tr>
<tr>
<td>24-321 Thermal-Fluids Engineering</td>
</tr>
<tr>
<td>27-357 Issues in Materials Selection</td>
</tr>
<tr>
<td>33-107 Physics for Engineering Students II</td>
</tr>
<tr>
<td>33-211 Physics III: Modern Essentials</td>
</tr>
<tr>
<td>33-225 Quantum Physics and Structure of Matter</td>
</tr>
<tr>
<td>33-228 Electronics</td>
</tr>
<tr>
<td>42-301 Physiology</td>
</tr>
<tr>
<td>42-604 Biological Transport</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 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 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 GSIA, 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 sections 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 units
- 06-607 Physical Chemistry of Colloids and Surfaces 9 units
- 06-426 Experimental Colloid and Surface Science 9 units
- 06-466 Experimental Polymer Science 9 units
- 06-609 Physical Chemistry of Macromolecules 9 units (cross-listed as 09-509)

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 internship after completion of the Junior year. Following the internship, students return to complete their Senior year. There are several advantages of a 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 important 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 QPA of 3.0. Junior and Senior undergraduates from the department may apply to the MChE program if they have an overall QPA of 3.0. Three letters of recommendation from professors within the department 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, Dean of CIT, University Mehrabian 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—.

ETHEL Z. CASASSA, Associate Professor Emerita of Chemical Engineering — Ph.D., Columbia University; Carnegie Mellon, 1974—.

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 — Ph.D., University of California, Berkeley; Carnegie Mellon, 1992—.

IGNACIO E. GROSSMANN, University Dean Professor of Chemical Engineering; Head of Department — Ph.D., Imperial College, University of London; Carnegie Mellon, 1979—.

STEINAR HAUAN, Assistant Professor of Chemical Engineering — Ph.D., Norwegian Institute of Science and Technology; Carnegie Mellon, 1996—.

ANNETTE M. JACOBSON, Principal Lecturer in Chemical Engineering and Director of Colloids, Polymers, and Surfaces Program — Ph.D., Carnegie Mellon; Carnegie Mellon, 1988—.

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. PRZYBYCIEN, Professor of Chemical Engineering and Head of Biomedical Engineering, Ph.D., California Institute of Technology; Carnegie Mellon, 1998—.

JAMES W. SCHNEIDER, Assistant 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, Associate 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, University Swearingen Professor of Chemical Engineering — Ph.D., D.I.C., 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 communication skills because of the complexity of large projects 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 minor programs, 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 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 Philosophy

The faculty in the Department of Civil and Environmental Engineering has developed a broad curriculum. Our undergraduates go into many fields of professional practice, and the curriculum is intended to be sufficiently flexible to accommodate various career paths. Today the MS degree is increasingly considered the professional level degree for engineers, so the curriculum accommodates breadth in professional development with the expectation that specialization will be addressed in graduate studies. Our required courses build a set of common concepts and problem formulation and solution skills, while providing exposure to several specialty areas in civil engineering. We believe a student’s experience in problem solving should go beyond introductory courses, and we have selected mechanics as a required topic to be explored in some depth.

Our philosophy on elective courses is 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 our students should attain appropriate “hands on” experiences though laboratory work and project activities in order to develop physical and intuitive understanding of engineered systems. Students are encouraged to participate in research projects.

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 graphics, speech and words.
- 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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105 Modern Chemistry I</td>
<td>10</td>
</tr>
<tr>
<td>09-101 Intro to Experimental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>21-115 Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-116 Integral Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-117 Integration and Differential Equations</td>
<td>5</td>
</tr>
<tr>
<td>21-118 Calculus of Approximations</td>
<td>5</td>
</tr>
<tr>
<td>33-106 Physics for Engineering Students I</td>
<td>12</td>
</tr>
<tr>
<td>33-107 Physics for Engineering Students II</td>
<td>12</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-100 Introduction to Civil and Environmental Engineering</td>
<td>12</td>
</tr>
<tr>
<td>21-115 Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-116 Integral Calculus</td>
<td>5</td>
</tr>
<tr>
<td>33-106 Physics for Engineering Students I</td>
<td>12</td>
</tr>
<tr>
<td>99-103 Computer Skill Workshop</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx-xxx Introduction to Engineering (other than CEE)</td>
<td>12</td>
</tr>
<tr>
<td>21-117 Integration and Differential Equations</td>
<td>5</td>
</tr>
<tr>
<td>21-118 Calculus of Approximations</td>
<td>5</td>
</tr>
<tr>
<td>33-107 Physics for Engineering Students II</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-251 Introduction to Environmental Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-252 Environmental Lab</td>
<td>3</td>
</tr>
<tr>
<td>12-271 Intro Computer Apps in Civil &amp; Environmental Engineering</td>
<td>9</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>
</tr>
<tr>
<td>xx-xxx H&amp;SS Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-235 Statics</td>
<td>9</td>
</tr>
<tr>
<td>21-280 Differential Equations</td>
<td>9</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

*Notes:
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

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-301 Civil and Environmental Engineering Projects</td>
<td>12</td>
</tr>
<tr>
<td>12-331 Solid Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>12-332 Solid Mechanics Lab</td>
<td>3</td>
</tr>
<tr>
<td>27-357 Materials Selection</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
</tr>
</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-355 Fluid Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>12-356 Fluid Mechanics Lab</td>
<td>3</td>
</tr>
<tr>
<td>12-335 Soil Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>12-336 Soil Mechanics and Materials Lab</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective 2</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective 3</td>
<td>9</td>
</tr>
</tbody>
</table>

Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-401 Civil and Environmental Engineering Design</td>
<td>12</td>
</tr>
<tr>
<td>12-411 Engineering Economics</td>
<td>9</td>
</tr>
<tr>
<td>36-211/220 Prob &amp; Stat or Engr Stat and Qual Control</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx 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>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-600 AutoCAD</td>
<td>9</td>
</tr>
<tr>
<td>12-605 Design and Construction</td>
<td>9</td>
</tr>
<tr>
<td>12-611 Project Management for Construction</td>
<td>9</td>
</tr>
<tr>
<td>12-631 Structural Design</td>
<td>9</td>
</tr>
<tr>
<td>12-636 Geotechnical Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-657 Water Resources Engineering</td>
<td>9</td>
</tr>
<tr>
<td>15-211 Fundamental Structures of Computer Science I</td>
<td>9</td>
</tr>
<tr>
<td>18-100 Introduction to Electrical and Computer Engineering</td>
<td>9</td>
</tr>
<tr>
<td>21-228 Discrete Mathematics</td>
<td>9</td>
</tr>
<tr>
<td>21-241 Matrix Algebra</td>
<td>9</td>
</tr>
</tbody>
</table>

Environmental Engineering

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-611 Project Management for Construction</td>
<td>9</td>
</tr>
<tr>
<td>12-657 Water Resources Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-655 Water Quality Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-656 Water Quality Engineering Laboratory</td>
<td>9</td>
</tr>
<tr>
<td>12-651 Air Quality Engineering</td>
<td>9</td>
</tr>
<tr>
<td>06-151 Thermodynamics</td>
<td>9</td>
</tr>
<tr>
<td>06-152 Principles of Transport Processes I</td>
<td>9</td>
</tr>
<tr>
<td>06-630 Atmospheric Chemistry, Air Pollution and Global Change</td>
<td>9</td>
</tr>
<tr>
<td>09-510 Introduction to Green Chemistry</td>
<td>9</td>
</tr>
</tbody>
</table>
Structures, Mechanics and Geotechnical Engineering

12-600 Auto CAD
12-605 Design and Construction
12-611 Project Management for Construction
12-635 Structural Analysis
12-631 Structural Design
12-636 Geotechnical Engineering
21-228 Discrete Mathematics
21-241 Matrix Algebra
24-203 Stress Analysis
24-242 Engineering Vibrations
24-251 Engineering Analysis

Double Majors and Minors

Civil engineers 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 BS/MS 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—.

ADAMS, PETER, 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, Principal Lecturer 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 F. DAVIDSON, Professor of Civil and Environmental Engineering and Director, Environmental Institute — Ph.D., California Institute of Technology; Carnegie Mellon, 1977—.

DAVID A. DZOMBOK, 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, 1996—.

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—.

DEBORAH A. LANGE, Research Engineer of Civil and Environmental Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1997—.

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—.

MARK E. PATTON, Research Engineer of Civil and Environmental Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1999—.

DANIEL R. REHAK, Professor of Civil and Environmental Engineering — Ph.D., University of Illinois; Carnegie Mellon, 1981—.

SUNIL SAIGAL, Professor of Civil and Environmental Engineering — Ph.D., Purdue University; Carnegie Mellon, 1989—.

MITCHELL J. SMALL, Professor of Civil and Environmental Engineering and Engineering and Public Policy — Ph.D., University of Michigan; Carnegie Mellon, 1982—.

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 and Philip and Marsha Dowd Professor of Engineering and Robotics
Tuvia E. Schlesinger, Associate Head and Professor of Electrical and Computer Engineering
Charles P. Neuman, Undergraduate Advisor and Professor of Electrical and Computer Engineering
Undergraduate Office: Hamerschlag Hall 1109
http://www.ece.cmu.edu/

The nature of electrical and computer engineering has changed significantly over the course of the careers of most electrical and computer engineers in the profession today. Today, electrical and computer engineering as a discipline encompasses a remarkably diverse and fertile set of technological areas, including, for example, analog and digital electronics, computer architecture, computer-aided design, nanotechnology, VLSI/ULSI designs, microprocessors, low-power circuits, controller-based control systems, telecommunications and computer networking, wireless communication systems, signal and information processing and multimedia systems, solid state physics and devices, 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 field of Electrical and Computer Engineering encompasses a wide spectrum of areas including electronic materials, devices, integrated circuits, computers, communications networks, control systems, power systems, information storage systems, robotics, and more. During the last 50 years the field has made remarkable advances and has impacted nearly every aspect of human activity. Advances in this field 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, monitoring and so on. The advanced communications and networking systems used today have fundamentally altered the manner in which business is conducted and the wealth of information concerning events around the world which is available to individuals. 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 today. The technological advances of the past several decades have altered the face of industry and educational institutions alike. The Department of Electrical and Computer Engineering at Carnegie Mellon is actively engaged in education and research at the forefront of these new technologies.

Fifty years ago electronics was based upon the vacuum tube. Thirty-five years ago, electronics had largely converted to the transistor, and the use of integrated circuits was beginning. Twenty-five years ago, development of the technology of microelectronics and very large scale integration (VLSI) that would lead to the computer revolution of the 80’s had begun. Twenty years ago the basic building blocks of the Internet as we know today were being put in place: the development of technologies leading to the world wide web started less than ten years ago, and only a few years ago the infrastructure for cell phones was being put in place. This exponential growth in the impact of the field of Electrical and Computer Engineering on individuals and the society we live in is the result of significant research activity and its deployment (through industry) for the benefit of mankind.

Because of the diverse and broad nature of the field of Electrical and Computer Engineering and the significant growth in knowledge in each of the sub areas, it is no longer possible for any single individual to know all aspects of electrical and computer engineering. At the same time, it is very important that all electrical and computer engineers have a solid knowledge of the fundamentals while demonstrating depth and breadth. Recognizing the ever changing nature of the technologies and the field of Electrical and Computer Engineering, the department has been actively engaged in structuring a curriculum and delivering an education that would train world-class electrical and computer engineers.

The B. S. in Electrical and Computer Engineering is a broad and highly flexible, ABET accredited degree program, based upon a recognition that Electrical and Computer Engineering is broad and multidimensional. The program is structured to provide students with the smallest set of constraints consistent with a rich and comprehensive view of the profession, as judged by the Faculty of the Department of Electrical and Computer Engineering.

The objectives of the B. S. in Electrical and Computer Engineering curriculum at Carnegie Mellon are:

- 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.
- To provide our students with the 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.
- To provide an environment that allows each student the opportunity to maximize her potential by providing the flexibility to pursue his interests and academic strengths and to thereby encourage flexibility in their thinking about their career.
- 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 or beyond engineering (such as social sciences and public policy).
- To develop in our students the ability to think in a sophisticated manner about systems and their careers. To encourage our students to always evaluate themselves and be engaged in lifelong learning.
- 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.
- 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.

Through consultation with the Undergraduate Advisor and the ECE Faculty members, students design a specific set of courses, tailored to satisfying individual interests and achieving their goals. Undergraduates also have the opportunity to receive a M.S. Degree in ECE by taking an additional 96 units (nominally eight 12 unit courses) of course work 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 course work 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. In the face of the ever increasing technological complexity of the work place, 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.

The department strongly believes in coupling the theoretical concepts introduced in the classroom with hands-on experience in laboratories or through projects. In order to accomplish this objective, the department maintains undergraduate laboratories that are well-equipped with state-of-the-art instruments and computers. In these laboratories students study, for example, the physical behavior of semiconductor devices such as transistors, design and experiment with electronic circuits, develop an understanding of real-time computer systems, and design and develop control systems. Design
experiences emphasize contemporary problems and provide a background for developing logic and computer design skills at the professional level. Students use instruments such as oscilloscopes for visualizing periodic signals, curve tracers for measuring the characteristics of transistors, function generators for producing voltage signals, and logic analyzers for investigating the performance of digital circuits. The laboratories are equipped with an ample number of state-of-the-art workstations for circuit simulation and analysis, real-time data acquisition, and processing and control activities.

The ECE Department is a leader in the innovation and use of computer-based educational tools. Computer-aided instruction has radically expanded the educational resources available to both faculty and students, and these new educational alternatives are having a major impact upon the ways in which students learn about and derive insights into engineering concepts. The Personal Computing Laboratory houses about 30 SUN workstations that are connected to a campus-wide network. These computers give students access to industry-standard computer-aided design and simulation programs, and to specifically developed software for departmental courses. In addition to regular course offerings, some advanced courses use the Personal Computing Laboratory to run software developed by the department's research centers. Several undergraduate courses routinely employ standard software packages such as MATLAB and the MATLAB toolboxes to tackle problems involving significant computation. In addition, the students have access to state-of-the-art computing facilities provided in clusters that are scattered across the campus.

Students are encouraged to participate in research by undertaking project work. Undergraduate projects not only provide the student with the opportunity to participate in the research programs of individual faculty members, but earn technical elective credits as well. The Department is home to several prestigious research centers, and research laboratories which provide a broad spectrum of research opportunities. These, for example, include:

- Data Storage Systems Center; Center for Silicon System Implementation; Center for Highly Integrated Information Processing and Storage Systems; Center for Computer and Communications Security; Carnegie Mellon – General Motors Satellite Research Laboratory; Center for Circuits, Systems and Software; Advanced Mechatronics Laboratory; Laboratory for Microelectromechanical (MEMS) systems; Parallel Data Laboratory; Laboratory for Computer Systems; Integrated Microsystems Laboratory; Laboratory for Signal Processing, Multimedia and Sensor Exploitation Systems; Center for Wireless and Broadband Networking; Laboratory for Advanced Networking and Internetworking.

In addition, the department faculty are involved in several multidisciplinary centers and institutes across campus that also allow students the opportunity to pursue research projects for academic credit or pay. These, for example, include:

- The Robotics Institute (RI)
- The Information Networking Institute (INI)
- Institute for Complex Engineered Systems (ICES)
- Institute for Software Research, International (ISRI)
- Institute for Complex Engineered Systems (ICES)
- Institute for Software Research, International (ISRI)
- Center for Automated Learning and Discovery (CALD)

Faculty in the department are involved in research that is both cutting-edge and multidisciplinary. Further, all research projects have the opportunity to involve undergraduate students with all levels of expertise (ranging from freshman to senior) and in all areas. The research within the department can be broadly classified into the following areas:

- Computer Engineering and Computer Systems; Embedded and Real-Time Software and Systems; Software Engineering and Adaptive Software; Computer-Aided Design and VLSI Manufacturing; Intelligent Robotic and Control Systems; Magnetics and Data Storage Systems; Micro-Electromechanical Systems (MEMS); Semiconductors Devices and Materials; Optical Computing and Optical Communications; Signal Processing and Communications; Multimedia and Speech Processing; Internetworking; Wireless Communications and Networking

For the detailed information and regulations of the curriculum along with the degree requirements and the most recent version of the ECE curriculum primer, research interests of the faculty and the faculty listing, and general information regarding the department please refer to the ECE World Wide Web Home Page:

http://www.ece.cmu.edu

An exemplary roadmap through our broad and flexible curriculum follows:

**B.S. Curriculum**

**Freshman Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>18-100 Introduction to Electrical &amp; Computer Engineering</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>21-115 Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>21-116 Integral Calculus</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>76-xxx Writing/Expression Course</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>99-100 Computer Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td><strong>44</strong></td>
</tr>
<tr>
<td>Spring</td>
<td>xx-xxx Introductory Engineering Elective</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>33-106 Physics for Engineering Students I</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>21-117 Integration and Differential Equations</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>21-118 Calculus of Approximation</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td><strong>43</strong></td>
</tr>
</tbody>
</table>

**Sophomore Year**

<table>
<thead>
<tr>
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<th>Course Description</th>
<th>Units</th>
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<tbody>
<tr>
<td>Fall</td>
<td>18-2x0 ECE Core Course</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>33-107 Physics for Engineering Students II</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td><strong>45/42</strong></td>
</tr>
<tr>
<td>Spring</td>
<td>18-2x0 ECE Core Course</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>18-205/21-xxx Mathematical Software in Engineering/Restricted Math Elective</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx ECE Breadth Course 1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td><strong>45/42</strong></td>
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**Junior Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Description</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Fall</td>
<td>xx-xxx ECE Breadth Course 2</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx ECE Breadth Course 3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx Probability and Statistics</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>xx-xxx Math/Science Elective 1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td><strong>51</strong></td>
</tr>
<tr>
<td>Spring</td>
<td>18-380 Junior Seminar</td>
<td>0</td>
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<tr>
<td></td>
<td>xx-xxx ECE Depth Course</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx ECE Coverage Course 1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx Engineering Elective</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

**Senior Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>xx-xxx Capstone Design (e.g., ECE Coverage Course 2)</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx Math/Science Elective 2</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>xx-xxx Free Elective</td>
<td>9/12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx Free Elective</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td><strong>45/48</strong></td>
</tr>
<tr>
<td>Spring</td>
<td>xx-xxx Free Elective</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx Free Elective</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx Free Elective</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

Minimum number of units required for degree: 360
(An average of 45 units per semester)
Notes on the Curriculum

Introductory Engineering Electives

Although shown in the Fall, Introduction to Electrical and Computer Engineering (18-100) may be taken in either semester of the Freshman Year, or as late as the Fall of the Sophomore year. However, the students who have not taken 18-100 by the end of the Freshman year should see the Undergraduate Advisor.

ECE Core

Students are required to take two fundamentals courses along with their associated Restricted Math Elective corequisites:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-220 Fundamentals of Electrical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>18-202 Mathematical Foundations of Electrical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>18-240 Fundamentals of Computer Engineering</td>
<td>12</td>
</tr>
<tr>
<td>21-127 Introduction to Modern Math (corequisite to 18-240)</td>
<td>9</td>
</tr>
</tbody>
</table>

Although the fundamentals courses may be taken in either order, students generally first take the course of their primary interest. This gives added flexibility to later course selections in related areas.

ECE Breadth

The courses in the ECE curriculum are grouped into five principal subject areas: Applied Physics, Signals and Systems, Circuits, Computer Hardware, and Computer Software. The courses in these areas are listed at the end of these notes. To satisfy the ECE Breadth requirement, at least one course must be completed from three of the five principal areas (nominally 36 units).

ECE Depth

At least one course (nominally 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.

ECE Coverage

At least two additional ECE curriculum courses are required (nominally 24 units). The courses used to satisfy this requirement may come from the Professional and Policy or Undergraduate Projects lists as well as the five principal area lists.

ECE Capstone Design Elective

One course from the following list must be taken (nominally 12 units).

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-517 Data Storage Systems Measurement and Design Laboratory</td>
<td>12</td>
</tr>
<tr>
<td>18-523 Analog Integrated Circuit Design</td>
<td>12</td>
</tr>
<tr>
<td>18-525 Integrated Circuit Design Project</td>
<td>12</td>
</tr>
<tr>
<td>18-544 Network Design and Evaluation</td>
<td>12</td>
</tr>
<tr>
<td>18-545 Advanced Digital Design Project</td>
<td>12</td>
</tr>
<tr>
<td>18-547 Advanced Computer Architecture</td>
<td>12</td>
</tr>
<tr>
<td>18-549 Distributed Embedded Systems</td>
<td>12</td>
</tr>
<tr>
<td>18-575 Control System Design</td>
<td>12</td>
</tr>
<tr>
<td>18-723 Advanced Analog Integrated Circuit Design</td>
<td>12</td>
</tr>
<tr>
<td>18-725 Digital Integrated Circuit Design</td>
<td>12</td>
</tr>
<tr>
<td>18-744 Hardware Systems Engineering</td>
<td>12</td>
</tr>
<tr>
<td>18-745 Rapid Prototyping of Computer Systems</td>
<td>12</td>
</tr>
<tr>
<td>18-778 Mechatronic Design</td>
<td>12</td>
</tr>
<tr>
<td>39-405 Engineering Design</td>
<td>12</td>
</tr>
<tr>
<td>39-500 CIT Honors Research Project (if advised and certified by ECE faculty member)</td>
<td>Variable</td>
</tr>
</tbody>
</table>

Engineering Elective

One additional engineering course (12 units) is required. Any technical course in CIT (with the exception of 18-202) or any 200 level or higher course in CS (with the exception of 15-251 and 15-351) will satisfy this requirement.

Probability and Statistics

One Probability and Statistics course is required (9 units). This requirement may be satisfied by 36-217, 36-220, or 36-225, 36-217 (a prerequisite for 18-345, Introduction to Telecommunications Networks and 18-450, Fundamentals of Communications Systems) 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. For students taking two probability and statistics courses, the first course will satisfy the probability and statistics requirement and the second course will fulfill a Math/Science Elective requirement.

Math/Science Electives

Two additional Math/Science Electives (18 units) are required. This requirement can be satisfied with any course that is technically oriented for engineering students in biology, chemistry, or physics; or any 200 level course or higher in Mathematics or Statistics except 09-103, 09-104, 21-257, 21-261, 33-106, 33-107, 33-124, 36-201 36-208, 36-209,and 36-210. 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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-228 Discrete Mathematics</td>
<td></td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td></td>
</tr>
<tr>
<td>21-260 Differential Equations</td>
<td></td>
</tr>
</tbody>
</table>

Free Electives

A Free Elective is defined as any graded course offered by any academic unit of the university (including research institutes such as the Robotics Institute and the Software Engineering Institute). A total of at least 51 units of Free Electives must be taken. Substitutions of courses from other high quality universities may be accepted through petition to the Associate Department Head or Undergraduate Advisor in consultation with the Undergraduate Education Committee. In the curriculum schedule shown above, all but two of the free elective courses have been assumed to be 12 units each. Under this assumption, the course load exceeds 45 units in at most two semesters. However, when choosing free electives outside of the ECE Department, courses may often be less than 12 units each. When such courses are chosen, additional semesters for which the course load exceeds 45 units may be required. ROTC and Physical Education courses will not be counted toward meeting the total units requirement. The large number of units without categorical constraints provides the student, in consultation with the Undergraduate Advisor, enormous flexibility to design a rich educational experience.

Policy on ECE Coverage Courses

with Fewer than 12 Units

The basic curriculum requirements for breadth, depth, coverage, and design are stated in terms of courses rather than units. The nominal total 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 this minimum. Any ECE coverage course is acceptable.

Presently, the breadth, depth, coverage and design courses sum to 72 units. Thus, if courses with fewer than 12 units are taken, additional courses from the ECE coverage lists must be taken until the total ECE units beyond the core meets or exceeds 72 units. 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. This policy applies only to units which can be counted toward degree requirements, as defined in the Free Elective note above.

To graduate, students must achieve a cumulative QPA of 2 or higher for all courses taken after the freshman year. In addition, a minimum QPA of 2 is required in the following nine courses: (totaling 108 units):

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-100 Introduction to Electrical and Computer Engineering</td>
<td></td>
</tr>
<tr>
<td>18-220 Fundamentals of Electrical Engineering</td>
<td></td>
</tr>
<tr>
<td>18-240 Fundamentals of Computer Engineering</td>
<td></td>
</tr>
<tr>
<td>xx-xx ECE Breadth course 1</td>
<td></td>
</tr>
<tr>
<td>xx-xx ECE Breadth course 2</td>
<td></td>
</tr>
<tr>
<td>xx-xx ECE Breadth course 3</td>
<td></td>
</tr>
<tr>
<td>xx-xx ECE Depth course</td>
<td></td>
</tr>
<tr>
<td>xx-xx ECE Coverage course 1</td>
<td></td>
</tr>
<tr>
<td>xx-xx ECE Coverage course 2</td>
<td></td>
</tr>
</tbody>
</table>

Note: The ECE Capstone Design course may also satisfy an ECE Depth or ECE Coverage requirement.

When more than one possibility exists for meeting a specific requirement (e.g., Breadth), the courses will be chosen 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.
ECE Cooperative Education Program
For many years, alumnae and potential employers and students have demonstrated a need and encouraged our Department of Electrical and Computer Engineering to establish an Undergraduate Cooperative Education Program. Over the 1995-1996 academic year this program was designed and we are gratified that potential employers throughout the country and the world are showing a great eagerness to hire our students for COOP employment.

The COOP experience begins in the Spring semester of the junior year. The ECE COOP comprises two phases. The first spans the eight-month period from January through August of the student’s third year at Carnegie Mellon and the optional second spans May through August following the student’s fourth year at Carnegie Mellon. The contiguous eight months of Phase I built upon our flexible curriculum is the unique feature of our COOP. The typical student will thus require 4.5 academic years from matriculation at Carnegie Mellon (but still eight semesters) to graduate. The accelerated student who will be able to complete our degree requirements in seven semesters will now graduate in four academic years. These students will only participate in the first phase of our ECE COOP program. We therefore require a minimum of eight months of COOP experience to identify the student as a COOP student on the transcript.

The students will apply to the ECE Undergraduate Office (the Associate Head and Undergraduate Advisor) for the program at the close of their sophomore year. To be eligible for the program, the students must have a minimum 3.0 QPA for their first four semesters. (The minimum 3 QPA is the admission requirement for our Integrated M.S./B.S. Degree Program.) The students are required to submit a formal application consisting of a transcript, a resume, and a one-page statement of purpose including a plan.

The Undergraduate Office monitors the list of acceptable employers, requires and then approves COOP JOB DESCRIPTIONS from these employers. While on the COOP 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 Undergraduate Office: a three to five page technical report of the COOP work, and a one page assessment and evaluation of the COOP experience.

Requirements for the Integrated M.S./B.S. Degrees Program
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 one of the requirements listed below. The requirements total 96 units (nominally eight 12 unit courses):

1. Of the 96 units, the College of Engineering requires that a minimum of 60 units must be at the ECE graduate level (700 level and above), including both course and project units.
   · At least 48 units of the 60 required ECE units must be ECE graduate-level courses (700 level and above).

2. 36 units additional units
   · 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) course may count toward the 96-unit requirement

*NOTE: No more than 15 units of project may be counted toward the 96-unit requirement.

Notes
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. 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 apply to the program during the spring semester of the junior year, or the semester in which they accumulate 270 or more units, whichever is earlier.

A total of 15 units of research can be used toward the M.S. degree. Additionally, only 12 units of graduate research (18-980) can be used to satisfy item 1. The remaining 3 units can be used towards item 2. Up to 15 units of 39-500, CIT Honors Project, can be used towards item 2; however, no additional research units can then be used to count towards the 96-unit requirement. You 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, submitted to the Associate Department Head and Undergraduate Advisor, and approved by them.

Students enrolled in the IMB program who do not complete the M.S. degree requirements within 8 semesters may maintain undergraduate standing. However, any student going beyond 8 semesters 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.

In the event that courses with fewer than 12 units are used to satisfy some of the M.S. requirements, additional courses from the same category must be taken to meet or exceed the unit requirement for that category.

Area Course Lists
In the following lists, courses satisfy one or more of the ECE requirements as indicated by the symbols:  B = Breadth, Ds = Design, Co = Coverage, Dp = Depth.

### Freshman Engineering and ECE Core

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-100</td>
<td>Introduction to Electrical and Computer Engineering</td>
<td>12</td>
</tr>
<tr>
<td>18-220</td>
<td>Fundamentals of Electrical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>18-240</td>
<td>Fundamentals of Computer Engineering</td>
<td>12</td>
</tr>
</tbody>
</table>

### ECE Mathematics

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-202</td>
<td>Mathematical Foundations of EE</td>
<td>12</td>
</tr>
</tbody>
</table>

### Applied Physics

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-303</td>
<td>Engineering Electromagnetics I (B, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-304</td>
<td>Engineering Electromagnetics II (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-311</td>
<td>Semiconductor Devices I (B, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-315</td>
<td>Introduction to Optical Communication Systems (B, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-316</td>
<td>Introduction to Data Storage Systems Technology (B, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-410</td>
<td>Physical Sensors, Transducers and Instrumentation (Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-412</td>
<td>Semiconductor Devices II (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-414</td>
<td>Introduction to Microelectromechanical Systems (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-501</td>
<td>Electromechanics (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-515</td>
<td>From Design to the Market for Deep Submicron ICs (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-517</td>
<td>Data Storage Systems Design (Dp, Ds, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-712</td>
<td>Opto-Electronics for Network (Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-713</td>
<td>Optical Networks (Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-715</td>
<td>Physics of Applied Magnetism (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-716</td>
<td>Advanced Applied Magnetism (Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-814</td>
<td>Microelectromechanical Systems (Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-815</td>
<td>Integrated Circuit Fabrication Processes (Co)</td>
<td>12</td>
</tr>
</tbody>
</table>

### Signals and Systems

<table>
<thead>
<tr>
<th>Units</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-370</td>
<td>Fundamentals of Control (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-396</td>
<td>Signals and Systems (B, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-450</td>
<td>Introduction to Digital Communication Systems (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-474</td>
<td>Real-Time Computer Control System Design (Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-551</td>
<td>Digital Communication and Signal Processing</td>
<td>12</td>
</tr>
<tr>
<td>18-552</td>
<td>Wireless Transmission Technologies (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-724</td>
<td>Microelectromechanical System Design (Dp, Co)</td>
<td>12</td>
</tr>
<tr>
<td>18-751</td>
<td>Applied Stochastic Processes (Co)</td>
<td>12</td>
</tr>
</tbody>
</table>
MOR HARCHOL-BALTER, Assistant Professor of Computer Science and Electrical and Computer Engineering — Ph.D., University of California at Berkeley; Carnegie Mellon, 1999—.

JAMES HOE, Assistant Professor of Electrical and Computer Engineering — Ph.D., Massachusetts Institute of Technology, Carnegie Mellon, 2000—.

JAMES F. HOBURG, Professor of Electrical and Computer Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1975—.

ANGEL JORDAN, Keithley University Professor Emeritus of Electrical and Computer Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1999—.

TAKEO KANADE, U.A. and Helen Whitaker Professor of Computer Science, Robotics and Electrical and Computer Engineering — Ph.D., Kyoto University; Carnegie Mellon, 1980—.

PRADEEP KHOSLA, Philip and Marsha Dowd Professor of Electrical and Computer Engineering and Robotics and Head of Electrical and Computer Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1986—.

HYONG S. KIM, Professor of Electrical and Computer Engineering — Ph.D., University of Pittsburgh; Carnegie Mellon, 1997—.

PHILIP J. KOOPMAN, Associate Professor of Electrical and Computer Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1989—.

BRUCE H. KROGH, Professor of Electrical and Computer Engineering — Ph.D., University of Illinois at Urbana-Champaign; Carnegie Mellon, 1983—.

MARK H. KRYDER, University Professor of Electrical and Computer Engineering; Director, Data Storage Systems Center — Ph.D., California Institute of Technology; Carnegie Mellon, 1978—.

R. V. K. VIJAYA KUMAR, Professor of Electrical and Computer Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1982—.

DAVID N. LAMBETH, Professor of Electrical and Computer Engineering; Associate Director, Data Storage Systems Center — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1989—.

DAVE LAUGHLIN, Professor of Material Science Engineering and Electrical and Computer Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1974—.

WOJCIECH MALY, U.A. and Helen Whitaker Professor of Electrical and Computer Engineering — Ph.D., Polish Academy of Sciences (Warsaw); Carnegie Mellon, 1986—.

DIANA MARCULESCU, Assistant Professor of Electrical and Computer Engineering — Ph.D., University of Southern California; Carnegie Mellon, 2000—.

RADU MARCULESCU, Assistant Professor of Electrical and Computer Engineering — Ph.D., University of Southern California; Carnegie Mellon, 2000—.

WILLIAM MESSNER, Associate Professor of Mechanical Engineering — Ph.D., University of California at Berkeley; Carnegie Mellon 1993—.

ARTHUR G. MILNES, Buhl Professor Emeritus of Electrical and Computer Engineering — D.Sc., University of Bristol, England; Carnegie Mellon, 1957—.

M. GRANGER MORGAN, Lord Professor of Electrical and Computer Engineering and Public Policy; Head, Department of Engineering and Public Policy — Ph.D., University of California, San Diego; Carnegie Mellon, 1974—.

JOSE’ N. F. MOURA, Professor of Electrical and Computer Engineering — Sc.D., Massachusetts Institute of Technology; Carnegie Mellon, 1986—.

TODD MOWRY, Associate Professor of Computer Science and Electrical and Computer Engineering — Ph.D., Stanford University; Carnegie Mellon, 1997—.

TAMAL MUKHERJEE, Senior Research Engineer — Ph.D., Carnegie Mellon University; Carnegie Mellon 1996—.

DAVID NAOLE, Senior Research Scientist, Computer Science and Electrical and Computer Engineering — Ph.D., The University of Michigan; Carnegie Mellon 1994—.

ROHIT NEGI, Assistant Professor of Electrical and Computer Engineering — Ph.D., Stanford University, Carnegie Mellon, 2000—.

CHARLES P. NEUMAN, Associate Professor of Electrical and Computer Engineering — Ph.D., Harvard University; Carnegie Mellon, 1969—.

ANDREAS NOWATZKY, Associate Professor of Computer Science and Electrical and Computer Engineering — Ph.D., Carnegie Mellon; Carnegie Mellon, 2001—.

DAVID O’HALLARON, Associate Professor of Computer Science and Electrical and Computer Engineering — Ph.D., University of Virginia; Carnegie Mellon, 1989—.

CHRIS PAREDIS, Research Scientist, Electrical and Computer Engineering and Institute for Complex Engineered Systems — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1996—.

JOANN PAUL, Research Engineer, Electrical and Computer Engineering — Ph.D., University of Pittsburgh; Carnegie Mellon, 1997—.

JON M. PEHA, Associate Professor of Electrical and Computer Engineering and Engineering and Public Policy — Ph.D., Stanford University; Carnegie Mellon, 1991—.

ADRIAN PERRUIG, Assistant Professor of Electrical and Computer Engineering — Ph.D., Carnegie Mellon; Carnegie Mellon, 2002—.

LAWRENCE T. PILEGGI, Professor of Electrical and Computer Engineering; Director, Center for Silicon System Implementation — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1996—.

RAGUNATHAN RAJKUMAR, Professor of Electrical and Computer Engineering; Director Real-Time and Multimedia Laboratory — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1992—.

RONALD A. ROHRER, Adjunct Professor of Electrical and Computer Engineering — Ph.D., University of California, Berkeley; Carnegie Mellon, 1974-75, 1985—.

ROB A. RUTENBAR, Steven J. Jatras Professor of Electrical and Computer Engineering and Computer Science; Director, Center for Circuits, Systems and Software — Ph.D., University of Michigan; Carnegie Mellon, 1984—.

TUFIJA E. SCHLESINGER, Associate Head and Professor of Electrical and Computer Engineering; Director, Carnegie Mellon-GM Satellite Research Laboratory — Ph.D., California Institute of Technology; Carnegie Mellon, 1985—.

HERMAN SCHMIT, Associate Professor of Electrical and Computer Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1995—.

SRINI SESHA, Associate Professor of Electrical and Computer Engineering — Ph.D., University of California, Berkeley, Carnegie Mellon 2000—.

PETER STEENKISTE, Associate 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 and Biomedical Engineering; Associate Director, Information Networking Institute — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1977—.

ANDREJ J. STROJWAS, Keithley Professor of Electrical and Computer Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1983—.

ROBERT M. UNETICH, Adjunct Professor of Electrical and Computer Engineering; Director, Center for Wireless and Broadband Networking — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1996—.

THOMAS SULLIVAN, Lecturer for Electrical and Computer Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1996—.

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ROBERT WHITE, University Professor of Electrical and Computer Engineering and Director of Data Storage Systems Center — Ph.D., Stanford University; Carnegie Mellon, 1993—.

HUI ZHANG, Associate Professor of Computer Science and Electrical and Computer Engineering — Ph.D., University of California at Berkeley; Carnegie Mellon 1999—.

JIAN-GANG ZHU, Professor of Electrical and Computer Engineering — Ph.D., University of California, San Diego; Carnegie Mellon, 1997—.
Essentially every technology depends on materials development and innovation. Materials Science & Engineering connects the atomic nature of matter to the use of materials for engineering solutions to problems: in common parlance, materials engineers look inside “stuff” to understand what makes it work. Novel technologies are as dependent on materials as ever, whether the product is improved optoelectronics for communications, prosthetics for joint replacement, batteries for portable computers, sensor materials for night-vision, or high strength-to-weight materials for airplanes. Advances in magnetic materials have made gigabyte disc drives affordable in the home; advances in materials development are anticipated to do the same for fuel cells. The overarching paradigm of materials science and engineering is to exploit the connection between microstructure and the properties of a material. Materials have an internal structure (microstructure), which must be understood at many different length scales from the atomic to the macroscopic in order to predict their behavior and to be able to engineer with them. It is also essential to understand how to process materials in order to obtain desirable microstructures and how the properties control the performance of the material in the engineering application. Essentially every successful technology has required the development of new materials and continues to do so. History in recent times is even defined by the advent of new materials as in the Bronze Age, Iron Age, and so on; indeed some refer to the current era as the Silicon Age. To quote Sir Alan Cottrell: This past century has seen an incredible change in developed society. It is the information revolution, based on radio, television, telecommunications of many kinds, computers everywhere, the Internet, intelligent monitoring and control systems, and a host of other services. One materials development has made all this possible: the silicon chip.

Materials Science & Engineering is therefore the discipline that applies the tools of basic and applied science to the refining, preparation, processing and manufacture of materials and devices. Graduates of the MSE department are pursuing careers in an expanding spectrum of companies, national laboratories, and universities. The activities cover a wide range and include microelectronics, energy storage, biomedical, aerospace, nuclear and primary materials production. Recycling of materials and substitution for scarce or expensive elements, energy conservation, pollution control, high temperature superconductors, light weight cars, composite materials and improved materials processing are just a few of the topics receiving active attention. Many of our undergraduates are able to participate in current research programs in the department, which they typically find very rewarding.

Materials Science and Engineering is a discipline which draws heavily on basic sciences such as chemistry, mathematics and physics, and also on engineering fundamentals, to refine, prepare, process, and manufacture materials which are useful for the technological needs of our society. The development of new materials, and the understanding and control of the structure and properties of new as well as existing materials, are essential parts of this discipline. Materials subjects fall into two broad areas: one dealing with the synthesis and processing of materials in order to obtain desired properties, and a second one which provides the basis to understand and predict the behavior of materials under diverse conditions. Thus a materials engineer or scientist is concerned with many different processes for synthesizing new materials, improvement of existing processing methods through engineering fundamentals, and using the techniques of both materials science and physics to understand the interplay between the internal structure of materials and their properties, whether physical, chemical or mechanical.

Materials science is the overarching term describing specific interests in metals, polymers, ceramics and electronic materials. It has become increasingly clear that the properties of all these types of materials are related fundamentally through parameters that describe internal structure. Furthermore, it has been found that the equipment and instrumentation, as well as the theoretical and analytical tools, which are necessary to process, study and understand 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, magnetic materials etc.

The standard curriculum of the department provides fundamental training for all of materials science and engineering areas. The core courses provide understanding and tools for working with the (atomic) structure of materials, the defects (dislocations, interfaces etc.) that largely govern their properties, the thermodynamic relationships that govern the stability of materials, and the rates at which changes take place in materials. The paradigm of materials science is that one must understand the internal structure of materials in order to predict and engineer their properties; this is addressed in the core courses on “Microstructure & Properties” and the capstone courses that deal with selection & performance of materials. The elective program allows the attainment of excellence in a student’s chosen specialty, whether it be ceramics, semiconductors, metals, magnetic materials, 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)

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 who find employment in industry, the program provides the foundation on which a company can build its 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. Our objectives for the BS program are therefore that students should have acquired the following set of skills and attributes.

Outcomes for students in the MSE BS Program

A. The 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.
B. An ability to apply core concepts in materials science (structure, properties, processing, and performance) to materials engineering problems.
C. An ability to communicate effectively.
D. An ability to design and conduct experiments with an emphasis on relating properties and processing to structure.
E. An ability to relate materials selection and performance to design of engineered systems and components.
F. An ability to function responsibly and ethically in a professional, multidisciplinary environment and as an individual member of a team.
G. An ability to employ the techniques, skills and tools of modern engineering practice in materials engineering.
H. Recognition of the need for lifelong scholarship.
I. A knowledge of contemporary issues.
J. The broad education necessary to understand the impact of engineering solutions in a global and societal context.
An industrial internship option (IIO - 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 coursework 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 IIO 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**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-115</td>
<td>Differential Calculus</td>
</tr>
<tr>
<td>21-116</td>
<td>Integral Calculus</td>
</tr>
<tr>
<td>33-106</td>
<td>Physics for Engineering Students I</td>
</tr>
<tr>
<td>27-100</td>
<td>Materials in Engineering*</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-117</td>
<td>Integration and Differential Equations</td>
</tr>
<tr>
<td>21-118</td>
<td>Calculus of Approximation</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Introductory Engineering Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
<tr>
<td>99-101</td>
<td>Computing Skills Workshop</td>
</tr>
</tbody>
</table>

**Sophomore Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
</tr>
<tr>
<td>33-107</td>
<td>Physics for Engineering Students II**</td>
</tr>
<tr>
<td>27-299</td>
<td>MSE Undergraduate Seminar (Session 1)</td>
</tr>
<tr>
<td>27-215</td>
<td>Thermodynamics of Materials</td>
</tr>
<tr>
<td>27-201</td>
<td>Perfect Crystals</td>
</tr>
<tr>
<td>27-202</td>
<td>Defects in Materials</td>
</tr>
</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>09-105</td>
<td>Modern Chemistry II**</td>
</tr>
<tr>
<td>09-101</td>
<td>Introduction to Experimental Chemistry**</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
<tr>
<td>27-216</td>
<td>Transport in Materials</td>
</tr>
<tr>
<td>27-217</td>
<td>Phase Relations and Diagrams</td>
</tr>
</tbody>
</table>

**Junior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx-xxx</td>
<td>Free Elective [1]</td>
</tr>
<tr>
<td>33-225</td>
<td>Quantum Physics and Structure of Matter</td>
</tr>
<tr>
<td>or 09-117</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>or 03-121</td>
<td>Modern Biology</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
<tr>
<td>27-399</td>
<td>MSE Undergraduate Seminar (Session 2)</td>
</tr>
<tr>
<td>27-xxxx</td>
<td>MSE Restricted Elective [1]**</td>
</tr>
<tr>
<td>27-301</td>
<td>Microstructure and Properties I</td>
</tr>
<tr>
<td>27-302</td>
<td>Microstructure and Properties II</td>
</tr>
</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-220</td>
<td>Engineering Statistics and Quality Control</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
<tr>
<td>27-xxxx</td>
<td>MSE Restricted Elective [3]</td>
</tr>
</tbody>
</table>

**Senior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
<tr>
<td>27-499</td>
<td>MSE Undergraduate Seminar (Session 3)</td>
</tr>
<tr>
<td>27-xxxx</td>
<td>MSE Restricted Elective [5]</td>
</tr>
<tr>
<td>27-401</td>
<td>MSE Capstone Course [1]</td>
</tr>
<tr>
<td>27-402</td>
<td>MSE Capstone Course [2]</td>
</tr>
</tbody>
</table>

**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.

- 27-322  | Processing of Metals  |
- 27-323  | Processing of Ceramic Materials  |
- 27-403  | MSE Capstone Course III  |
- 27-404  | MSE Capstone Course IV  |
- 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  |
- 27-642  | 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  |
- 27-789  | Magnetic Materials  |
- 06-314  | Experimental Polymer Science  |
- 06-609  | Physical Chemistry of Macromolecules  |
- 06-619  | Semiconductor Processing Technology  |
- 09-466  | Experimental Polymer Science  |
- 12-605  | Design and Construction  |
- 12-611  | Project Management for Construction  |
- 12-631  | Structural Design  |
- 18-311  | Semiconductor Devices I  |
- 18-312  | Semiconductor Devices II  |
- 24-262  | Mechanics of Materials  |
- 24-341  | Manufacturing Sciences  |
- 24-381  | Intermediate Stress Analysis  |
- 24-401  | Engineering Analysis  |
- 42-644  | Medical Devices  |
Industrial Internship Option (Cooperative Education Program)

The industrial internship option (ICO) unique to the Department of Materials Science and Engineering 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. More details may be found in the booklet entitled “The Industrial Internship Option.”

Freshman Year

Standard Program

Sophomore Year

Fall

Standard Program for the Fall semester; coop interviews in Fall

Spring

Industry 1

Summer

Units
21-260  Differential Equations 9
xx-xx  H&SS Elective 9
xx-xx  H&SS Elective 9
xx-xx  H&SS Elective 9

36

Junior Year

Fall

Industry 2

Spring

Units
09-105  Modern Chemistry I** 3
09-101  Introduction to Experimental Chemistry** 3
xx-xx  H&SS Elective 9
27-xx  MSE Restricted Elective [1]^ 6
27-216  Transport in Materials 9+3
27-217  Phase Relations and Diagrams 9+3

52

Summer

Industry 3

Senior Year

Fall

Units
xx-xx  Free Elective [1] 9
33-225  Quantum Physics and Structure of Matter 9
or 09-117  Organic Chemistry 9
or 03-121  Modern Biology 9
xx-xx  H&SS Elective 9
27-399  MSE Undergraduate Seminar (Session 2) 1
27-301  Microstructure and Properties I 6+3
27-302  Microstructure and Properties II 6+3

52

Spring

Units
36-220  Engineering Statistics and Quality Control 9
xx-xx  H&SS Elective 9

54

Summer

Industry 4

Fall

Units
27-499  MSE Undergraduate Seminar (session 3) 1
27-xx  MSE Restricted Elective [8] 6
27-401  MSE Capstone Course [1] 6
27-402  MSE Capstone Course [2] 6

49

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 (nominally eight 12 unit courses) 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, interested students 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 one of the requirements listed below. The requirements total 96 units (nominally eight 12 unit courses.) The 96 additional units needed to satisfy the M.S. degree component of the Integrated Program can not be used to satisfy any other requirements such as a double major or minor.

1. Course Option (96 units)

27-780  Thermodynamics 9
27-776  Foundations of Materials Science 9
27-779  Bonding in Crystalline Materials 9

• 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 9
27-776  Foundations of Materials Science 9
27-779  Bonding in Crystalline Materials 9

• plus 30 units of 500 or 700 level Materials Science and Engineering courses.

The Integrated M.S./B.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 27-403, 27-404 MSE Capstone Course III and IV 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—.

ALAN W. CRAMB, POSCO Professor and Head of Materials Science and Engineering — Ph.D., University of Pennsylvania; Carnegie Mellon, 1986—.

MARCI DE GRAEF, Professor of Materials Science and Engineering — Ph.D., Catholic University Leuven (Belgium); Carnegie Mellon, 1993—.

RICHARD J. FRUEHAN, University Professor and U.S. Steel Professor of Materials Science and Engineering — Ph.D., University of Pennsylvania; Carnegie Mellon, 1981—.

WARREN M. GARRISON, JR., Professor of Materials Science and Engineering — Ph.D., University of California at Berkeley; Carnegie Mellon, 1984—.

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, Assistant Professor of Materials Science and Engineering — Ph.D., Northwestern University; Carnegie Mellon, 1999—.

SRIKAR SEETHARAMAN, Assistant 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, Professor of Materials Science and Engineering and Electrical and Computer Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2001—.

PAUL WYNBLATT, Professor of Materials Science and Engineering — Ph.D., University of California at Berkeley; Carnegie Mellon, 1981—.

Emeritus Faculty

HUBERT I. AARONSON, Robert Franklin Mehl Professor Emeritus of Materials Science and Engineering — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1979—.

THADEUS B. MASSALS, Professor Emeritus of Physics, Materials Science and Engineering — Ph.D., D.Sc., University of Birmingham, England; D.Sc. (h), University of Warsaw; Carnegie Mellon, 1959—.

DAVID M. MOON, Part—time Instructor, Coordinator of Industrial Internship Option — Ph.D., Carnegie Mellon; Carnegie Mellon, 1998—.

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—.

Affiliated Faculty

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—.

ANDREW GELLMAN, Lord Professor, Chemical Engineering — Ph.D., University of California, Berkeley; Carnegie Mellon 1992—.

DAVID W. GREVE, Professor of Electrical and Computer Engineering — Ph.D., Lehigh University; Carnegie Mellon, 1982—.

DAVID LAMBETH, Professor, Electrical and Computer Engineering and Materials Science and Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon 1989—.

KACEY MARRA, Research Scientist, Institute for Complex Engineered Systems — Ph.D., University of Pittsburgh; Carnegie Mellon, 1997—.

ROBERT SEKERKA, University Professor, Physics, Mathematics and Materials Science — Ph.D., Harvard; Carnegie Mellon, 1969—.

JIAN-GANG ZHU, Professor, Electrical and Computer Engineering — Ph.D. University of California at San Diego, 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 creating new technologies 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; microelectromechanical acceleration and pressure sensors; heating, ventilation, and air conditioning systems; power generation systems; such biomedical and biomechanical devices 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 down-loaded to a multi-axis computer-controlled milling machine, from which the part is manufactured.

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 402.

Educational Objectives

The faculty of the Department of Mechanical Engineering have identified the following objectives for its undergraduate program which articulate at the highest level the Department’s needs and goals.

- To establish and maintain a world-class educational environment that involves the entire faculty and is based on an innovative teaching agenda.
• To assure that our teaching and curriculum prepare our graduates to successfully obtain and hold positions in industry nationwide, or to pursue graduate study in the nation’s top graduate schools.

• To provide a well-integrated curriculum that balances engineering science, problem-solving skills, and engineering tools and technologies.

• To assure that the curriculum is dynamic, forward-looking, and offers students the flexibility to tailor the academic program to their specific career objectives.

• To leverage our strong research agenda and our close contacts with industry for the benefit of the undergraduate program.

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).

Beginning in the Freshman year, students take one general education course each semester. In the Sophomore and Junior years, core sequences of required courses cover the fundamental subject matter of mechanical engineering. In addition, seven elective courses are available in order for students to build programs best suited to their individual interests and areas of specialization. Of the seven available electives, students take at least two electives from within the Mechanical Engineering Department. Of the remaining five electives, one can be any course offered by the University, and the other four can be courses except those in the areas of physical education and military science. Through consultation with a faculty advisor, students can use these electives to develop student-structured areas of concentration, minors, and double majors. A faculty advisor is assigned to each student prior to the beginning of the Sophomore year.

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>Fall</td>
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</tr>
<tr>
<td>21-115 Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-116 Integral Calculus</td>
<td>5</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></td>
<td>46</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>21-117 Integration and Differential Equations</td>
<td>5</td>
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<tr>
<td>21-118 Calculus of Approximation</td>
<td>5</td>
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<tr>
<td>xx-xxx Second Introductory Engineering Course</td>
<td>12</td>
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<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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<td></td>
<td>41-44</td>
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Sophomore Year

<table>
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<tbody>
<tr>
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<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></td>
<td>48-51</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
</tr>
<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>
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<tr>
<td>xx-xxx Restricted Technical Elective</td>
<td>10-13</td>
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<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
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Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
</tr>
<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-xxx Mechanical Engineering Technical Elective</td>
<td>9-12</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>53</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>24-371 Electromechanical Systems</td>
<td>10</td>
</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>
<td>9</td>
</tr>
<tr>
<td></td>
<td>44</td>
</tr>
</tbody>
</table>

Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
</tr>
<tr>
<td>24-401 Introduction to Mechanical Engineering</td>
<td>9-12</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></td>
<td>48-51</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>24-441 Engineering Design</td>
<td>12</td>
</tr>
<tr>
<td>24-xxx Engineering Analysis</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>
</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:  

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-115 Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-116 Integral Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-117 Integration and Differential Equations</td>
<td>5</td>
</tr>
<tr>
<td>21-118 Calculus of Approximation</td>
<td>5</td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>21-260 Differential Equations</td>
<td>9</td>
</tr>
<tr>
<td>33-106 Physics for Engineering Students I</td>
<td>12</td>
</tr>
<tr>
<td>33-107 Physics for Engineering Students II</td>
<td>12</td>
</tr>
<tr>
<td>09-101 Introduction to Experimental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-105 Modern Chemistry I</td>
<td>10</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>15-111 Intermediate/Advanced Programming</td>
</tr>
<tr>
<td>24-101 Introduction to Mechanical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx Second Introductory Engineering Course</td>
<td>12</td>
</tr>
</tbody>
</table>

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. In 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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-107</td>
<td>Physics for Engineering Students II</td>
<td>12</td>
</tr>
<tr>
<td>09-101</td>
<td>Introduction to Experimental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-105</td>
<td>Modern Chemistry I</td>
<td>10</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>or 15-111</td>
<td>Intermediate/Advanced Programming</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
- 39-500 CIT Honors Research

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
- 24-391/392 Mechanical Engineering Project
- 24-491/492 Departmental Research Honors

**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 (i) 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. Faculty advisors have information available to identify courses and concentrations appropriate to the career objectives of each student. Many options require taking a sequence of courses, some of which might have pre-requisites. Academic advisors can provide students with technical details about the curriculum, and they are available to discuss options after graduation. Advisors can help with personal problems, planning for summer internships, applications to graduate school, study abroad options, and the job interview process.

The Department’s web site for undergraduate advising is based on the Blackboard system, and it is available at “24-000 Mechanical Engineering Advising” through secure login to the Blackboard system. All students who have declared the mechanical engineering major are automatically enrolled in the advising web site. This site is used for announcements regarding the curriculum, for scheduling meetings with advisors, and as an archive for the undergraduate handbook, lists of points of contact, graphical flow charts of the curriculum, and other resources.

As a regular part of monitoring progress toward completion of the degree, students should compare their transcripts with the department’s degree requirements. Academic audits are available on-line through secure login at the web site for the HUB Enrollment Services: http://www.cmu.edu:8001/hub/online_services.html.

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 QPA 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
The Department of Engineering and Public Policy (EPP) is a unique engineering department, whose objective is to enhance 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 are embedded in 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.

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, the only requirements are a 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 undergraduate 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 Sciences.

All undergraduates interested in the programs of the department complete their freshman year before declaring their major. Students planning to be double majors with chemical, mechanical, or materials sciences and engineering are especially advised to check the double-major curriculum before selecting their freshman elective courses so as to avoid possible overloads later in the program.

Some of the designated minors such as the Environmental Engineering minor are also compatible with the EPP double major without overload, if the program of study is carefully planned beginning in the freshman year. Additional non-CIT minors such as in Business Administration or an H&SS discipline may not be possible without overloads. If you are interested in exploring these options, please contact the EPP undergraduate advisers early.

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 graduates elect 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 advisers of the program are the following:

For Chemical Engineering/Engineering and Public Policy majors: Spyros Pandis
For Civil and Environmental Engineering/EPP majors: Cliff I. Davidson, Francis C. McMichael, Mitchell J. Small
For Computer Science/EPP majors: Mark Kieler
For Electrical and Computer Engineering/EPP majors: Jon Peha, Marvin A. Sirbu, Mark Kieler
For Mechanical Engineering/EPP majors: Edward S. Rubin, Allen Robinson
For Materials Science and Engineering/ EPP majors: Henry R. Piehler
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 assistant department head of EPP.

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.
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:

<table>
<thead>
<tr>
<th>Field</th>
<th>Number of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Engineering</td>
<td>385</td>
</tr>
<tr>
<td>Civil and Environmental Engineering</td>
<td>373</td>
</tr>
<tr>
<td>Computer Science</td>
<td>360</td>
</tr>
<tr>
<td>Electrical &amp; Computer Engineering</td>
<td>360</td>
</tr>
<tr>
<td>Materials Science and Engineering</td>
<td>382</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>380</td>
</tr>
</tbody>
</table>

Course requirements for each double-major degree are listed below. By completing these requirements, a student simultaneously completes all requirements for each departmental degree. Students who feel that they may be interested in an EPP double major program are advised to check with the appropriate faculty advisor or with Mark Kieler in the EPP Department about the optimal selection of courses. By planning the four-year curriculum in the freshman year, the student can be sure to get the maximum flexibility, and the maximum advantage from any advanced placement credits he or she may have.

**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, MechE, 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)
- 4 EPP Technical Electives
- 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 MechE/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.

- ChemE/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.
- MechE/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 the 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:

- ChemE/EPP students count the following ChemE 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 12-411 Engineering Economics as an EPP Technical Elective. CE/EPP students take only three more EPP Technical Electives.
- MechE/EPP students count 24-442 Engineering Design for EPP, as an EPP technical elective. MechE/EPP students take only three more EPP technical electives.
- MSE/EPP students count 27-401 and 402 in place of one EPP technical elective. So MSE/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:

- 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 12-411 Engineering Economics as an EPP Technical Elective. CE/EPP students take only three more EPP Technical Electives.

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 compiles 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;
- “We Know Where You Are: A Study of Location Tracking” (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 QPA 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>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>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type B [Social Analysis] Courses</th>
<th>24 units</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type C [EPP Core] Courses</th>
<th>36 units*</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-701 Theory and Practice of Policy Analysis</td>
<td>12 units**</td>
</tr>
<tr>
<td>AND</td>
<td></td>
</tr>
<tr>
<td>19-702 Quantitative Methods for Policy Analysis</td>
<td>12 units**</td>
</tr>
</tbody>
</table>

Or any two of the following 6 unit courses:

<table>
<thead>
<tr>
<th>Courses</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-703 Survey Design and Analysis</td>
<td>12 units</td>
</tr>
<tr>
<td>19-704 Applied Data Analysis</td>
<td>12 units</td>
</tr>
<tr>
<td>19-705 Workshop in Applied Policy Analysis</td>
<td>12 units</td>
</tr>
<tr>
<td>AND</td>
<td></td>
</tr>
<tr>
<td>19-752 EPP Project Management</td>
<td>12 units</td>
</tr>
</tbody>
</table>

Total units required for degree  96 units

*12 units of these courses will be taken (and counted) as an undergraduate 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.

 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.

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.
Chemical Engineering

Single Major

Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-259 Calculus in Three-Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>06-221 Thermodynamics</td>
<td>9</td>
</tr>
<tr>
<td>06-222 Sophomore Chemical Engineering Seminar</td>
<td>1</td>
</tr>
<tr>
<td>09-206 Physical Principles of Analytic Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>or 09-106 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>15-100/ Introductory Intermediate Programming / 33-107 Physics for Engineering Students II</td>
<td>10-12</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall</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 / 15-100 Introductory Intermediate Programming</td>
<td>12-10</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-321 Chemical Engineering Thermodynamics</td>
<td>9</td>
</tr>
<tr>
<td>06-323 Heat and Mass Transfer</td>
<td>9</td>
</tr>
<tr>
<td>06-322 Junior Chemical Engineering Seminar</td>
<td>2</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-347 Advanced Physical Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
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</table>

Junior Year

<table>
<thead>
<tr>
<th>Fall</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>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
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</tbody>
</table>

Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-421 Chemical Process Systems Design</td>
<td>12</td>
</tr>
<tr>
<td>06-422 Chemical Reaction Engineering</td>
<td>9</td>
</tr>
<tr>
<td>06-423 Unit Operations Laboratory</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>
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</table>

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-461 Process Design Project</td>
<td>6</td>
</tr>
<tr>
<td>06-462 Economics &amp; Optimization</td>
<td>6</td>
</tr>
<tr>
<td>xx-xxx Elective</td>
<td>9</td>
</tr>
<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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</table>

Minimum number of units required for degree: 385

Chemical Engineering/Engineering and Public Policy

Double Major

Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-259 Same</td>
<td>9</td>
</tr>
<tr>
<td>06-221 Same (Seminar requirement is met by 19-102)</td>
<td>9</td>
</tr>
<tr>
<td>09-206 Same</td>
<td>9</td>
</tr>
<tr>
<td>or 09-106 Same</td>
<td>10</td>
</tr>
<tr>
<td>15-100/ Same</td>
<td>10-12</td>
</tr>
<tr>
<td>33-107/ Principles of Economics</td>
<td>9</td>
</tr>
<tr>
<td>19-102 EPP Sophomore Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-261 Same</td>
<td>9</td>
</tr>
<tr>
<td>06-262 Same</td>
<td>12</td>
</tr>
<tr>
<td>09-221 Same</td>
<td>12</td>
</tr>
<tr>
<td>33-107/ Same</td>
<td>12-10</td>
</tr>
<tr>
<td>xx-xxx 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>06-321 Same</td>
<td>9</td>
</tr>
<tr>
<td>06-323 Same</td>
<td>9</td>
</tr>
<tr>
<td>09-217 Same</td>
<td>9</td>
</tr>
<tr>
<td>09-347 Same</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx EPP Social Analysis Elective*</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-361 Same</td>
<td>9</td>
</tr>
<tr>
<td>06-362 Same</td>
<td>9</td>
</tr>
<tr>
<td>09-363 Same</td>
<td>6</td>
</tr>
<tr>
<td>36-220 Engineering Stats and Quality Control (replaces 03-232)</td>
<td>9</td>
</tr>
<tr>
<td>19-451 EPP Project</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx 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>06-421 Same</td>
<td>12</td>
</tr>
<tr>
<td>06-422 Same</td>
<td>9</td>
</tr>
<tr>
<td>06-423 Same</td>
<td>9</td>
</tr>
<tr>
<td>06-461 Same</td>
<td>6</td>
</tr>
<tr>
<td>xx-xxx Same</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Same</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-462 Same</td>
<td>6</td>
</tr>
<tr>
<td>06-462 Same</td>
<td>6</td>
</tr>
<tr>
<td>xx-xxx Same</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Same</td>
<td>9</td>
</tr>
<tr>
<td>36-310 Fundamentals of Statistical Modeling</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: 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

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-251 Introduction to Environmental Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-252 Environmental Engineering Lab</td>
<td>3</td>
</tr>
<tr>
<td>12-271 Intro Computer Apps in Civil &amp; Environmental Engr</td>
<td>9</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>
</tr>
<tr>
<td>xx-xxx H&amp;SS Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Spring

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-235 Statics</td>
<td>9</td>
</tr>
<tr>
<td>21-260 Differential Equations</td>
<td>9</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Elective 1</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-301 Civil and Environmental Engineering Projects</td>
<td>12</td>
</tr>
<tr>
<td>12-331 Solid Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>12-332 Solid Mechanics Lab</td>
<td>3</td>
</tr>
<tr>
<td>27-357 Materials Selection</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-401 Civil and Environmental Engineering Design</td>
<td>12</td>
</tr>
<tr>
<td>12-411 Engineering Economics</td>
<td>9</td>
</tr>
<tr>
<td>36-211/220 Prob &amp; Stat or Engr Stat and Qual Control</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS or CFA Elective</td>
<td>9</td>
</tr>
<tr>
<td>12-xxx Elective 4</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Minimum number of units required for degree: 373

## Civil and Environmental Engineering / Engineering and Public Policy

### Double Major

#### Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-251 Same</td>
<td>9</td>
</tr>
<tr>
<td>12-252 Same</td>
<td>3</td>
</tr>
<tr>
<td>12-271 Same</td>
<td>9</td>
</tr>
<tr>
<td>09-101 Same</td>
<td>3</td>
</tr>
<tr>
<td>09-105 Same</td>
<td>10</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>
</tr>
</tbody>
</table>

#### Spring

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-235 Same</td>
<td>9</td>
</tr>
<tr>
<td>21-260 Same</td>
<td>9</td>
</tr>
<tr>
<td>15-100 Same</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx EPP Social Analysis Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Basic Science Elective (09-106, 33-104, or 03-121)</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-301 Same</td>
<td>9</td>
</tr>
<tr>
<td>12-331 Same</td>
<td>9</td>
</tr>
<tr>
<td>12-332 Same</td>
<td>3</td>
</tr>
<tr>
<td>27-357 Same</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Same</td>
<td>9</td>
</tr>
<tr>
<td>21-259 Same</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-401 Same</td>
<td>12</td>
</tr>
<tr>
<td>12-411 Same</td>
<td>9</td>
</tr>
<tr>
<td>36-220 Engineering Statistics and Quality Control</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx EPP Social Analysis Elective</td>
<td>9</td>
</tr>
<tr>
<td>19-452 EPP Project</td>
<td>12</td>
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</table>

#### Minimum number of units required for degree: 382

*One of these must be taken from the following list:
88-302 Behavioral Decision Making
89-223 Decision Analysis and Decision Support Systems
19-426 Environmental Decision Making
### Computer Science

#### Single Major

**Sophomore Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-113</td>
<td>Systems Skills in C</td>
<td>5</td>
</tr>
<tr>
<td>15-212</td>
<td>Principles of Programming</td>
<td>12</td>
</tr>
<tr>
<td>36-217</td>
<td>Probability Theory and Random Processes</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Minor Requirement/ Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Humanities and Arts Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

**Fall Units**: 53

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-213</td>
<td>Introduction to Computer Systems</td>
<td>12</td>
</tr>
<tr>
<td>15-xxx</td>
<td>Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>21-241</td>
<td>Matrix Algebra</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Engineering / Science Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Humanities and Arts Elective</td>
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</tr>
</tbody>
</table>

**Spring Units**: 48

**Junior Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-451</td>
<td>Algorithm Design and Analysis</td>
<td>9</td>
</tr>
<tr>
<td>15-xxx</td>
<td>Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Minor Requirement/ Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Humanities and Arts Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

**Fall Units**: 45

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-xxx</td>
<td>Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>15-xxx</td>
<td>Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Minor Requirement/ Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Humanities and Arts Elective</td>
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</table>

**Spring Units**: 36

**Senior Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-xxx</td>
<td>Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Minor Requirement/ Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Humanities and Arts Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Minor Requirement/ Free Elective</td>
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**Fall Units**: 39

<table>
<thead>
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<th>Units</th>
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**Spring Units**: 36

**Minimum units required for degree**: 360

---

### Computer Science/ Engineering and Public Policy

#### Double Major

**Sophomore Year**

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**Fall Units**: 56

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**Spring Units**: 46

**Junior Year**

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**Spring Units**: 39

**Senior Year**

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**Fall Units**: 42

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**Spring Units**: 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**

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<thead>
<tr>
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<tr>
<td>18-2x0 ECE Core Course</td>
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<tr>
<td>18-202 Mathematical Foundations of Electrical Engineering</td>
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<td>33-107 Physics for Engineering Students II</td>
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<tr>
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**Spring**

<table>
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<tr>
<td>18-2x0 ECE Core Course</td>
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**Junior Year**

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<td>xx-xxx ECE Coverage Course 1</td>
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**Senior Year**

<table>
<thead>
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**Spring**

<table>
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Minimum number of units required for degree: 360

### Electrical and Computer Engineering/Engineering and Public Policy

#### Double Major

**Sophomore Year**

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**Spring**

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**Junior Year**

(Seminar requirement is met by 19-102)

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**Spring**

<table>
<thead>
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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

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<td>21-259 Calculus in Three Dimensions</td>
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<td>27-215 Thermodynamics of Materials</td>
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### Materials Science and Engineering/ Engineering and Public Policy

#### Double Major

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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
### Mechanical Engineering

#### Single Major

**Sophomore Year**

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<tbody>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
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<td>xx-xxx General Education Course**</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>48-51</td>
</tr>
</tbody>
</table>

**Spring**

| 21-260 Differential Equations             | 9     |
| 24-231 Fluid Mechanics                    | 10    |
| 24-262 Stress Analysis                    | 12    |
| xx-xxx Restricted Technical Elective      | 10-13 |
| xx-xxx General Education Course           | 9     |
|                                           | 50-53 |

**Junior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<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-xxx Mechanical Engineering Technical Elective</td>
<td>9-12</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>50-53</td>
</tr>
</tbody>
</table>

**Spring**

| 24-371 Electromechanical Systems          | 10    |
| 24-303 Mechanical Engineering Seminar II  | 1     |
| 24-321 Thermal-Fluids Engineering         | 12    |
| 24-352 Dynamic Systems and Control        | 12    |
| xx-xxx General Education Course           | 9     |
|                                           | 44    |

**Senior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-401 Engineering Analysis</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>24-441 Engineering Design</td>
<td>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></td>
<td>48</td>
</tr>
</tbody>
</table>

**Spring**

| 24-441 Engineering Design                 |       |
| or                                       |       |
| 24-401 Engineering Analysis               | 12    |
| 24-xxx Mechanical Engineering Technical Elective | 9-12  |
| xx-xxx Elective                          | 9     |
| xx-xxx Elective                          | 9     |
| xx-xxx General Education Course          | 9     |
|                                           | 48-51 |

**Minimum number of units required for degree: 380**

### Mechanical Engineering/Engineering and Public Policy

#### Double Major

**Sophomore Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-259 Same</td>
<td>9</td>
</tr>
<tr>
<td>24-221 Same</td>
<td>10</td>
</tr>
<tr>
<td>24-261 Same</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx Restricted Technical Elective*</td>
<td>10-13</td>
</tr>
<tr>
<td>19-102 Principles of Economics</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>51-54</td>
</tr>
</tbody>
</table>

**Spring**

| 21-260 Same                              | 9     |
| 24-231 Same                              | 10    |
| 24-262 Same                              | 12    |
| xx-xxx Restricted Technical Elective     | 10-13 |
| xx-xxx General Education Course          | 9     |
|                                           | 50-53 |

**Junior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-302 Same</td>
<td>1</td>
</tr>
<tr>
<td>24-311 Same</td>
<td>9</td>
</tr>
<tr>
<td>24-322 Same</td>
<td>10</td>
</tr>
<tr>
<td>24-351 Same</td>
<td>12</td>
</tr>
<tr>
<td>24-xxx Mechanical Engineering Technical Elective</td>
<td>9-12</td>
</tr>
<tr>
<td>xx-xxx General Education Course</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>49</td>
</tr>
</tbody>
</table>

**Spring**

| 24-371 Same                               | 10    |
|                                           | 12    |
|                                           | 12    |
|                                           | 12    |

**Senior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-442 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 I</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx EPP Social Analysis Elective*</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>51</td>
</tr>
</tbody>
</table>

**Spring**

| 36-310 Fundamentals of Statistical Modeling| 9      |
|                                           | 9-12   |
| xx-xxx EPP Technical Elective             | 9      |
| xx-xxx EPP Social Analysis Elective       | 9      |
| xx-xxx EPP Social Analysis Elective       | 9      |
|                                           | 45-48  |

**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 be 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 course should consult 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 current semester advising packet list always has precedent over the course listing below.

#### Energy, Resources and the Environment

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-424</td>
<td>Energy and the Environment</td>
</tr>
<tr>
<td>24-424</td>
<td>Energy and the Environment</td>
</tr>
<tr>
<td>12-651</td>
<td>Air Quality Engineering</td>
</tr>
<tr>
<td>12-657</td>
<td>Water Resource Engineering</td>
</tr>
<tr>
<td>19-630/0630</td>
<td>Atmospheric Chemistry/Air Pollution and Global Change</td>
</tr>
<tr>
<td>19-650</td>
<td>Climate and Energy: Science and Public Policy</td>
</tr>
</tbody>
</table>

#### Information and Telecommunication Technologies

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-402</td>
<td>Telecommunications Policy Analysis</td>
</tr>
<tr>
<td>18-482</td>
<td>Artificial Intelligence: Representation and Problem Solving</td>
</tr>
<tr>
<td>15-381</td>
<td>Artificial Intelligence: Computer Vision</td>
</tr>
<tr>
<td>15-827</td>
<td>Security and Cryptography</td>
</tr>
<tr>
<td>19-601</td>
<td>Information Warfare</td>
</tr>
</tbody>
</table>

#### Other

<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>03-360</td>
<td>The Biology of the Brain</td>
</tr>
<tr>
<td>15-540</td>
<td>Rapid Design and Prototyping of Computer Systems</td>
</tr>
<tr>
<td>19-442</td>
<td>New Technologies and Economic Growth</td>
</tr>
</tbody>
</table>

#### 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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-100</td>
<td>Principles of Economics (required)</td>
</tr>
<tr>
<td>73-250</td>
<td>Intermediate Microeconomics</td>
</tr>
<tr>
<td>73-359</td>
<td>Benefit-Cost Analysis</td>
</tr>
<tr>
<td>73-248</td>
<td>Environmental Economics</td>
</tr>
<tr>
<td>73-469</td>
<td>Economics of E Commerce</td>
</tr>
</tbody>
</table>

#### 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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-221</td>
<td>Principles of Child Development</td>
</tr>
<tr>
<td>85-241</td>
<td>Social Psychology</td>
</tr>
<tr>
<td>70-311</td>
<td>Organizational Behavior</td>
</tr>
<tr>
<td>88-260</td>
<td>Organizations</td>
</tr>
<tr>
<td>88-302</td>
<td>Behavioral Decision Making</td>
</tr>
</tbody>
</table>

#### 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.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<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>80-244</td>
<td>Management, Environment, and Ethics</td>
</tr>
<tr>
<td>80-245</td>
<td>Medical Ethics</td>
</tr>
<tr>
<td>80-340</td>
<td>Environmental Ethics</td>
</tr>
</tbody>
</table>

#### Political Analysis

Political analysis includes knowledge of the structure of American government, especially legislative, executive, budgetary, regulatory and electoral processes.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-364</td>
<td>Business Law</td>
</tr>
<tr>
<td>88-104</td>
<td>Decision Processes in American Political Institutions</td>
</tr>
<tr>
<td>88-324</td>
<td>Electoral Processes</td>
</tr>
<tr>
<td>88-358</td>
<td>Policy Making Institutions</td>
</tr>
<tr>
<td>88-444</td>
<td>Public Policy and Regulation</td>
</tr>
</tbody>
</table>

#### 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.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-448/748</td>
<td>Science, Technology and Ethics</td>
</tr>
<tr>
<td>18-443/</td>
<td>Civilian and Military Applications of Space</td>
</tr>
<tr>
<td>19-430</td>
<td></td>
</tr>
<tr>
<td>15-391</td>
<td>Computer Science and the Community</td>
</tr>
<tr>
<td>21-292</td>
<td>Operations Research</td>
</tr>
<tr>
<td>39-600</td>
<td>Integrated Product Development</td>
</tr>
</tbody>
</table>
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.

International Peace and Security
National and international problems dealing with security and strategy and their political and historical perspectives are examined in these courses.

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.

Role of Computers in Institutions
This area deals with the institutional, interpersonal, and policy aspects of the increasing role of computers in our society.

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.

Faculty

PETER ADAMS, Assistant Professor of Civil and Environmental Engineering and Public Policy—Ph.D., Caltech; Carnegie Mellon 2001—.

JAY APT, Distinguished Service Professor of Engineering and Public Policy—Ph.D., MIT; Carnegie Mellon 2007—.

V.S. ARUNACHALAM, Distinguished Service Professor of Engineering and Public Policy/Materials Science and Engineering/Robotics Institute —Ph.D., Wales; Dr.Eng. (h.c.), Roorkee; Carnegie Mellon 1992—.

ALFRED BLUMSTEIN, J. Erik Jonsson University Professor of Urban Systems and Operations Research, H. John Heinz III School of Public Policy and Management; Professor of Engineering and Public Policy —Ph.D., Cornell University; Carnegie Mellon 1969—.

KATHLEEN M. CARLEY, Professor of Social and Decision Sciences/H. John Heinz III School of Public Policy and Management/Engineering and Public Policy —Ph.D., Cornell University; Carnegie Mellon 1997—.

ELIZABETH CASMAN, Research Engineer, Engineering and Public Policy —Ph.D., The Johns Hopkins University; Carnegie Mellon 1997—.

WESLEY M. COHEN, Professor of Economics and Social Science/Engineering and Public Policy —Ph.D., Yale University; Carnegie Mellon 1982—.

JARED L. COHON, President, Carnegie Mellon University; Professor of Civil and Environmental Engineering/Engineering and Public Policy —Ph.D., MIT; Carnegie Mellon 1997—.

CLIFF F. DAVIDSON, Professor of Civil and Environmental Engineering/Engineering and Public Policy; Director, Environmental Institute —Ph.D., California Institute of Technology; Carnegie Mellon 1977—.

OTTO B. DAVIS, William W. Cooper Professor of Economics and Public Policy —Ph.D., University of Virginia; Carnegie Mellon 1960—.

MICHAEL L. DEKAY, Assistant Professor of Engineering and Public Policy and Decision Sciences —Ph.D., University of Colorado, Boulder; Carnegie Mellon 1996—.

ALEX FARRELL, Research Engineer and Executive Director, Carnegie Mellon Electricity Industry Center; —Ph.D., University of Pennsylvania; Carnegie Mellon 1998—.

SCOTT FARROW, Director, Center for the Study and Improvement of Regulation, Engineering and Public Policy; Principal Research Engineer, Engineering and Public Policy —Ph.D., Washington State University; Carnegie Mellon 1998—.

PAUL S. FISCHBECK, Associate Professor of Social and Decision Sciences/Engineering and Public Policy —Ph.D. Stanford; Carnegie Mellon 1991—.

BARUCH FISCHHOFF, University Professor; Professor of Social and Decision Sciences/Engineering and Public Policy —Ph.D., Hebrew University; Carnegie Mellon 1987—.

H. KEITH FLORIG, Senior Research Engineer, Engineering and Public Policy —Ph.D., Carnegie Mellon; Carnegie Mellon 1995—.

ALEX HILLS, Distinguished Service Professor of Engineering and Public Policy/School of Computer Science —Ph.D., Carnegie Mellon; Carnegie Mellon 1992—.

DAVID A. HOUNSHELL, Henry R. Luce Professor of Technology and Social Change; Professor of History/Social and Decision Sciences/Engineering and Public Policy —Ph.D., Yale University; Carnegie Mellon 1963—.

FRANCIS C. McMICHAEL, Walter J. Blenko, Sr., Professor of Environmental Engineering; Professor of Civil and Environmental Engineering/Engineering and Public Policy —Ph.D., California Institute of Technology; Carnegie Mellon 1967—.

BENOÎT MOREL, Senior Lecturer, Engineering and Public Policy/Physics —Ph.D., University of Geneva; Carnegie Mellon 1987—.

M. GRANGER MORGAN, Lord Chair Professor of Engineering; Professor of Engineering and Public Policy; Professor of Engineering and Public Policy/Computers and Information Systems/Engineering and Public Policy —Ph.D., California Institute of Technology; Carnegie Mellon 1993—.

INDIRA NAIR, Vice Provost of Education, Carnegie Mellon University; Professor of Engineering and Public Policy —Ph.D., Northwestern University; Carnegie Mellon 1978—.

SPYROS N. PANDIS, Gerard G. Elia Career Development Professor of Engineering; Associate Professor of Chemical Engineering/Engineering and Public Policy —Ph.D., California Institute of Technology; Carnegie Mellon 1993—.

JON M. PEHA, Associate Professor of Electrical and Computer Engineering/Engineering and Public Policy —Ph.D., Stanford University; Carnegie Mellon 1991—.

HENRY R. PIEHLER, Professor of Materials Science and Engineering/Engineering and Public Policy —Sc.D., Massachusetts Institute of Technology; Carnegie Mellon 1967—.

LESTER B. LAVE, University Professor; Higgins Professor of Economics and Finance; Professor of the Graduate School of Industrial Administration/Engineering and Public Policy/H. John Heinz III School of Public Policy and Management —Ph.D., Harvard University; Carnegie Mellon 1963—.

EDWARD S. RUBIN, The Alumni Professor of Environmental Engineering and Science; Professor of Engineering and Public Policy/Environmental Engineering; Director, Center for Energy and Environmental Studies —Ph.D., Stanford University; Carnegie Mellon 1969—.

MARTIN J. SMITH, Professor of Engineering and Public Policy/Industrial Administration/Electrical and Computer Engineering/Chairman, Executive Committee, Information Networking Institute —Sc.D., Massachusetts Institute of Technology; Carnegie Mellon 1985—.

MITCHELL J. SMALL, H. John Heinz III Professor of Civil and Environmental Engineering and Professor and Associate Department Head for Graduate Affairs, Engineering and Public Policy —Ph.D., University of Michigan; Carnegie Mellon 1982—.

JOEL A. TARR, Richard S. Calliguiri Professor of Urban and Environmental History and Policy; Ph.D., Northwestern University; Carnegie Mellon 1997—.

RAHUL TONGIA, Research Engineer, Engineering and Public Policy —Ph.D., Carnegie Mellon; Carnegie Mellon 1998—.

HERBERT L. TOOR, Emeritus Mobay Professor of Chemical Engineering/Engineering and Public Policy —Ph.D., Northwestern University; Carnegie Mellon, 1953—.

ROBERT M. WHITE, University Professor; Professor of Electrical and Computer Engineering/Engineering and Public Policy; Director, Data Storage Systems Center —Ph.D., Stanford; Carnegie Mellon, 1993—.
The College of Fine Arts

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
Office: College of Fine Arts 201
http://www.cmu.edu/interdisciplinary

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 museums; have designed buildings; 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, practitioners 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 Master of Arts Management (MAM, 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 Innovation 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 (105 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 (120-136 units), and free electives (30-46 units). Please refer to Intercollege Programs in this catalog on page 76.

The acting or music theatre concentrations in the School of Drama are not appropriate for either of these programs.
The search for both increased support and larger audiences has intensified over the last decade and 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), United States Institute for Theatre Technology (USITT), 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 standards 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, or 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 part-time and summer 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 33.

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 Design
Drama
History of the Arts
Industrial Design
Jazz Performance
Music
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 advisers 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 Kampert; 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
48-100 Design Fundamentals or 48-095 Architecture for Non-Majors* 9-12
48-240 Architecture History 1: Survey of World Architecture & Urbanism 9

Elective Courses (Choose three)** 27 units
48-130 Introduction to Architectural Drawing 6
48-230 Perspective (Prereq. 48-130) 9
48-210 Statics (Prereq. 21-115, 21-116, 33-106) 9
48-215 Materials and Assemblies 9
48-217 Structures 1 (Prereq. 48-210 or 12-207) 9
48-34x Arch. History (Prereq.48-240) 9
48-351 Psychology of Habitation 9
48-412 Environment 3: Mechanical Systems 9
48-452 Design Economics (Prereq. 73-100 or 36-201) 9
48-551 Ethics and Decision Making in Architecture 9
48-56x, 57x, 58x Dept. Elective (Prereq. various) 9

Minimum Units: 54

* Where students can demonstrate equivalent experience with design issues within other disciplines, as for example in the School of Design, this requirement can be waived. However this 18 unit requirement must then be replaced with another 18 units of elected coursework within the School.

** Students interested in a minor in Architecture should consult the assistant head regarding elective choice.

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 (Choose five) 45 units
Students select five additional courses in Architectural History. The list below is indicative of current listings but is not comprehensive of all possible courses in any given semester. Students should consult with the Architecture office for up-to-date listings.

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
48-135 Architectural Drawing 9
48-230 Perspective 9

Elective Courses 21 units
48-125 Computer Modeling 2 6
48-560 Computer Modeling 3 6
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

Elective Courses (Choose six) 54 units
48-210 Statics (Prereq. 21-115, 21-116, 33-106) 9
48-215 Materials and Assemblies 9
48-217 Structures (Prereq. 48-210 or 12-207) 9
48-315 Environment 1: Climate & Energy 9
48-410 Environment 2: Space Sound Light 9
48-412 Environment 3: Mechanical Systems 9
48-415 Advanced Building Systems 9
48-56x, 57x, 58x Designated Dept. Technical Elective 9

Minimum Units: 54

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 45 units
48-711 Research Models and Methods 9

Elective Courses 60 units
48-721 Building Controls & Diagnostics 12
48-723 Advanced Building Systems 9
48-742 Design Databases 6
48-745 Geometric Modeling 6
48-747 Shape Grammars 6
48-743 Symbolic Modeling 12
48-746 Interface for Design 6
48-725 Building Economics 9
48-729 Special Topics in BDP 9
48-749 Special Topics in CAD 9
48-750 Strategic Use of CAD 12
48-756 Object-Oriented Application Development in CAD 12

Minimum units required: 54

Minor in Art

Concept Studio (Choose one) 10 units
60-101 Concept Studio I: The Human Being (fall) 10
60-102 Concept Studio II: Time and Space (spring) 10
60-201 Concept Studio III: Systems and Processes (fall) 10

Media Studios (Choose two) 20 units
60-110 Electronic Media Studio I: Computer Art (fall) 10
60-210 Electronic Media Studio II: Video Art (fall and spring) 10
60-130 Three-Dimensional Media Studio I (spring) 10
60-230 Three-Dimensional Media Studio II (fall) 10
60-150 Two-Dimensional Studio I: Drawing (fall) 10
60-151 Two-Dimensional Studio II: Drawing (spring) 10
60-250 Two-Dimensional Studio III: Painting (fall and spring) 10
60-251 Two-Dimensional Studio IV: Printmaking (spring) 10

Advanced Media (Choose two) 20 units
60-4xx Advanced ETB: Electives 10
60-4xx Advanced SIS: Electives 10
60-4xx Advanced PDP: Electives 10

Art History/Theory (Choose one) 9 units
60-105 Pre-Industrial Visual Cultures 1789 (spring) 9
60-205 Modern Visual Cultures 1789-1945 (fall) 9
60-206 Contemporary Visual Cultures 1945 to the Present 9
60-3xx Art History/Theory Electives 9

Minimum units required: 59

Minor in the History of Arts

This minor of six or more courses as designated below, will offer students a grouping of Art Histories 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 of 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.

Introductory Level Courses: 27 units
(Choose three, CFA students pick 3 outside of major)
48-140 Architectural History I: Historical Survey of World Architecture & Urbanism 9
51-271 Design Principles: History and Theory of Design 9
54-281 History of Drama I 9
57-173 Survey of Western Music History 9
60-105 Pre-Industrial Visual Cultures; to 1789 9
60-205 Modern Visual Culture; 1789-1945 9
60-206 Contemporary Visual Culture; 1945 to the Present 9

Advanced Courses: 27 units
(Choose at least three, CFA students pick 3 outside of major)
48-34x Architectural History 9
48-44x Architectural History 9
54-3xx Advanced Drama History Minis 3 units each
57-2xx Advanced Music History Electives 9
60-3xx Advanced Art History Electives 9

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
51-261 Communication 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 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

- **54-163/164** Introduction to Production 12
- **54-177/178** Text to Stage 12
- **54-281 or 282** History of Drama 6

**Elective Courses:** 30 units

- **54-113/114** Ballet Elective (Beginning & Advanced) 12
- **54-134** Directing for Non-Majors 6
- **54-157/158** Introduction to Playwriting 6
- **54-169/180** Advanced Playwriting 9
- **54-191/192** Acting for Non-Majors 9
- **54-239/240** History of Architecture and Decor 6
- **54-245/246** History of Clothing 6
- **54-259 or 262** Production II (Crew) 9
- **54-251/252** Introduction to Lighting Design 6
- **54-309/310** Theatre Lab 4
- **54-381/382** History of Drama (minis) 3 (per mini)
- **54-481/482** History of Drama (minis) 3 (per mini)
- **54-475** Theatre Management 6

The following courses are available by audition and the agreement of the instructor

- **54-123/124** Dance I 6
- **54-223/224** Dance II 6

* Indicates year-long courses. The fall sections of these courses are prerequisite for the spring sections, except with permission of the instructor.

Other courses in the Drama curriculum will be considered as substitutes for elective credit, at the discretion of the Drama Advisor and with permission of the instructor.

Minimum units required: 60

**Minor in Jazz Performance**

This sequence is for candidates who are music majors or 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 162).

2. The student must perform an acceptable audition. The requirements for the audition can be found in the Undergraduate Catalog.

**Prerequisite Courses** 12 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
- **57-091** Basic Solfege Skills 0
- **57-152** Harmony I 6
- **57-161** Solfege I 6
- **57-162** Harmony I 6
- **57-173** Survey of Western Music History 9

**Required Jazz Courses** 24 units

- **57-xxx** Jazz Ensemble or Jazz Vocal Ensemble 3
- **57-xxx** 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
- **57-457** Jazz History I 6
- **57-458** Jazz History II 6

Minimum units required: 54

**Minor in Music Performance**

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 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 162).

2. The student must perform an acceptable audition. Requirements for the audition can be found in the Undergraduate Catalog.

**Prerequisite Courses** 0 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.

- **57-09x** Basic Theory Skills 0
- **57-09x** Basic Solfege Skills 0

**Introductory Courses** 24 units

- **57-161** Eurhythmics I 3
- **57-181** 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** 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.)

Minimum units required: 72

**Minor in Music Technology**

This sequence is for candidates who are music majors; art, design, or drama majors who are interested in recording, sound-editing and other music technology areas (in addition to courses in their home schools); or majors from any discipline in the university 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 162).

**Prerequisite Courses** 3-6 units

Basic Theory Skills is required of students who do not qualify for entrance into Harmony I, based on their scores on the theory placement test. Beginning Piano is required of students who do not pass a piano proficiency test. Computer Skills Workshop must be passed before taking any of the required technology courses.

- **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
- **57-338** Sound Editing and Production 6
- **57-347** Electronic and Computer Music 6
- **57-438** MultiTrack Recording 9

**Elective Courses** 24-28 units

Other courses may also be approved as electives with the approval of the advisor for music minors.

**Music history courses (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&S multimedia course 9
15-127 Intro to Programming and Computer Science 10
15-229 MultiMedia Information Processing 9
33-114 Physics of Musical Sound 9
54-165 Sound I 6
57-610 Internship 9

Minimum units required: 63-67

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 162).

Prerequisite Courses  
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.

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>57-090 Basic Theory Skills</td>
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<tr>
<td>57-291 Basic Solfege Skills</td>
<td>0</td>
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<tr>
<td>57-103 Beginning Piano</td>
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Introductory Courses  
15 units

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<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>57-152 Harmony I</td>
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<tr>
<td>57-151 Eurythmics I</td>
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</tr>
<tr>
<td>57-181 Solfege I</td>
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Required Theory Courses  
27 units

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<tbody>
<tr>
<td>57-153 Harmony II</td>
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<tr>
<td>57-154 18th Century Counterpoint</td>
<td>6</td>
</tr>
<tr>
<td>57-257 Orchestration I</td>
<td>6</td>
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<tr>
<td>57-612 Independent Study in Music Theory</td>
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Elective Courses  
15 units

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<th>Course</th>
<th>Units</th>
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<tr>
<td>57-335 Analysis Seminar</td>
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<tr>
<td>57-442 Analytical Techniques</td>
<td>6</td>
</tr>
<tr>
<td>57-760 Introduction to Schenker Analysis</td>
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history courses (choose 1)

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>57-173 Survey of Western Music History</td>
<td>9</td>
</tr>
<tr>
<td>57-202 Opera History</td>
<td>9</td>
</tr>
<tr>
<td>57-205 20th Century Music History</td>
<td>9</td>
</tr>
</tbody>
</table>

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 107 Margaret Morrison Carnegie Hall.

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

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

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

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</th>
<th>Units</th>
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<tbody>
<tr>
<td>15-462 Computer Graphics I</td>
<td>9</td>
</tr>
<tr>
<td>18-360 Intro to Computer-Aided Design</td>
<td>9</td>
</tr>
<tr>
<td>24-201 Engineering Graphics</td>
<td>9</td>
</tr>
<tr>
<td>48-105 Experiments in Design with Shop &amp; Computer Modeling</td>
<td>9</td>
</tr>
<tr>
<td>48-125 Computer Modeling, Part II</td>
<td>9</td>
</tr>
<tr>
<td>51-246 Photo Documentation</td>
<td>9</td>
</tr>
<tr>
<td>51-330 Photo Book Design</td>
<td>9</td>
</tr>
<tr>
<td>51-344 Advanced Digital Prototyping</td>
<td>9</td>
</tr>
<tr>
<td>51-346 Production Prototyping</td>
<td>9</td>
</tr>
<tr>
<td>54-270 Computer Applications</td>
<td>9</td>
</tr>
<tr>
<td>60-210 Electronic Media Studio I</td>
<td>9</td>
</tr>
<tr>
<td>62-286 The Constructed Photograph</td>
<td>9</td>
</tr>
<tr>
<td>62-372 Photo Book Design</td>
<td>9</td>
</tr>
<tr>
<td>62-381 Color Photography I</td>
<td>9</td>
</tr>
<tr>
<td>70-161 Intro to Graphic Communications II</td>
<td>9</td>
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</table>

Production - Pittsburgh Filmmakers Courses:

All Courses offered at Filmmakers are 9 units.

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>FM-200 Intermediate Filmmaking</td>
<td>9</td>
</tr>
<tr>
<td>FM-301 Advanced Filmmaking</td>
<td>9</td>
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<tr>
<td>FM-161 Black and White Photography I</td>
<td>9</td>
</tr>
<tr>
<td>FM-162 Black and White Photography II</td>
<td>9</td>
</tr>
<tr>
<td>FM-201 Black and White Photography III</td>
<td>9</td>
</tr>
<tr>
<td>FM-202 Color Photography I</td>
<td>9</td>
</tr>
<tr>
<td>FM-203 Color Photography II</td>
<td>9</td>
</tr>
<tr>
<td>FM-306 Cinematography</td>
<td>9</td>
</tr>
<tr>
<td>FM-404 Digital Non-Linear Editing Video Production</td>
<td>9</td>
</tr>
<tr>
<td>FM-163 Elements of Film</td>
<td>9</td>
</tr>
<tr>
<td>FM-164 Filmmaking I</td>
<td>9</td>
</tr>
<tr>
<td>FM-167 Introduction to Digital</td>
<td>9</td>
</tr>
<tr>
<td>FM-169 Introduction to Screenwriting</td>
<td>9</td>
</tr>
<tr>
<td>FM-310 Lighting for Film and Video</td>
<td>9</td>
</tr>
<tr>
<td>FM-211 Photoshop for Photographers</td>
<td>9</td>
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<tr>
<td>FM-212 Script Analysis</td>
<td>9</td>
</tr>
<tr>
<td>FM-408 Senior Film Production II</td>
<td>9</td>
</tr>
<tr>
<td>FM-407 Senior Film Production I</td>
<td>9</td>
</tr>
<tr>
<td>FM-316 View Camera Techniques</td>
<td>9</td>
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<tr>
<td>FM-215 Video Production Digital</td>
<td>9</td>
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<tr>
<td>FM-216 Web Design Digital</td>
<td>9</td>
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<tr>
<td>FM-171 Acting for the Camera</td>
<td>9</td>
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<tr>
<td>FM-218 Advanced Screenplay Workshop</td>
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<tr>
<td>FM-170 American Film History</td>
<td>9</td>
</tr>
<tr>
<td>FM-317 Advanced Video Production</td>
<td>9</td>
</tr>
<tr>
<td>FM-219 Animation Basics</td>
<td>9</td>
</tr>
<tr>
<td>FM-308 Developing the Feature Script</td>
<td>9</td>
</tr>
<tr>
<td>FM-209 Experimental Film/Video Art</td>
<td>9</td>
</tr>
<tr>
<td>FM-166 Film Genre: Women in Animated Media</td>
<td>9</td>
</tr>
</tbody>
</table>
Photo/Film History, Theory or Criticism - Carnegie Mellon

courses:
51-271 Design History I
51-272 Design History II
57-399 Music, Cinema, Culture
76-239 Intro to Film Studies
76-366 Revealing Place: Photographers & Writers Working Together
76-339 Advanced Studies in Film and Media
76-439 Advanced Seminar in Film
79-227 History of World Architecture
79-351 Cold War in Documents and Film
79-361 Film Festival (Topic subject to change by semester)
88-314.1 Politics Through Film (Summer Only)

Courses subject to change by semester. Actual listing available in the Dean’s Office, CFA 100.

Minimum units required: 54
The mission of the School of Architecture is to educate outstanding professionals with design creativity, social responsibility, historical perspective, technical competence, 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 in nine areas: Fundamental University Courses and Electives, the Design Studio Sequence, Design Theory and History, Drawing and Computational Design, Design and Technological Innovation, Design for the Environment, Design for Social Responsibility and Human Factors, Professional Practice and Management, and Departmental Electives. Some courses belong to more than one sequence. 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 five-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)

**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).

- 21-115 Differential Calculus (mini)
- 21-116 Integral Calculus (mini)
- 33-106 Physics for Engineering Students
- 36-201 Statistical Reasoning or 36-220 Engineering Statistics and Quality Control
- 73-100 Principles of Economics
- 76-101 Designed Writing
- 79-104 Introduction to World History

**Design Studio Sequence**

(10 studios)

Architectural design is 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: design fundamentals, architecture fundamentals, composition, materials, site, construction, occupancy, systems integration, and urban design. Studio X is meant to allow for study abroad, independent studios, or other areas of proposed study with a focus on urban context. Design studios are taught on a team approach with a common lecture series and set of related exercises required of all students. 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.

- 48-100 Design Fundamentals
- 48-105 Architecture Fundamentals
- 48-200 Architecture, Design & Composition
- 48-205 Architecture, Design & Materials
- 48-300 Architecture, Design & Site
- 48-305 Architecture, Design & Construction
- 48-400 Architecture, Design & Occupancy
- 48-405 Architecture, Design & Systems Integration
- 48-500 Architecture & Urban Design
- 48-505 Studio X

**Design Theory and History**

(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 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.

- 48-34x Architecture History 2: Time or Place
- 48-44x Architecture History 3
- 48-34on44on Architectural History Electives
- 79-104 Introduction to World History

**Drawing and Computational Design**

(5 lecture 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 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: Computer Modeling 1 and 2, Introduction to Architectural Drawing and Architectural Drawing in the first year, and Perspective in the second year. Thereafter, students may elect to take further
The School views social responsibility and design for human factors as a primary professional goal. Both studio and lecture courses address the questions and opportunities of human differences by introducing knowledge related to: the psychology of the individual, the sociocultural group, ergonomics, ADA codes & standards, as well as in-depth study and minors in associated fields.

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 CFA section on Interdisciplinary Programs and in similar sections provided by each college.

Minors in Architecture
Undergraduate students in architecture can also qualify to earn two minors within the subject of architecture. These are the Minor in Building Science and the Minor in Architectural History. The Minor in Building Science is intended for those degree candidates seeking in-depth knowledge in several areas of architectural science and for those who are interested in gaining advance placement into the graduate M.S. programs offered by the School in the areas of Building Performance and Computer Aided Design. The Minor in Architectural History is intended for those candidates who want particular depth in this area. It is earned by applying all three departmental electives and one university elective to courses in architectural history.

Student Advising and Review
Students are urged to meet with the Associate or Assistant Head of the Department 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. Students should also check their progress using the online academic audit (https://acls.as.cmu.edu/moksha/audit/degreeaudit.html?)

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. Subsequent reviews monitor and insure continued progress in all sequences of the program. It is the policy of the School of Architecture that no student who has a GPA below 3.0 from the previous semester can take an overload.

Drawing and media courses during years three, four, and five in fulfillment of the departmental elective requirements. One of these courses, Computer Modeling 3, covers advanced topics in computer visualization.

Design, Professional Practice, and Management
(3 lecture courses, 2 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.

Departmental Electives
A minimum of three departmental electives, usually taken during the fourth and fifth years, is required for the Bachelor of Architecture degree (the departmental elective requirements can also be satisfied by taking advanced architectural history electives). The general goal of the departmental 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 departmental electives build on prerequisite courses taken in science, technology, architectural history, and drawing. Areas in which departmental electives are offered are: drawing/media (including computer aided design), environmental psychology, criticism, architectural history, planning/management, and building engineering. With approval, qualified students can take graduate level courses to satisfy the departmental 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 program, most frequently in GSIA’s undergraduate Business Administration program, engineering at CIT, History in H&SS, and Industrial Design in the School of Design.
### Curriculum

#### First Year

<table>
<thead>
<tr>
<th>Term</th>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Fall</td>
<td>48-100 Design Fundamentals</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>48-120 Computer Modeling 1 w/Computer Skills Workshop</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>48-130 Introduction to Architectural Drawing</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>21-115 Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>21-116 Integral Calculus</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>79-104 Introduction to World History</td>
<td>9</td>
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<td><strong>Total</strong></td>
<td><strong>46</strong></td>
</tr>
<tr>
<td>Spring</td>
<td>48-105 Architecture Fundamentals</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>48-125 Computer Modeling 2</td>
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<td></td>
<td>48-135 Architectural Drawing</td>
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</tr>
<tr>
<td></td>
<td>33-106 Physics for Engineering Students</td>
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<tr>
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<td>76-101 Designated Writing</td>
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#### Second Year

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<tr>
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<th>Course</th>
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<tbody>
<tr>
<td>Fall</td>
<td>48-200 Architecture, Design &amp; Composition</td>
<td>18</td>
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<td>48-210 Statics</td>
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</tr>
<tr>
<td></td>
<td>48-230 Perspective</td>
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<tr>
<td></td>
<td>73-100 Principles of Economics</td>
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<tr>
<td>Spring</td>
<td>48-205 Architecture, Design &amp; Materials</td>
<td>18</td>
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<td>48-215 Materials and Assemblies</td>
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<tr>
<td></td>
<td>48-217 Structures 1</td>
<td>9</td>
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<td></td>
<td>xx-xxx Elective</td>
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<tr>
<td></td>
<td>xx-xxx Elective</td>
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#### Third Year

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<tbody>
<tr>
<td>Fall</td>
<td>48-300 Architecture, Design &amp; Site</td>
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<tr>
<td></td>
<td>48-310 Structures 2</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>48-312 Site Engineering and Foundations</td>
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<tr>
<td></td>
<td>48-34x Architecture History 2: Time or Place</td>
<td>9</td>
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<tr>
<td></td>
<td>xx-xxx Elective</td>
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<td>Spring</td>
<td>48-305 Architecture, Design &amp; Construction</td>
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<td>48-315 Environment 1: Climate and Energy</td>
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<td>48-351 Psychology of Habitation</td>
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<td>36-201 Statistical Reasoning or 36-220 Engineering Statistics &amp; Quality Control</td>
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</tr>
<tr>
<td></td>
<td>xx-xxx Elective</td>
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#### Fourth Year

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<tr>
<td>Fall</td>
<td>48-400 Architecture, Design &amp; Occupancy</td>
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<tr>
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<td>48-410 Environment 2: Space, Sound, Light</td>
<td>9</td>
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<tr>
<td></td>
<td>48-452 Design Economics</td>
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<tr>
<td></td>
<td>48-412 Environment 3: Mechanical Systems</td>
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<tr>
<td></td>
<td>xx-xxx Elective</td>
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<td><strong>Total</strong></td>
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<tr>
<td>Spring</td>
<td>48-34x or 4xx Architecture History 2 or 3</td>
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<tr>
<td></td>
<td>48-405 Architecture, Design &amp; Systems Integration</td>
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<td>48-415 Advanced Building Systems</td>
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<td>48-453 Urban Design</td>
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<td>xx-xxx Elective</td>
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<tr>
<td>Fall</td>
<td>48-500 Architecture &amp; Urban Design</td>
<td>18</td>
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<tr>
<td></td>
<td>48-550 Issues of Practice</td>
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<td>xx-xxx Elective</td>
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<td>Spring</td>
<td>48-505 Studio X</td>
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<td>48-551 Ethics and Decision Making in Architecture</td>
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<tr>
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<td><strong>Total</strong></td>
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</tr>
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</table>

### 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. Valentour Traveling Scholarship Fund, the Burdett Assistantship, the Lusher Lashmit Award, and the Jan Junge Award.

### Study Abroad and Summer Abroad Program

As with other schools at Carnegie Mellon, the school conducts an officially recognized exchange program for fourth year students to study abroad at the EPFL in Lausanne, Switzerland; ITESM in Monterrey, Mexico; and the National University of Singapore. 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. Students present study abroad plans to the School for review at the beginning of the third year and upon return they must present their work. 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 one summer-abroad program each summer. The location at which these programs are conducted varies from year to year. Recent offerings have included 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.

### Advanced Masters Degrees: 5+1

The School has forged several alliances to support advanced study in a student's undergraduate years and to enable them to receive a Masters degree with one additional year on campus beyond the professional B.Arch.

- Masters of Science in Computational Design
- Masters of Science in Building Performance and Diagnostics
- Masters of Science in Sustainable Design
- Masters of Urban Design
- Masters of Science in Architecture Engineering Construction Management
- Masters in Public Policy and Management (H. John Heinz III School of Public Policy & Management)

In addition to the in-house Masters of Science degrees, the School has joined forces with the Heinz School of Public Policy and Management to create a MSPPM degree program to place professional practitioners in a more active role in public policy and planning at the urban, regional, and national level.

Another partnership has been formed with the Department of Civil and Environmental Engineering in the Carnegie Institute of Technology to create the Masters of Science in Architecture Engineering Construction Management.

### Summer Courses

Students are able to take design studios and courses in some sequences during the summer. Studios are taught on a vertical format that develops the focus of each semester’s topic on an individual format. 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. Two areas of emphasis that involve multiple faculty and graduate students are computer-aided architectural design and performance of advanced technologies in buildings. 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 makes no distinction between graduate research faculty and undergraduate faculty. All faculty teach undergraduate courses as a regular part of their yearly teaching load. As a result, undergraduate students enjoy regular contact with faculty who are in positions of leadership in expanding the knowledge base of the profession.
Faculty
ÖMER AKIN, Professor of Architecture — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1977—.

STEPHANIE BARTOS, Assistant 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—.

WALTER BOYKOWYCZ, Perﬁdo Weiskopf Architects, Adjunct Professor of Architecture — M.U.R.P., University of Pittsburgh; Carnegie Mellon, 1979—.

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—.

ANNE CHEN, EDGE Architecture + Graphic Design, Adjunct Assistant Professor of Architecture — M.Arch., Columbia University; Carnegie Mellon, 1999—.

DOUGLAS COOPER, 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—.

STEFANI DANES, Perkins Eastman, Adjunct Associate Professor of Architecture — M.Arch., Yale University; Carnegie Mellon, 1979—.

JEFF DAVIS, Davis Gannon, Adjunct Assistant Professor of Architecture — BS, University of Illinois Urbana Champaign; Carnegie Mellon, 1996—.

ERIC FISHER, Perﬁdo Weiskopf Architects, Adjunct Assistant Professor of Architecture — M.Arch., Harvard University; Carnegie Mellon, 2001—.

ULRICH FLEMMING, Professor Emeritus of Architecture — Ph.D., Technical University of Berlin; Carnegie Mellon, 1981—.

KEVIN GANNON, Davis Gannon, Adjunct Assistant Professor of Architecture — M.Arch., Yale University; Carnegie Mellon, 1993—.

ANTON GERMISHUZEN, Burt Hill Kosar Rittelmann Associates, Adjunct Professor of Architecture — M.Arch., University of Pennsylvania; Carnegie Mellon, 1993—.

SHELTON GOETTEL, Perﬁdo Weiskopf Architects, Adjunct Professor of Architecture — M.Arch., Carnegie Mellon University; Carnegie Mellon, 1990—.

LUIS RICO GUTIERREZ, Special Faculty in Architecture & Associate Dean of the College of Fine Arts — MS., Carnegie Mellon University; Carnegie Mellon, 1998—.

KAI GUTSCHOW, Assistant Professor of Architecture — M.Arch., University of California, Berkeley; Carnegie Mellon, 1998—.

TIM HADFIELD, Adjunct Assistant Professor of Architecture — M.F.A., Chelsea School of Art; Carnegie Mellon, 2001—.

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—.

ROBERT KOBET, Sustainaissance International, Adjunct Assistant Professor of Architecture — B.Arch., University of Cincinnati; Carnegie Mellon, 1996—.

RAMESH KRISHNAMURTI, Professor of Architecture — Ph.D. (Systems Design), University of Waterloo; Carnegie Mellon, 1989—.

KRISTIN KURLAND, Senior Lecturer in Architecture and Heinz School of Public Policy and Management, University of Pittsburgh; Carnegie Mellon, 1996—.

LAURA LEE, Associate Professor of Architecture — 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 Professor of Urban Design — M.Arch., Leeds College of Architecture; Carnegie Mellon, 1982—.


VIVIAN LOFTNESS, Professor of Architecture and Head — 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—.

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 eventualities. Evidence of leadership is a plus.

Admission to the undergraduate program is highly competitive. Students must show promise of excellence in both academic and artistic performance.

The art 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. Concepts and topics addressed through these courses are divided into five categories: the self and the human being, space/time, systems/processes, and context.

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 Concept Studios, titled Art-in-Context, are devoted entirely to context-related issues. 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 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 or in College of Fine Arts Interdisciplinary courses.

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
- Freshman Year (fall): Modern Visual Culture: 1789-1945
- Sophomore Year (fall): Contemporary Visual Culture: 1945 to the Present

After the sophomore year, students must take two additional art history/theory 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, English Composition.

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”

And the student must then take at least three additional courses from ONE of the academic area/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.

### Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-101 Concept Studio I</td>
<td>10</td>
</tr>
<tr>
<td>60-110 Electronic Media Studio I: Computer Art</td>
<td>10</td>
</tr>
<tr>
<td>60-150 2D Media Studio I: Drawing</td>
<td>10</td>
</tr>
<tr>
<td>60-104 Contemporary Issues Forum</td>
<td>6</td>
</tr>
<tr>
<td>99-103 Computer Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>76-101 Interpretation and Argument (English Composition)</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>48</td>
</tr>
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</table>

### Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-201 Concept Studio III</td>
<td>10</td>
</tr>
<tr>
<td>60-230 3-Dimensional Media Studio II</td>
<td>10</td>
</tr>
<tr>
<td>60-250 2D Media Studio III: Painting</td>
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</tr>
<tr>
<td>60-205 Modern Visual Culture: 1789-945</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Academic Elective</td>
<td>9</td>
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<tr>
<td></td>
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### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-301 Art-in-Context</td>
<td>10</td>
</tr>
<tr>
<td>60-4xx Advanced Studio</td>
<td>10</td>
</tr>
<tr>
<td>60-4xx Advanced Studio</td>
<td>10</td>
</tr>
<tr>
<td>60-3xx Academic Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Academic Elective</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>48</td>
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</tbody>
</table>

### Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-401 Senior Project</td>
<td>10</td>
</tr>
<tr>
<td>60-4xx Advanced Studio</td>
<td>10</td>
</tr>
<tr>
<td>60-4xx Advanced Studio</td>
<td>10</td>
</tr>
<tr>
<td>60-3xx Academic Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Academic Elective</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>48</td>
</tr>
</tbody>
</table>

**Total Units: 384**

### 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 should discuss their plans with representatives from other departments as well as those in the School of Art.

### Study Abroad

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
- **Chile**  
  Instituto Superior de Arte y Communicacion, Santiago
- **China**  
  Chinese University of Hong Kong, Shatin, Hong Kong
- **Ecador**  
  Universidad de San Francisco de Quito, Quito
- **England**  
- **Finland**  
  Kuvataideakademia, Helsinki
- **France**  
  Ecole d’Aix-en Provence
  Ecole nationale superieure des Beaux-Arts, Paris
- **Germany**  
  Akademie der Bildenden Kunste, Munich
  Universitat der Kunste Berlin, Berlin
  University of Applied Sciences, Hamburg
  University of Applied Sciences, (Kunstseminar) Schwabisch Hall
  University of Applied Sciences, Wedel
- **Israel**  
  Bezalel Academy, Jerusalem
- **Italy**  
  Accademia Di Belle Arti Brera, Milan
- **Japan**  
  College of Art & Design, Nagoya
- **Netherlands**  
  Gerrit Rietveld Academie, Amsterdam
- **New Zealand**  
  Auckland Institute of Technology, Auckland
- **Poland**  
  Academy of Fine Arts in Poznan, Poznan
- **Scotland**  
  Duncan Jordanstone College of Art and Design, Dundee
  Glasgow School of Fine Art, Glasgow
- **Spain**  
  Universitat Politecnica de Valencia, Valencia
- **Switzerland**  
  Ecole Superieure d’Art Visuel, Geneva
- **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 and at Pittsburgh Filmmakers. Established agreements with these accredited institutions and other Pittsburgh colleges, universities or centers offer cross-registration opportunities at no additional expense to the student.
The Bachelor of Humanities and Arts (B.H.A.) and the Bachelor of Science and Arts (B.S.A.) Degrees

Carnegie Mellon University offers a degree program that combines an Art Focus (11 courses) with coursework in the College of Humanities and Social Sciences and/or the Mellon College of Science. The Assistant Head of the School advises the BHA and BSA major 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 3-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 web site: http://www.art.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 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

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, 1988—

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, Associate Professor of Art—M.F.A. University of California, Davis; Carnegie Mellon, 1997—

PAMELA JENNINGS, Assistant Professor of Art and HCII—M.F.A. School of Visual Arts; Carnegie Mellon, 2001—

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—

JOSEPH MANNINO, Associate Professor of Art—M.F.A. University of Southern Illinois; Carnegie Mellon, 1988—

CLAYTON MERRELL, Assistant Professor of Art—M.F.A. Yale University; Carnegie Mellon, 1998—

AYANAH MOOR, Assistant Professor of Art—M.F.A. Tyler School of Art; Carnegie Mellon, 1999—

KEITH PIPER, Assistant Professor of Art—M.A. Royal College of Art, London; Carnegie Mellon, 2000—

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, 1979—

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

HILARY HARP, Visiting Associate Professor of Art—M.F.A. Tyler School of Art; Carnegie Mellon, 2001—

SIMONE JONES, Visiting Assistant Professor of Art—M.F.A. York University, Ontario; Carnegie Mellon, 2000—

IRINA NAKHOVA, Visiting Assistant Professor of Art—M.F.A. equivalent, Moscow Institute of Graphic Arts, Moscow; Carnegie Mellon, 2001—

SEAN REGAN, Visiting Assistant Professor of Art—M.F.A. University of Iowa; Carnegie Mellon, 2001—

LANCE WINN, Visiting Assistant Professor of Art—M.F.A. Cranbrook Academy of Art; Carnegie Mellon, 2001—

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—
Design at Carnegie Mellon

Design is the art that humanizes our environment through visual communication and the construction of all of the 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, machinery, 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 capabilities 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 the fine arts, 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 department 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, multi-media 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. 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 model-making, 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 majors 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 individual projects determined to a large extent by the personal interest of the student. 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, new ways of combining words and images for effective communication, 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 Studio</td>
<td>Design Studio I</td>
<td>9</td>
</tr>
<tr>
<td>51-121 Ideas &amp; Methods</td>
<td>Design Drawing I</td>
<td>9</td>
</tr>
<tr>
<td>51-171 Design Studies</td>
<td>Human Experience in Design</td>
<td>9</td>
</tr>
<tr>
<td>76-101 General Education</td>
<td>English Argument</td>
<td>9</td>
</tr>
<tr>
<td>85-100</td>
<td>Introduction to Intelligence</td>
<td>9</td>
</tr>
<tr>
<td>99-101</td>
<td>Computer Skills Workshop</td>
<td>3</td>
</tr>
</tbody>
</table>

School of Design

Dan Boyarski, Head

Office: Margaret Morrison Carnegie Hall 110

http://www.cmu.edu/design
The Second- and Third-Year Experience: Concentration and Development

Following the first-year program, students enter one of the professional design majors: communication design or industrial design. Each option is built around six semesters of required and elective courses, covering the sophomore, junior, and senior years. The courses pose increasingly complex design problems similar to those faced by professional designers. They require students to use all of their creative, technical, and theoretical skills. In addition to studios, each option also requires a series of ideas and methods courses and a series of design studies courses covering design history, theory, and criticism as well as issues of professional practice. Students are also required to take general education courses to gain a broad vision of many disciplines and fields of knowledge that are relevant to design.

Communication Design

This is the second- and third-year curriculum for students in communication design, with required courses noted in bold type and other available courses (often open to students of industrial design as well as communication 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.

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.
The Fourth-Year Experience: Integration and Advanced Study

In the senior year, the studio experience involves team projects. Team projects typically involve cooperation with an industrial or institutional client, as well as a combination of communication designers and industrial designers. The client 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.

### Fourth Year

#### Fall

<table>
<thead>
<tr>
<th>Studio</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>51-403</td>
<td>Sr. Project: Interaction Design 12</td>
</tr>
<tr>
<td>51-405</td>
<td>Sr. Project: Communication Design 12</td>
</tr>
<tr>
<td>51-407</td>
<td>Sr. Project: Product Design 12</td>
</tr>
<tr>
<td>51-409</td>
<td>Sr. Project: Environmental Design 12</td>
</tr>
<tr>
<td>51-412</td>
<td>Sr. Project: Integrated Product Development 12</td>
</tr>
<tr>
<td>51-421</td>
<td>Visual Interface &amp; Interaction Design 9</td>
</tr>
<tr>
<td>51-451</td>
<td>Fundamentals of Joinery &amp; Furniture Design (I) 9</td>
</tr>
<tr>
<td>51-471</td>
<td>Issues of Professional Practice 9</td>
</tr>
</tbody>
</table>

**Other**

**General Education**

**Academic Elective**

**Free Elective**

#### Spring

<table>
<thead>
<tr>
<th>Studio</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>51-404</td>
<td>Sr. Project: Interaction Design 12</td>
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<tr>
<td>51-406</td>
<td>Sr. Project: Communication Design 12</td>
</tr>
<tr>
<td>51-408</td>
<td>Sr. Project: Environmental Design 12</td>
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<tr>
<td>51-412</td>
<td>Sr. Project: Integrated Product Development 12</td>
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<tr>
<td>51-425</td>
<td>Letterpress &amp; Bookbinding 9</td>
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<tr>
<td>51-452</td>
<td>Furniture Design (II) 9</td>
</tr>
<tr>
<td>51-472</td>
<td>Topics in Design Studies 9</td>
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</tbody>
</table>

**Other**

**General Education**

**Academic Elective**

**Free Electives**

### 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 English 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 course 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. If necessary, courses in which a student receives less than a “C” will be repeated until the GPA satisfies the departmental requirement for program status. This may require that a student take courses in the summer or beyond the standard four years. Regulations regarding overloads will apply. The School offers a very limited summer program, based on the availability of faculty.

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 submit a portfolio or to complete a portfolio project determined by the School 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, Assistant Professor of Design — M.A., Ohio State University; Carnegie Mellon, 1998—.

DANIEL BOYARSKI, AIGA, Professor of Design, Head, School of Design — M.F.A., Indiana University; School for Design, Kunsthochschule, Basel, Switzerland; Carnegie Mellon, 1982—.

CHARLEE MAE BRODSKY, Professor of Photography — M.F.A., Yale University; Carnegie Mellon, 1978—.

RICHARD BUCHANAN, IDSA, DMI, DRS, ACD, SIP, IICS, Professor of Design—Ph.D. University of Chicago; Carnegie Mellon, 1992—.

BRUCE HANINGTON, Assistant Professor of Design — Master of Environmental and Industrial Design, University of Calgary; Carnegie Mellon, 1998—.

KRISTIN HUGHES, AIGA, 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, 1979—.


KAREN MOYER, AIGA, ACD, Senior Lecturer in Design — B.F.A., Philadelphia College of Art; Carnegie Mellon, 1979—.
STEPHEN J. STADELMIEIER, IDSA, Associate Professor of Design — M.S., Cornell University; Carnegie Mellon, 1977—.

ROBERT O. SWINEHART, HMACD, AIGA, Professor of Design — M.F.A., Northern Illinois University; Carnegie Mellon, 1974—.

CRAIG M. VOGEL, IDSA, GDEA, IVLA, FATE, CAA, Professor of Design— M.I.D., Pratt Institute; Carnegie Mellon, 1990—.

BRONWEN WALTERS, IDSA, Assistant Professor of Design — M.S., Stevens Institute of Technology; Carnegie Mellon, 2000—.

ELIZABETH WELLMAN, Lecturer in Design — M.Arch., Virginia Polytechnic Institute and State University; Carnegie Mellon, 1996—.

Adjunct Faculty
MATTHEW BEALE, IDSA, Adjunct Assistant Professor — B.A., University of Michigan.

KAREN BERNTSEN, Adjunct Assistant Professor — B.F.A., University of Michigan.

LISA CARVAJAL, Graduate Program Coordinator and Adjunct Instructor — B.F.A., Carnegie Mellon University.

RICK LANDESBERG, AIGA, Adjunct Associate Professor — B.F.A., Philadelphia College of Art and Design.

MYRNA ROSEN, Adjunct Instructor

KEITH SAFT, Adjunct Instructor — B.A., Carnegie Mellon University.

BERNARD UY, Adjunct Assistant Professor — B.F.A., Carnegie Mellon University.

Joint Appointments
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.

Special Faculty

EDWARD FISHER JR., Associate Professor of Design, Emeritus.

HOWARD WORNER, Associate Professor of Design, Emeritus.
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 media.

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 classwork, 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 vicinity of the campus.

Acting Option

The acting program is designed for the student who has made the choice to seek a professional career as an actor. It is structured so that the student will be capable of entering the theatrical profession after four years of training. The curriculum focuses primarily on the creative process, but teaches a craft appropriate for all media. Courses in acting, voice, speech, movement, and/or dance are integral parts of the program at all four levels. The freshman year is a discovery year in which the acting process is taken apart through exercises, text work and improvisation. The fundamental elements of acting are explored in depth as the student learns how they fit together and how to integrate oneself fully into the imaginary world of the play. Sophomores develop and expand these techniques through scene study and character development; exploring a wide range of classical and modern styles to develop a way of working that will support and enrich the student’s natural talent. Juniors and seniors progressively test and strengthen these skills in supervised rehearsal and performance situations, while continuing to develop their craft in advanced technique classes.

Music Theatre Option

The School of Drama offers the music theatre option for students with special skills in singing, dancing and acting. The program’s rigorous curriculum includes training in the disciplines of acting, vocal music, voice and speech, movement, dance and deals with such forms as musical comedy, cabaret theatre, experimental musical theatre, and the epic musical. The curriculum in this option is demanding and adheres to the strictest requirements for a full technique in singing, dancing and acting. The department believes that good music theatre must come from the combined excellence of these three disciplines. Applicants to the music theatre option should have the same potential acting talent and trainability as the acting major. Students in this option share the same curriculum as those in the acting option plus courses particular to music theatre. The School of Drama considers the music theatre option 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.

To expand their interests and vision, the students in this option are encouraged to take several electives and to pursue a minor outside the drama department.

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.

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 option will give students from any of the School’s conservatory programs the opportunity to continue developing their creative skills while expanding their interests in 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 option is to encourage students to explore the diverse professional opportunities in which conservatory drama training can be used, and to examine the possibility of graduate schools for future 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 partaking in a recommended internship is required for one semester, either in the Fall or Spring.

Acting Option

**Freshman Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>54-101 Acting I</td>
<td>12</td>
</tr>
<tr>
<td>54-103 Speech I</td>
<td>6</td>
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<td>54-105 Voice</td>
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<tr>
<td>54-107 Introduction to Movement</td>
<td>4</td>
</tr>
<tr>
<td>54-111 Text</td>
<td>3</td>
</tr>
<tr>
<td>54-163 Introduction to Production (crew)</td>
<td>6</td>
</tr>
<tr>
<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>
</tr>
<tr>
<td>99-xxx Computer Skills Workshop</td>
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**Spring**

<table>
<thead>
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<tbody>
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<td>54-104 Speech I</td>
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</tr>
<tr>
<td>54-106 Voice</td>
<td>6</td>
</tr>
<tr>
<td>54-108 Movement I</td>
<td>4</td>
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<tr>
<td>54-164 Introduction to Production (crew)</td>
<td>6</td>
</tr>
<tr>
<td>54-178 Text to Stage</td>
<td>6</td>
</tr>
<tr>
<td>76-101 Interpretation and Argument (English)</td>
<td>9</td>
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<tr>
<td>xx-xxx Non-Drama Elective (minimum)</td>
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**Sophomore Year**

<table>
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<tr>
<td>54-201 Acting II</td>
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<tr>
<td>54-203 Voice &amp; Speech II</td>
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<tr>
<td>54-207 Movement II</td>
<td>6</td>
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<td>54-221 Directing II</td>
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<td>54-241 Improvisation</td>
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<td>54-259 Production Preparation II (crew)</td>
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<td>54-281 History of Drama</td>
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<td>54-301 Junior Studio – Directing</td>
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**Junior Year**

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<td>54-305 Voice III</td>
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<tr>
<td>54-307 Movement II</td>
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<tr>
<td>54-311 Rehearsal &amp; Performance</td>
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<td>54-312 Rehearsal &amp; Performance</td>
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<tr>
<td>54-406 Graduate Directing</td>
<td>6</td>
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<td>54-420 Stage Combat</td>
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<tr>
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<tr>
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**Spring**

<table>
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<tbody>
<tr>
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<td>54-302 Acting I</td>
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<td>54-304 Voice II</td>
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<tr>
<td>54-306 Voice III</td>
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<td>54-308 Movement III</td>
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<tr>
<td>54-312 Rehearsal &amp; Performance</td>
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<tr>
<td>54-406 Graduate Directing</td>
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</tr>
<tr>
<td>54-420 Stage Combat</td>
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<tr>
<td>54-502 Junior Auditioning (optional)</td>
<td>2</td>
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<tr>
<td>xx-xxx History of Drama (if necessary) (variable)</td>
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<tr>
<td>xx-xxx Non-Drama Elective (minimum)</td>
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**Senior Year**

<table>
<thead>
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<tr>
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<td>54-403 Voice Over (optional)</td>
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<td>54-405 Graduate Directing</td>
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<td>54-407 Movement IV</td>
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<td>54-409 Theatre Lab</td>
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<tr>
<td>54-411 Rehearsal &amp; Performance</td>
<td>12</td>
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<tr>
<td>54-437 Acting IV</td>
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<td>54-494 Business of the Business</td>
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<td>xx-xxx Non-Drama Elective (minimum)</td>
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</table>

**Music Theater Option**

The Drama Department considers this option to be the equivalent of a double major. No non-drama electives are required.

**Freshman Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
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<td>54-101 Acting I</td>
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<td>54-107 Movement I</td>
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<tr>
<td>54-164 Introduction to Production (crew)</td>
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<tr>
<td>54-178 Text to Stage</td>
<td>6</td>
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<tr>
<td>76-101 Interpretation and Argument (English)</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Non-Drama Elective (minimum)</td>
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**Spring**

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<tbody>
<tr>
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<td>54-123 Dance I</td>
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<td>54-125 Music Skills I</td>
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<tr>
<td>54-177 Text to Stage</td>
<td>6</td>
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<tr>
<td>54-500 Singing Lesson/Lab</td>
<td>6</td>
</tr>
<tr>
<td>79-xxx Introduction to World History</td>
<td>9</td>
</tr>
<tr>
<td>99-xxx Computer Skills Workshop</td>
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**Senior Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>54-101 Acting III</td>
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</tr>
<tr>
<td>54-103 Voice &amp; Speech III (dialects)</td>
<td>6</td>
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<td>54-105 Voice IV</td>
<td>3</td>
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<tr>
<td>54-107 Movement IV</td>
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<td>54-123 Dance IV</td>
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<td>54-125 Music Skills IV</td>
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<td>54-163 Introduction to Production</td>
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<td>54-500 Singing Lesson/Lab</td>
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<tr>
<td>79-xxx Introduction to World History</td>
<td>9</td>
</tr>
<tr>
<td>99-xxx Computer Skills Workshop</td>
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Minimum units - 59
### Spring
- 54-102 Acting I 12
- 54-104 Speech I 6
- 54-106 Voice 6
- 54-108 Movement I 4
- 54-124 Dance I 4
- 54-126 Music Skills 2 6
- 54-164 Introduction to Production 6
- 54-178 Text to Stage 6
- 54-500 Singing Lesson/Lab 6
- 76-101 Interpretation and Argument (English) 6

**Sophomore Year**

#### Fall
- 54-201 Acting II 12
- 54-203 Voice & Speech II 6
- 54-207 Movement II 2
- 54-219 Music Theatre Ensemble Singing 6
- 54-223 Dance II 6
- 54-259 Production Preparation II (crew) 9
- 54-281 History of Drama 6
- 54-294 Make-Up 2
- 54-500 Singing Lesson/Lab 6

**Minimum units - 55**

#### Spring
- 54-202 Acting II 12
- 54-204 Voice & Speech II 6
- 54-206 Acting Lab II 2
- 54-208 Movement II 4
- 54-220 Music Theatre Workshop II 6
- 54-224 Dance II 6
- 54-226 Acting A Song 6
- 54-262 Production Preparation II (crew) 9
- 54-282 History of Drama 6
- 54-294 Make-Up 2
- 54-500 Singing Lesson/Lab 6

**Minimum units - 55**

### Junior Year

#### Fall
- 54-301 Acting III 9
- 54-303 Voice & Speech III (dialects) 6
- 54-305 Voice III 6
- 54-311 Rehearsal & Performance 12
- 54-319 Cabaret 6
- 54-323 Dance III 6
- 54-500 Singing Lesson/Lab 6
- 54-xxx History of Drama (if necessary) (variable)

**Minimum units - 57**

#### Spring
- 54-302 Acting III 9
- 54-304 Voice & Speech III (accents) 6
- 54-306 Voice III 6
- 54-312 Rehearsal & Performance 12
- 54-320 Music Theatre Scenes 6
- 54-324 Dance III 6
- 54-500 Singing Lesson/Lab 6
- 54-xxx History of Drama (if necessary) (variable)

**Minimum units - 57**

### Senior Year

#### Fall
- 54-401 Camera Lab 6
- 54-403 Voice & Speech IV (optional) 6
- 54-409 Theatre Lab 4
- 54-411 Rehearsal & Performance 12
- 54-415 Coaching 2
- 54-423 Dance IV 6
- 54-437 Acting IV 9
- 54-494 Business of the Business 3
- 54-500 Singing Lesson/Lab 6
- 54-xxx History of Drama (if necessary) (variable)

**Minimum units - 54**

#### Spring
- 54-402 Camera Lab 6
- 54-410 Theatre Lab 4
- 54-412 Rehearsal & Performance 12
- 54-414 Leagues 9
- 54-416 Coaching 2
- 54-423 Dance IV 6
- 54-437 Acting IV 9
- 54-500 Singing Lesson/Lab 6
- 54-xxx History of Drama (if necessary) (variable)

**Minimum units - 54**

### Design Option

#### Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>54-151 Electrics Stagecraft</td>
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</tr>
<tr>
<td>54-153 Costumes Stagecraft</td>
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<tr>
<td>54-171 Media Studio</td>
<td>16</td>
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<tr>
<td>54-163 Introduction to Production</td>
<td>6</td>
</tr>
<tr>
<td>54-177 Text to Stage</td>
<td>6</td>
</tr>
<tr>
<td>79-xxx Introduction to World History</td>
<td>9</td>
</tr>
<tr>
<td>99-xxx Computer Skills Workshop</td>
<td>(minimum) 6</td>
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</tbody>
</table>

**Minimum units - 46**

#### Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>54-221 Directing II</td>
<td>9</td>
</tr>
<tr>
<td>54-231 Design for the Stage</td>
<td>9</td>
</tr>
<tr>
<td>54-251 Intro to Lighting</td>
<td>6</td>
</tr>
<tr>
<td>54-259 Production Preparation II</td>
<td>9</td>
</tr>
<tr>
<td>54-269 Autocad</td>
<td>6</td>
</tr>
<tr>
<td>54-272 Standard Scenery Construction</td>
<td>4</td>
</tr>
<tr>
<td>54-281 History of Drama</td>
<td>6</td>
</tr>
<tr>
<td>62-148 Art and Culture</td>
<td>6</td>
</tr>
<tr>
<td>xx-xxx Non-Drama Elective</td>
<td>(minimum) 6</td>
</tr>
</tbody>
</table>

**Minimum units - 43**

#### Junior Year

Required for all Junior Design
- 54-239 History of Architecture and Décor 4
- 54-245 History of Clothing 4
- 54-361 Production Preparation III 12

**Minimum units - 48**

#### LIGHTING DESIGN

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>54-349 Automated Lighting</td>
<td>6</td>
</tr>
<tr>
<td>54-351 Lighting Design I</td>
<td>9</td>
</tr>
<tr>
<td>54-367 Production Electrics</td>
<td>6</td>
</tr>
<tr>
<td>54-xxx History of Drama (if necessary)</td>
<td>(variable)</td>
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<tr>
<td>xx-xxx Non-Drama Elective</td>
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**Minimum units - 37**

#### COSTUME DESIGN

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>54-341 Costume Design I</td>
<td>9</td>
</tr>
<tr>
<td>54-343 Costume Construction I</td>
<td>6</td>
</tr>
<tr>
<td>54-347 Figure Drawing</td>
<td>4</td>
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<tr>
<td>54-xxx History of Drama (if necessary)</td>
<td>(variable)</td>
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<tr>
<td>xx-xxx Non-Drama Elective</td>
<td>(minimum) 6</td>
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</table>

**Minimum units - 45**

#### SCENE DESIGN

<table>
<thead>
<tr>
<th>Fall</th>
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<tbody>
<tr>
<td>54-237 Introduction to Scene Painting</td>
<td>6</td>
</tr>
<tr>
<td>54-331 Scene Design I</td>
<td>9</td>
</tr>
<tr>
<td>54-347 Figure Drawing</td>
<td>4</td>
</tr>
<tr>
<td>54-xxx History of Drama (if necessary)</td>
<td>(variable)</td>
</tr>
<tr>
<td>xx-xxx Non-Drama Elective</td>
<td>(minimum) 6</td>
</tr>
</tbody>
</table>

**Minimum units - 45**

#### Spring

Required for all Junior Design
- 54-240 History of Architecture and Décor 4
- 54-246 History of Clothing 4
- 54-270 Photoshop 6
- 54-294 Make-up 2
- 54-362 Production Preparation III 12
- 54-363 Production Preparation III 12
- 54-xxx History of Drama (if necessary) (variable)

**Minimum units - 54**
### Lighting Design
- **Lighting Design I** 9
- History of Drama (if necessary) (variable)
- Non-Drama Elective (minimum) 6

Minimum units – 43

### Costume Design
- **Costume Design I** 9
- Costume Construction I 6
- History of Drama (if necessary) (variable)
- Non-Drama Elective (minimum) 6

Minimum units – 49

### Scene Design
- **Introduction to Scene Painting** 4
- Scene Design I 9
- History of Drama (if necessary) (variable)
- Non-Drama Elective (minimum) 6

Minimum units – 47

### Senior Year

#### Fall & Spring Units

- 54-451/2 Lighting Design II 9
- Drama Elective (minimum) 6

Minimum units - 36

#### Costume Design
- **Costume Design II** 9
- Costume Construction II 6
- Drama Elective (minimum) 6

Minimum units - 42

#### Scene Design
- **Scene Design II** 9
- Drama Elective (minimum) 6

Minimum units - 36

### Directing Option

#### Freshman Year

#### Fall Units
- 54-101 Acting I 12
- 54-107 Movement I 4
- 54-121 Introduction to Directing 12
- 54-163 Introduction to Production 6
- 54-177 Text to Stage 6
- 79-xxx Introduction to World History 9
- 99-xxx Computer Skills Workshop

Minimum units - 52

#### Spring Units
- 54-102 Acting I 12
- 54-122 Directing I 12
- 54-164 Introduction to Production 6
- 54-178 Text to Stage 6
- 76-101 Interpretation & Argument (English) 9
- Non-Drama Elective (minimum) 6

Minimum units - 51

#### Sophomore Year

#### Fall Units
- 54-201 Acting II 12
- 54-221 Directing II 9
- 54-251 Introduction to Lighting Design 6
- 54-257 Production II, as assigned 6
- 54-281 History of Drama 6
- One elective (minimum) 6
- Non-Drama Elective (minimum) 6

Minimum units - 51

### Production Technology and Management Option

#### All Tracks

#### Freshmen Year

#### Fall Units
- 54-151 Electrics Stagecraft 3
- 54-153 Costumes Stagecraft 3
- 54-171 Media Studio 16
- 54-163 Introduction to Production 6
- 54-177 Text to Stage 6
- 79-xxx Introduction to World History 9
- Computer Skills Workshop 3

Minimum units - 46

#### Spring Units
- 54-164 Introduction to Production 6
- 54-172 Media Studio 16
- 54-178 Text to Stage 6
- 76-101 Interpretation and Argument (English) 9
- Non-Drama Elective (minimum) 6

Minimum units - 43
### Sophomore Year

#### Fall
- 54-221 Directing II 9
- 54-231 Design for the Stage 9
- 54-251 Introduction to Lighting Design 6
- 54-259 Production Preparation II 9
- 54-263 Welding (elective) 4-6
- 54-269 Computer Applications: Autocad 6
- 54-272 Standard Scenery Construction 4
- 54-281 History of Drama 6
- xx-xxx Non-Drama Elective (minimum) 6

**Minimum units - 55**

#### Spring
- 54-232 Design for the Stage 9
- 54-252 Introduction to Lighting 6
- 54-262 Production Preparation II 9
- 54-264 Welding (elective) 4-6
- 54-274 Production Planning 9
- 54-278 Stage Management (elective) 4-6
- 54-292 History of Drama 6
- 54-376 Rigging 6
- 62-148 Art and Culture 6
- xx-xxx Non-Drama Elective (minimum) 6

**Minimum units - 57**

### Junior Year

#### Fall
- 54-165 Introduction to Sound Design for the Theatre 6
- 54-239 History of Architecture and Décor 4
- 54-273 Technical Direction 9
- 54-349 Automated Lighting Technology (elective) 4-6
- 54-361 Production Preparation III 12
- 54-367 Production Electrics (elective) 4-6
- 54-353 Structural Design I 9
- 54-xxx History of Drama (if necessary) (variable)
- xx-xxx Non-Drama Elective (minimum) 6

**Minimum units - 46**

#### Spring
- 54-166 Introduction to Sound Design for the Theatre 6
- 54-240 History of Architecture and Décor 4
- 54-354 Structural Design II 9
- 54-362 Production Preparation III 12
- 54-366 Physics of Stage Machinery 9
- 54-378 Technical Design I 12
- 54-xxx History of Drama (if necessary) (variable)
- xx-xxx Non-Drama Elective (minimum) 6

**Minimum units - 58**

### Senior Year

#### Fall
- 54-365 Machine Design I 9
- 54-461 Production Preparation IV 15
- 54-475 Theatre Management 6
- 54-477 Technical Design II 9
- 54-xxx History of Drama (if necessary) (variable)
- 90-775 Management Seminar for Artists 9
- xx-xxx Non-Drama Elective (minimum) 6

**Minimum units - 54**

#### Spring
- 54-268 Sound Design I 9
- 54-402 Camera Lab 6
- 54-461 Production Preparation IV 15
- 54-866 Machinery Design 9
- 54-xxx Drama Elective 6-9
- 54-xxx History of Drama (if necessary) (variable)
- xx-xxx Non-Drama Elective (minimum) 6

**Minimum units - 51**

### 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
- Thesis: 54-491/92, 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. This 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 and after consulting with the head of the Drama Department.

### Electives for Non-Drama Department Students
- 54-113/4 Ballet for Non-Majors, Beginning and Advanced 6
- 54-134 Directing for Non-Majors 6
- 54-163/4 Introduction to Production 6
- 54-177/8 Text to Stage 6
- 54-187/8 Introduction to Playwriting 6
- 54-189/90 Advanced Playwriting 9
- 54-231/2 Design for the Stage 6
- 54-239/40 History of Architecture and Decor 6
- 54-245/6 History of Clothing 6
- 54-309/10 Theatre Lab 4
- 54-331/2 Scene Design I 9
- 54-341/2 Costume Design I 9
- 54-343/4 Costume Construction II 6
- 54-409/10 Theatre Lab 4
- 54-431/2 Scene Design II 9
- 54-433 Producing for Television and Film 6
- 54-441/2 Costume Design II 9
- 54-443/4 Costume Construction II 6
- 54-451/2 Lighting Design III 6
- 54-475 Theatre Management 6

*Permission of Instructor Required*
Faculty

BARBARA BENZ ANDERSON, Professor of Drama/Design — M.F.A., Yale University; Carnegie Mellon, 1968—.

CLETUS 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, Senior Lecturer of Design — M.F.A., Northwestern University; Carnegie Mellon. 1988—.

DAVID BOEVERS, Assistant Professor of Technical Design — 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, 1996—.

JAMES CATON, Lecturer of Dance — Carnegie Mellon, 1988—.

JUDITH CONTE, Senior Lecturer of Dance — B.F.A., University of Wisconsin/ Milwaukee; Carnegie Mellon, 1978—.

SCOTT LEE DENIER, Assistant Professor of Acting/Drama Literature — M.A., Northwestern; Carnegie Mellon, 2000—.

THOMAS DOUGLAS, Lecturer of Voice — M.M. Duquesne University; Carnegie Mellon 1991—.

JANET FEINDEL, Associate Professor of Voice & Speech — M.F.A. in Drama, Carnegie Mellon; Carnegie Mellon, 1996—.

LAWRENCE FITZKEE, Associate Professor of Voice & Speech — M.F.A. in Drama, Carnegie Mellon; Carnegie Mellon, 1996—.


KEVIN HINES, Lecturer of Technical Direction — M.F.A. Yale University; Carnegie Mellon, 1998—.

GREGORY LEHANE, Professor of Directing; Option Coordinator, Directing — M.F.A., Carnegie Mellon; Carnegie Mellon, 1991—.

CINDY LIMAUR; Associate Professor of Drama/Lighting — 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/ Dramatic Literature — 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 —.

ANNIE MUNDELL, Associate Professor of Design; Option Coordinator, Design — M.F.A. Brandeis University; Carnegie Mellon, 1989—.

MICHAEL OLICH, Associate Professor of Design — M.F.A. Carnegie Mellon; Carnegie Mellon, 1999—.

KEN LEIGH ROGERS, Senior Lecturer of Dance — Carnegie Mellon, 2001—.

INGRID SONNICHSEN, Associate 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—.

DON WADSWORTH, Professor of Drama/Voice & Speech — M.F.A., University of Pittsburgh; Carnegie Mellon, 1989—.

The School of Music at Carnegie Mellon is a “Conservatory in a University Setting”. A comprehensive curriculum is offered in an environment rich in diverse musical experiences and academic opportunities. The School of Music is an accredited institutional member of the National Association of Schools of Music.

The School is committed to developing each student’s full range of talents. A strong classical and contemporary program provides a solid background for professional careers in music, while the possibility of combining a music degree with minors or majors in other disciplines expands students’ future career options.

Each student receives the highest level of individualized instruction from professional musicians and master teachers, many from the renowned Pittsburgh Symphony Orchestra. The Cuarteto Latinoamericano, Carnegie Mellon’s resident string quartet, has toured extensively throughout Western and Eastern Europe, the United States, and Latin America. The full time faculty includes specialists in Music History, Theory, Counterpoint, Analysis, Composition, Computer Music, Eurhythmics, Solfege, Pedagogy, Music Education, Accompanying, Chamber Music, Jazz, Conducting, and Recording Technology.

Performance is the heart of the School. Students participate in ensembles with expert professional guidance. Performing ensembles include the Carnegie Mellon Philharmonic Orchestra, Wind Ensemble, Jazz Ensemble, Concert Choir, Repertory Chorus, Jazz Vocal Ensemble, Opera/Music Theater Production, Contemporary Ensemble, Flute Ensemble, Horn Choir, Percussion Ensemble, and numerous chamber groups.

With an intense program in composition and a university environment enriched by computer technology, the School of Music places a strong emphasis on contemporary music. All members of the composition faculty are professional composers, who share the creative evolution of their own works with their students in a master/apprentice relationship. Students compose works for all types of instrumental and vocal groupings, culminating in an orchestral piece during the senior year. All student compositions are performed or given rehearsed readings by one of the School’s ensembles and are recorded professionally by the technical staff of the School.

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 the finest Steinway pianos. Music students also have access to a state-of-the-art recording studio and music technology cluster. Performances take place in Kresge Theater, Mellon Institute, 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 eurhythmics, 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, and Jazz History.

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:

<table>
<thead>
<tr>
<th>Building Block</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Studio</strong></td>
<td>57-501 Studio</td>
</tr>
<tr>
<td>1. Studio</td>
<td>This is the heart of the school. Students receive individualized instruction in their major area of study: performance or composition.</td>
</tr>
<tr>
<td>2. Theory</td>
<td>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.</td>
</tr>
<tr>
<td>3. History</td>
<td>These courses cover in depth the music of the western world and survey the styles and musical structures of non-western music.</td>
</tr>
<tr>
<td>4. Ensemble</td>
<td>This area includes student participation in some of the following ensembles: Carnegie Mellon Philharmonic Orchestra, Wind Ensemble, Jazz Ensemble, Concert Choir, Repertory Chorus, Jazz Vocal Ensemble, Opera/Music Theater Production, Contemporary Ensemble, Flute Ensemble, Horn 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.</td>
</tr>
<tr>
<td>5. Academics</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td>The total number of units required for graduation is 396. Three units equal one credit.</td>
</tr>
</tbody>
</table>

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## Piano

### Freshman Year

<table>
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<th>Semester</th>
<th>Units</th>
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<tr>
<td><strong>Fall</strong></td>
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<tr>
<td>57-501</td>
<td>Studio 9</td>
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<tr>
<td>57-4xx</td>
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<td>57-193</td>
<td>Skills of Accompanying I 3</td>
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<tr>
<td>57-152</td>
<td>Harmony I 6</td>
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<tr>
<td>57-161</td>
<td>Eurhythmics I 3</td>
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<td>57-181</td>
<td>Solfège I 6</td>
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<td>57-173</td>
<td>Survey of Western Music History 9</td>
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<td>Designated Writing Course 9</td>
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<td><strong>Spring</strong></td>
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<tr>
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<td>57-4xx</td>
<td>Major Ensemble 6</td>
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<tr>
<td>57-193</td>
<td>Skills of Accompanying II 3</td>
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<tr>
<td>57-153</td>
<td>Harmony II 6</td>
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<tr>
<td>57-162</td>
<td>Eurhythmics II 3</td>
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<td>57-182</td>
<td>Solfège II 6</td>
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<tr>
<td>57-203</td>
<td>Medieval Renaissance and Baroque Music History 9</td>
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<tr>
<td>57-101</td>
<td>Introduction to Music Technology 6</td>
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<td>99-xxx</td>
<td>Computer Skills Workshop 3</td>
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<tr>
<td>57-501</td>
<td>Studio 9</td>
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<td>57-154</td>
<td>18th Century Counterpoint 6</td>
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<td>57-164</td>
<td>Eurhythmics IV 3</td>
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<td>57-184</td>
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<td>57-205</td>
<td>20th Century Music History 9</td>
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<td>xx-xxx</td>
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<td><strong>Junior Year</strong></td>
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<tr>
<td>57-501</td>
<td>Studio 12</td>
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<tr>
<td>57-4xx</td>
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<tr>
<td>57-xxx</td>
<td>Performance Elective 3</td>
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<tr>
<td>57-xxx</td>
<td>Music Support Courses (Theory/History) 12</td>
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<td>xx-xxx</td>
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<td>xx-xxx</td>
<td>Basic Conducting Seminar 3</td>
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<tr>
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<td>57-4xx</td>
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<tr>
<td>57-xxx</td>
<td>Performance Elective 3</td>
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<tr>
<td>57-xxx</td>
<td>Music Support Courses (Theory/History) 12</td>
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<td>xx-xxx</td>
<td>General Studies Course 9</td>
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<tr>
<td>xx-xxx</td>
<td>Elective 6</td>
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<td><strong>Senior Year</strong></td>
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<tr>
<td>57-501</td>
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<td>57-xxx</td>
<td>Performance Elective 9</td>
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**Credits**

- The total number of units required for graduation is 396. Three units equal one credit.
**Organ**

**Freshman Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>57-502</td>
<td>Studio 9</td>
</tr>
<tr>
<td>57-4xx</td>
<td>Major Ensemble 6</td>
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<tr>
<td>57-191</td>
<td>Keyboard Studies I 3</td>
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<tr>
<td>57-152</td>
<td>Harmony I 6</td>
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**Spring**

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<td>Medieval, Renaissance, and Baroque Music History 9</td>
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**Sophomore Year**

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**Junior Year**

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**Senior Year**

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**Voice**

**Freshman Year**

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**Sophomore Year**

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**Junior Year**

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<td>57-433</td>
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<td>82-101</td>
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**Senior Year**

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### Spring

57-500  Studio  
57-4xx  Major Ensemble  
57-xxx  Production Course  
57-416  Dance VIII  
57-440  Acting VI  
57-436  English/Contemporary Literature and Repertoire  
xx -xxx  Elective

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### Instrumental

#### Freshman Year

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#### Sophomore Year

**Fall**

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#### Junior Year

**Fall**

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#### Senior Year

**Fall**

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### Composition

#### Freshman Year

**Fall**

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#### Sophomore Year

**Fall**

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#### Junior Year

**Fall**

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#### Senior Year

**Fall**

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<th>Units</th>
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</table>
**Minor in Conducting for Students in the School of Music**

**Admission Requirements**
- The student must apply to enter the program in the office of the Director of Student Services (CFA160A).

**Required Courses**
- 57-381 Accompanying I 6
- 57-382 Accompanying II 6
- 57-383 Accompanying III 6
- 57-384 Accompanying IV 6
- 57-385 Accompanying V 6
- 57-386 Accompanying VI 6

**Electives**
- Electives must be chosen from the following courses:
  - 57-202 Opera History 9
  - 57-220 English Diction 3
  - 57-221 Italian Diction 3
  - 57-222 French Diction 3
  - 57-223 German Diction 3
  - 57-332 Introduction to Conducting 6
  - 57-336 Instrumental/Choral Conducting 6
  - 57-431 Italian Literature and Repertoire 3
  - 57-432 French Literature and Repertoire 3
  - 57-433 Music Theater Literature and Repertoire 3
  - 57-434 Music Theater Literature and Repertoire 3
  - 57-435 German Literature and Repertoire 3
  - 57-436 English/Contemporary Literature and Repertoire 3
  - 57-459 Score Reading and Keyboard Harmony 6
  - 57-607 Vocal Methods 3

**Minimum required for Conducting minor: 54 units**

**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 (CFA162).

**Required Courses**
- 57-381 Accompanying I 6
- 57-382 Accompanying II 6
- 57-383 Accompanying III 6
- 57-384 Accompanying IV 6
- 57-385 Accompanying V 6
- 57-386 Accompanying VI 6

**Electives**
- Electives must be chosen from the following courses or performance opportunities:
  - 57-220 English Diction 9
  - 57-221 Italian Diction 3
  - 57-222 French Diction 3
  - 57-223 German Diction 3
  - 57-258 Twentieth Century Techniques 6
  - 57-272 Orchestration III 6
  - 57-336 Instrumental/Choral Conducting 6
  - 57-337 Sound Recording 6
  - 57-338 Sound Editing and Production 6
  - 57-360 Brass Methods 3
  - 57-363 String Methods 3
  - 57-431 Italian Literature and Repertoire 3
  - 57-432 French Literature and Repertoire 3
  - 57-433 German Literature and Repertoire 3
  - 57-450 Jazz Ear Training 3
  - 57-607 Vocal Methods 3

**Performance Opportunities:**
- 57-225 Contemporary Ensemble 3
- 57-227 Jazz Ensemble 3
- 57-228 Chamber Music 3
- 57-328 Jazz Chamber Music 3

**Minimum required for Accompanying minor: 54 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 advisor for music minors (CFA 162).
2. The student must perform an acceptable audition. For the audition, the student should perform two contrasting pieces and demonstrate their jazz performance skills.

**Prerequisite Courses**
- 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.

**Required Courses**
- 57-381 Accompanying I 6
- 57-382 Accompanying II 6
- 57-383 Accompanying III 6
- 57-384 Accompanying IV 6
- 57-385 Accompanying V 6
- 57-386 Accompanying VI 6

**Electives**
- Electives must be chosen from the following courses or performance opportunities:
  - 57-202 Opera History 9
  - 57-220 English Diction 3
  - 57-221 Italian Diction 3
  - 57-222 French Diction 3
  - 57-223 German Diction 3
  - 57-332 Introduction to Conducting 6
  - 57-336 Instrumental/Choral Conducting 6
  - 57-431 Italian Literature and Repertoire 3
  - 57-432 French Literature and Repertoire 3
  - 57-433 German Literature and Repertoire 3
  - 57-450 Jazz Ear Training 3
  - 57-607 Vocal Methods 3
  - 57-225 Contemporary Ensemble 3
  - 57-227 Jazz Ensemble 3
  - 57-228 Chamber Music 3
  - 57-328 Jazz Chamber Music 3

**Minor in Jazz Performance for Students in the School of Music**

This sequence is for candidates 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 162).
2. The student must perform an acceptable audition. For the audition, the student should perform two contrasting pieces and demonstrate their jazz performance skills.

**Prerequisite Courses**
- 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.

**Required Courses**
- 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.

**Electives**
- Electives must be chosen from the following courses or performance opportunities:
  - 57-202 Opera History 9
  - 57-220 English Diction 3
  - 57-221 Italian Diction 3
  - 57-222 French Diction 3
  - 57-223 German Diction 3
  - 57-332 Introduction to Conducting 6
  - 57-336 Instrumental/Choral Conducting 6
  - 57-431 Italian Literature and Repertoire 3
  - 57-432 French Literature and Repertoire 3
  - 57-433 German Literature and Repertoire 3
  - 57-450 Jazz Ear Training 3
  - 57-607 Vocal Methods 3
  - 57-225 Contemporary Ensemble 3
  - 57-227 Jazz Ensemble 3
  - 57-228 Chamber Music 3
  - 57-328 Jazz Chamber Music 3

**Minor in Jazz Performance for Students in the School of Music**

This sequence is for candidates who have substantial potential as demonstrated by an acceptable audition and would like to improve their jazz performance skills.
## 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
- 57-457 Jazz History I 6
- 57-458 Jazz History II 6

**Minimum units required: 54**

### Minor in Music Education for Students in the School of Music

#### Admission Requirements
1. Students apply to the music education faculty no earlier than spring of the freshman year.

#### Corequisite General Courses 45 units
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<td>mathematics course #2</td>
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#### Corequisite Music Courses 18 units
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#### Conducting Courses
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<tbody>
<tr>
<td>57-332</td>
<td>Introduction to Conducting</td>
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</tr>
<tr>
<td>57-336</td>
<td>Instrumental/Choral Conducting</td>
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#### General Education Courses 18 units
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<td>Principles of Education</td>
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#### Music Education Methods Courses 45 units
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<tr>
<td>57-376</td>
<td>Elementary Guided Teaching</td>
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<tr>
<td>57-377</td>
<td>Music in the Secondary School</td>
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#### Applied Area Methods Courses
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#### Band Methods Courses
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<td>Fundamentals of Marching Band</td>
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<tr>
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<td>Band and Choral Arranging</td>
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#### Music Education Teaching Courses 15 units
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<td>Practice Teaching</td>
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**Minimum units required: 78**

### Minor in Music Technology for Students in the School of Music

This sequence is for candidates who are interested in recording, sound-editing and other music technology areas.

#### Admission Requirements
1. The student must apply to enter the program in the office of the Director of Student Services (CFA160A).

#### Prerequisite Courses 3 units
Basic Theory Skills is required of students who do not qualify for entrance into Harmony I, based on their scores on the theory placement test. Computer Skills Workshop must be passed before taking any of the required technology courses.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tr>
<td>57-090</td>
<td>Basic Theory Skills</td>
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<tr>
<td>99-xxx</td>
<td>Computer Skills Workshop</td>
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#### Introductory Theory Course 6 units
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<tr>
<td>57-152</td>
<td>Harmony I</td>
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**Required Music Technology Courses 33 units**
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<tr>
<td>57-101</td>
<td>Introduction to Music Technology</td>
<td>6</td>
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<tr>
<td>57-337</td>
<td>Sound Recording</td>
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</tr>
<tr>
<td>57-338</td>
<td>Sound Editing and Production</td>
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</tr>
<tr>
<td>57-347</td>
<td>Electronic and Computer Music</td>
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</tr>
<tr>
<td>57-438</td>
<td>MultiTrack Recording</td>
<td>9</td>
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#### Elective Courses 24-28 units
- Other courses may also be approved as electives with the approval of the advisor for music minors.

#### Music History courses (choose 1)
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<tr>
<td>57-173</td>
<td>Survey of Western Music History</td>
<td>9</td>
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<tr>
<td>57-202</td>
<td>Opera History</td>
<td>9</td>
</tr>
<tr>
<td>57-205</td>
<td>20th Century Music History</td>
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#### Technical courses (choose 2)
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<tr>
<td>xx-xxx</td>
<td>HASS multimedia course</td>
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</tr>
<tr>
<td>15-127</td>
<td>Intro to Programming and Computer Science</td>
<td>10</td>
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<tr>
<td>15-229</td>
<td>MultiMedia Information Processing</td>
<td>9</td>
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<tr>
<td>33-114</td>
<td>Physics of Musical Sound</td>
<td>9</td>
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<tr>
<td>54-165</td>
<td>Sound I</td>
<td>6</td>
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<tr>
<td>57-610</td>
<td>Internship</td>
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**Minimum units required: 63-67**

### Faculty
- DENNIS ABELESON, Artist Lecturer in French Horn — B.M., Duquesne University; Carnegie Mellon, 1987—.
- TIMOTHY ADAMS, Associate Professor of Percussion; Carnegie Mellon, 1995—.
- DOUGLAS AHLSTEDT, Associate Professor of Voice — M.M., Eastman School of Music; Carnegie Mellon, 1998—.
- EDUARDO ALONSO CRESPO, Director of Contemporary Ensemble — M.F.A., Carnegie Mellon University; Carnegie Mellon, 1989—.
- DONNA AMATO, Staff Accompanist; Carnegie Mellon, 1998—.
- EFRAIN AMAYA, Resident Conductor; Carnegie Mellon, 1993—.
- TOBY APPEL, Artist Lecturer in Viola — B.M., Curtis Institute of Music; Carnegie Mellon, 2002—.
- LEONARDO BALADA, Professor of Composition — Diploma, The Juilliard School of Music; Carnegie Mellon, 1970—.
- JEANNE BAXTRESSER, Professor of Flute — B.M., The Juilliard School of Music; Carnegie Mellon, 1997—.
- SCOTT BELL, Artist Lecturer in Oboe; Carnegie Mellon, 1994—.
- 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—.
- ANDRES CARDENES, Professor of Violin; Carnegie Mellon, 1989—.
- DAVID CARROLL, Senior Lecturer; Carnegie Mellon, 2000—.
- L. MARK CARVER, Artist Lecturer in Accompanying/Coaching — M.M., Carnegie Mellon University; Carnegie Mellon, 1995—.
- REBECCA CHERIAN, Artist Lecturer in Trombone; Carnegie Mellon, 1993—.
- DENIS COLWELL, Associate Professor, Director of Wind Ensemble; Carnegie Mellon, 1979—.
- JOHN D’AMICO, Artist Lecturer in Jazz Piano; Carnegie Mellon, 1995—.
- MURRAY CREWE, Artist Lecturer in Bass Trombone; Carnegie Mellon, 2001—.
- DONNA CREWE, Artist Lecturer in Accompanying/Coaching — M.M., Carnegie Mellon University; Carnegie Mellon, 1995—.
- ERIC DEFADE, Artist Lecturer in Jazz Saxophone; Carnegie Mellon, 2002—.
- THOMAS DOUGLAS, Lecturer in Conducting/Jazz Vocal Ensemble/Musical Theatre — M.M., Duquesne University; Carnegie Mellon, 1991—.
- JONATHAN EATON, Associate Professor of Opera; Carnegie Mellon, 1999—.
- SUMNER ERICKSON, Artist Lecturer in Tuba; Carnegie Mellon, 1991—.
- CYNTHIA DE ALMEIDA, Artist Lecturer in Oboe — M.M., Temple University; Carnegie Mellon, 2002—.
- DENNIS FRIEDMAN, Lecturer; Carnegie Mellon, 1989—.
- AMAL GARGIULO, Professor of Violin; Carnegie Mellon, 1987—.
- JOHN DAVIS, Artist Lecturer in Conducting — M.M., Duquesne University; Carnegie Mellon, 1989—.
- DAVID DELOACH, Lecturer in Jazz Saxophone; Carnegie Mellon, 1987—.
- EDUARDO DE LA CRUZ, Professor of Composition — Diploma, The Juilliard School of Music; Carnegie Mellon, 1970—.
- DONNA DEUTSCH, Staff Accompanist; Carnegie Mellon, 1989—.
- TRACI DESLONCH, Artist Lecturer in String Bass; Carnegie Mellon, 2000—.
- KURT DITTMER, Lecturer in Accompanying/Coaching — M.M., Carnegie Mellon University; Carnegie Mellon, 1995—.
- EDUARDO DIAZ, Lecturer in Conducting — M.M., Duquesne University; Carnegie Mellon, 1987—.
- DONNA DILLON, Staff Accompanist; Carnegie Mellon, 1998—.
- KIRK DILORENZO, Artist Lecturer in Percussion; Carnegie Mellon, 2000—.
- ROBERT DIXON, Lecturer in Accompanying/Coaching — M.M., Carnegie Mellon University; Carnegie Mellon, 1995—.
- JOHN DOLAN, Lecturer in Accompanying/Coaching — M.M., Carnegie Mellon University; Carnegie Mellon, 1995—.
ALAN FLETCHER, Professor of Music and Head, School of Music — D.M.A., The Juilliard School of Music; Carnegie Mellon, 2001—.

CYRUS FOROUGH, Artist Lecturer in Violin; Carnegie Mellon, 2001—.

HARRY FRANKLIN, Professor Emeritus — Diploma, The Juilliard School of Music; Carnegie Mellon, 1957—.

MICHAEL FULLER, Artist Lecturer in Acting — M.F.A, Carnegie Mellon University; Carnegie Mellon, 1996—.

NANCY GALBRAITH, Associate 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, 1982—.

ALASDAIR GILLIES, Artist Lecturer in Bagpipe Music, Director of Bagpipe Band — Pipe Majors Certificate, Army School of Bagpipe Music; Carnegie Mellon, 1997—.

NANCY GOERES, Artist Lecturer in Bassoon — B.M., Boston University; Carnegie Mellon, 1988—.

ENRIQUE GRAF, Artist Lecturer in Piano; Carnegie Mellon, 1996—.

ANDREA HANSON, Assistant Professor in Voice; Carnegie Mellon, 2000—.

SIDNEY HARTH, Artist Lecturer in Violin; Carnegie Mellon, 2000—.

ROSEANNA IRWIN, Artist Lecturer in Accompanying/Coaching — M.M., Duquesne University; Carnegie Mellon, 1990—.

JUAN PABLO IZQUIERDO, Director of Orchestral Studies — Composition, University of Chile; Carnegie Mellon, 1990—.

ANNABELLE JOSEPH, Professor of Music — D.A., Carnegie Mellon University, Carnegie Mellon, 1986—.

KENNETH KEELING, Professor of Music — D.M.A., Catholic University of America; Carnegie Mellon, 1996—.

SEAN KELLY, Opera Coach and Staff Accompanist; Carnegie Mellon, 2001—.

BEATRICE KREBS, Professor Emerita of Voice — Diploma, Hochschule für Musik; Carnegie Mellon, 1983—.


ELIZABETH LAWRENCE CINSKI, Artist Lecturer in Jazz Voice; Carnegie Mellon, 1996—.

MIMI LERNER, Associate Professor of Voice — M.F.A., Carnegie Mellon University; Carnegie Mellon, 1993—.

HANNA WU LI, Associate Professor of Piano Pedagogy — M.M., Northwestern University; Carnegie Mellon, 1969—.

LUZ MANRIQUEZ, Artist Lecturer in Accompanying/Coaching; Carnegie Mellon, 1992—.

JOHN MARCZINZYK, Artist Lecturer in Guitar — Ph.D., University of Pittsburgh; Carnegie Mellon, 1991—.

ANNE MARGUERITE MICHAUD, Artist Lecturer in Harp — B.M., The Juilliard School of Music; Carnegie Mellon, 1988—.

SUZANNE MARSSE, Artist Lecturer in Voice; Carnegie Mellon, 2000—.

MILDRED MILLER POSTVAR, Artist Lecturer in Voice; Carnegie Mellon, 1981—.

BILLY JO MULLER WARD, Staff Accompanist; Carnegie Mellon, 1996—.

FRANCISCO JAVIER MONTIEL, Artist-in-Residence in Viola, Cuarteto Latinoamericano; Carnegie Mellon, 1987—.

ROBERT MOYER, Instructor in Music Education — M.M, Indiana University of Pennsylvania; Carnegie Mellon, 1987—.


NATALIE OZEAS, Associate Professor, Director of Music Education, and Associate Head, School of Music — Ed. D., University of Pittsburgh; Carnegie Mellon, 1989—.

ROBERT PAGE, Director of Choral Studies — M.M., Indiana University; Carnegie Mellon, 1976—.

PHILIP PANDOLFI, Artist Lecturer in Bassoon; Carnegie Mellon, 1995—.

ANTHONY PASQUARELLI, Artist Lecturer in Trumpet; Carnegie Mellon, 1957—.

DAVID PELLOW, Director of Jazz Studies — M.M., Duquesne University; Carnegie Mellon, 1991—.

DAVID PREMO, Artist Lecturer in Cello; Carnegie Mellon, 1994—.

REBECCA ROLLETT, Staff Accompanist; Carnegie Mellon, 1998—.

MICHAEL RUSINEK, Artist Lecturer in Clarinet; Carnegie Mellon, 1998—.

IRENE SCHREIER, Artist Lecturer in Piano and Theory — Diploma, Konservatorium Luzern; Carnegie Mellon, 1985—.

RICCARDO SCHULZ, Instructor in Recording Technology — M.A., University of Pittsburgh; Carnegie Mellon, 1988—.

FRANCO SCIANNIMEO, Artist Lecturer in Interdisciplinary Studies — D.M., Accademia Nazionale de Santa Cecilia; Carnegie Mellon, 1990—.

LEWIS STROUSE, Senior Lecturer in Music Education — D.A., Ball State University; Carnegie Mellon, 1992—.

MARTIL BAFF THOMAS, Professor of Theory and Composition — Ph.D., University of Pittsburgh; Carnegie Mellon, 1981—.

GEORGE THOMPSON, Lecturer in Dance; Carnegie Mellon, 1989—.

THOMAS THOMPSON, Artist Lecturer in Clarinet — M.M., Northwestern University; Carnegie Mellon, 1986—.

JEFFREY TURNER, Artist Lecturer in String Bass; Carnegie Mellon, 1989—.

REZA VALI, Associate Professor of Theory and Computer Music — Ph.D., University of Pittsburgh; Carnegie Mellon, 1988—.

GRETCHEN VAN HOESEN, Artist Lecturer in Harp — M.M., The Juilliard School; Carnegie Mellon, 1985—.

JAMES WHITFIELD, Artist Lecturer in Theory — 1995—.

EARL WILD, Distinguished Artist-in-Residence; Carnegie Mellon, 1993—.

COLETTE WILKINS, Instructor in Solfège — Diploma, National Conservatoire de Versailles; Carnegie Mellon, 1974—.

DONALD WILKINS, Professor Emeritus — M.A., Harvard University; Carnegie Mellon, 1966—.

ANNE MARTINDALE WILLIAMS, Artist Lecturer in Cello — Diploma, Curtis Institute of Music; Carnegie Mellon, 1987—.


RALPH ZITTEBART, Associate Professor of Piano — M.F.A., Carnegie Tech; Carnegie Mellon, 1963—.
The College of Humanities and Social Sciences

The College of Humanities and Social Sciences ..................... 170
H&SS General Education Program ........................................ 172
College-Wide Services, Programs and Research Centers ...... 176
H&SS Interdepartmental Majors ......................................... 184
H&SS Interdepartmental Minors ........................................ 192
Department of Economics ............................................... 201
Department of English .................................................... 205
Department of History .................................................... 213
Department of Modern Languages .................................... 218
Department of Philosophy ................................................ 227
Department of Psychology ............................................... 231
Department of Social and Decision Sciences ................... 236
Department of Statistics ............................................... 243
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
http://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 also houses a number of theoretical and applied research centers, as well as the Carnegie Mellon University Press. Current College enrollment is 1350, with 1120 who are undergraduates. The College accounts for approximately one-fourth of the university’s undergraduate population, and 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’s identity as an institution that merges first-rate, innovative research and creativity with classroom teaching. All faculty engage in both teaching and research. Undergraduates, therefore, benefit from contact in the classroom with highly accomplished faculty researchers and creative artists.

For example, beginning with the College’s General Education 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 20 students. Sophomores and second-semester freshmen may also select a "Faculty" course, a "Tuning" 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 year 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 quite 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 five-year programs that result in both a bachelor’s and master’s degree. These options provide an H&SS student with a great deal of flexibility and choice in designing a program of study.

H&SS Majors

<table>
<thead>
<tr>
<th>Name of Major (Degree Options)</th>
<th>Department</th>
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<td>Economics (B.S.) ................</td>
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<tr>
<td>Managerial Economics (B.S.) ...</td>
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<tr>
<td>English (B.A.) ..................</td>
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</tr>
<tr>
<td>Creative Writing (B.A.) ........</td>
<td>English</td>
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<tr>
<td>Professional Writing (B.A.) ...</td>
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<tr>
<td>Technical Writing and Communication (B.S.)</td>
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<td>Anthropology and History (B.A. or B.S.)</td>
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<tr>
<td>History and Policy (B.A. or B.S.)</td>
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<td>Ethics, History, and Public Policy (B.A. or B.S.)</td>
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<td>European Studies (B.A.) ........</td>
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<td>Information Systems (B.S.) .....</td>
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<td>International Relations (additional major only)</td>
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<tr>
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<tr>
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<td>Spanish (B.A.) ...............</td>
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<td>Modern Languages with a concentration in English as a Second Language (B.A.)</td>
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<td>Philosophy (B.A.) .............</td>
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<tr>
<td>Logic and Computation (B.S.) ..</td>
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<td>Psychology (B.A. or B.S.) ....</td>
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<tr>
<td>Psychology and Biological Sciences (B.S.)*</td>
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<td>Cognitive Science (B.S.) .......</td>
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<tr>
<td>Decision Science (B.S.) .......</td>
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<td>Policy and Management (B.S.) ...</td>
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<td>Political Science (B.S.) ......</td>
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<tr>
<td>Mathematical and Statistical Sciences (BS)**</td>
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* Joint with the Biological Sciences Department, Mellon College of Science
** Joint with the Mathematical Sciences Department, Mellon College of Science and the Statistics Department, College of Humanities and Social Sciences
**Additional Majors**

Many H&SS students pursue additional majors and/or minors in the college, and in some cases attained 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 program that are prerequisites to courses required for the H&SS major they are completing.

Space permitting, a number of additional majors and minors elsewhere in the university are available to H&SS students.

**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>Minor</th>
<th>Department</th>
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<tr>
<td>English</td>
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<tr>
<td>History</td>
<td>History</td>
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</tr>
<tr>
<td>French</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>
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<tr>
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<td>English as a Second Language</td>
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<tr>
<td>Ethics</td>
<td>Philosophy</td>
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<td>Logic and Computation</td>
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<tr>
<td>Decision Science</td>
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<tr>
<td>Political Science</td>
<td>Social and Decision Sciences</td>
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<tr>
<td>Statistics</td>
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**H&SS Interdepartmental Minors**

<table>
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<th>Minor</th>
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<tbody>
<tr>
<td>Arts in Society</td>
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<td>European Studies</td>
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<td>Film and Media Studies</td>
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<tr>
<td>Gender Studies</td>
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<tr>
<td>Health Care Policy and Management*</td>
</tr>
<tr>
<td>International Relations</td>
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<tr>
<td>Linguistics</td>
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<td>Minority Studies</td>
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<td>Multimedia Production</td>
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<td>Religious Studies</td>
</tr>
<tr>
<td>Russian Studies</td>
</tr>
<tr>
<td>Science, Technology and Society</td>
</tr>
<tr>
<td>Sociology</td>
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<tr>
<td>Student-Defined</td>
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</tbody>
</table>

*intercollege minor with the H. John Heinz III School and the Mellon College of Science, and the College of Humanities and Social Sciences*

**Fifth-Year Graduate Degree Options**

A number of Five-Year programs are available to H&SS students that lead to both an undergraduate and graduate degree.

- M.S. in Public Management and Policy, Accelerated Masters Program, H. John Heinz III School of Public Policy and Management
- M.S. in Logic and Computation, Philosophy Department, College of Humanities and Social Sciences
- M.A. Teaching of English to Speakers of Other Languages (“TESOL”), Modern Languages Department, College of Humanities and Social Sciences

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.

A.B. 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, 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 General Education Program

In H&SS, we believe in the importance of exposure to and appreciation of disciplines other than the ones represented in our majors. Engaging this spirit, the General Education (GenEd) Program provides students with a balanced integration of reflection and practice. Students are offered a variety of subjects not only within the college but also in science, technology, and the arts. The GenEd curriculum is structured to provide a great deal of flexibility and independence.

Organizing Ideas, Salient Features

All H&SS students complete a minimum of 13 courses in the GenEd program, accomplished largely in the first two years. These courses emphasize basic analytical categories combined with a wide range of choice in specific courses that exemplify these categories. It is designed to expose students to a variety of subjects and methodologies, and thereby broaden their horizons and range of possible subsequent major choices—not only within H&SS, but also in the sciences, the arts, and technology.

Unlike most conventional general education programs, the H&SS GenEd program goes beyond simple exposure to subjects. It also focuses on the analytical styles appropriate to solving different kinds of problems, with attention to both the strengths and limitations of each style. The styles or modes of thought stressed are diverse and transferable, and thus designed to open doors to new learning, teaching how to compare basic assumptions in preparation for more specialized learning, and stimulate intellectual awareness.

The program is flexible, and designed to be completed largely in the first two years of study. This flexibility allows for declaration of majors and minors to occur as early as the end of the first year or by the end of the second year.

General Education Categories

I. Three Common Course Requirements (CCR)
   CCR1, CCR2, CCR3
   These are requirements that all students take “in common.” They are to be completed in the freshman year.

II. Eight Distributional Course Requirements (DCR)
   DCR1, DCR2, DCR3, DCR4, DCR5, DCR6, 8th DCR
   These requirements are “distributed” across six course categories.

III. One University Requirement (UR)
     Computing Skills Workshop (CSW)
     This is a mini-course graded pass/fail.

IV. One Freshman Seminar Requirement (FSR)
     Students complete one designated seminar course in the first year.

I. COMMON COURSE REQUIREMENTS (CCR)

These courses introduce a style of thought essential to participation in this university and today’s society and develop intellectual capacities that can be used throughout life. Complete one course from each CCR 1, 2, and 3 by the end of the freshman year.

CCR1, WORLD CULTURES 9 units
This requirement seeks to recognize cultures that have shaped and continue to shape the human experience and analyze materials that provide clues as to how these cultures work.

79-104 Introduction to World History

Notes: This is the designated course for this requirement and is to be completed in the first year.

CCR2, 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.

76-101 Interpretation and 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.

CCR3, STATISTICAL REASONING 9 units
Numerical data surrounds us, from baseball box scores to the gross national product and from crime statistics to demographic trends. Statistical methodology and practice allow us to quantify data in order to draw conclusions. This requirement is designed to teach what types of data are quantifiable, how to gather data, what methods to use when evaluating data, and how to test hypotheses when using quantitative analysis.

36-201 Statistical Reasoning

Notes: This is the designated course for this requirement and is to be completed in the first year.

II. DISTRIBUTIONAL COURSE REQUIREMENTS (DCR)

Complete eight courses (minimum of 9 units from DCR 1, 2, 3, 4, 5, and two courses from DCR6). Complete the eighth course (minimum 9 units) from DCR 1, 2, 3, 4 or 5. Only one course taken from DCR 1, 2, 3, or 4 may be double-counted toward a major or minor requirement.

DCR1, COGNITION, CHOICE, AND BEHAVIOR 9 units
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.

80-150 The Nature of Reason
80-180 The Nature of Language
80-181 Language and Thought
80-242 Conflict and Dispute Resolution
85-100 Intro. 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
88-120 Reason, Passion & Cognition

Notes: Complete one course.

DCR2, ECONOMIC, POLITICAL, & SOCIAL INSTITUTIONS 9 units
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
73-100 Principles of Economics
73-389-110 Experiments with Economic Principles
79-266 Times of Feast/Famine: Population and Family in History
80-135 Introduction to Political Philosophy
80-136 Social Structure, Public & Ethical Dilemmas
88-104 Decision Processes in American Political Institutions
88-205 Comparative Politics

Notes: Complete one course. The courses 73-110 and 88-110 are the same course, cross-listed in different departments.

DCR3, CREATIVE PRODUCTION & REFLECTION 9 units
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.

48-095 Architecture for Non-Majors I
51-261 Communication Design Fundamentals
51-263 Industrial Design Fundamentals
51-265 Beginning Photography
54-161/162 Production Preparation
54-183/184 Fundamentals of Drama
54-187/188 Introduction to Playwriting
54-191/192 Acting for Non-Majors
54-251/252 Introduction to Lighting Design (6 units)
54-309/310 Theatre Lab (4 units)
54-351/352 Lighting Design I
57-117 Choral Ensemble for Non-Majors (6 units)
57-118 Instrumental Ensemble for Non-Majors (6 units)
57-328 Jazz Ensemble Music (3 units)
57-417 Major Choral Ensemble (6 units)
57-418 Major Instrumental Ensemble (6 units)
57-453/454 Jazz Improvisation I (3 units)
57-458/456 Jazz Improvisation II (3 units)
60-101 Concept Studio I
60-110 Electronic Media Studio I
60-130 3-D Media Studio I
62-102/103 Modern Dance Workshop (6 units)
62-299 CFA Interdisciplinary Workshop
76-206 Introduction to Creative Writing
80-120 Reflections on Science
80-241 Ethical Judgments in Professional Life
### Courses

**1. Philosophy and Art**
- 80-260 Philosophy and Art
- 82-101 Elementary French I
- 82-102 Elementary French II
- 82-103 Elementary French I, On-Line
- 82-104 Elementary French II, On-Line
- 82-121 Elementary German I
- 82-122 Elementary German II
- 82-131 Elementary Mandarin Chinese I
- 82-132 Elementary Mandarin Chinese II
- 82-135 Intensive Elementary Chinese
- 82-141 Elementary Spanish I
- 82-142 Elementary Spanish II
- 82-143 Elementary Spanish I, On-Line
- 82-161 Elementary Italian I
- 82-162 Elementary Italian II
- 82-171 Elementary Japanese I
- 82-172 Elementary Japanese II
- 82-191 Elementary Russian I
- 82-192 Elementary Russian II

**Notes:** Complete a minimum of 9 units.

**DCR4, CULTURAL ANALYSIS** **9 units**

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.

- 76-201 Literature & the Social
- 76-227 Comedy
- 79-112 Race, Nationality, and Culture in American Society
- 79-201 Introduction to Anthropology
- 79-206 Development of American Culture
- 79-207 The Development of European Culture
- 79-366 Poverty, Charity & Welfare
- 80-100 What Philosophy Is
- 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
- 82-204 Francophone World
- 82-415/416 Topics in French & Francophone Studies
- 82-420 German Classical Literature
- 82-423 Postwar German Literature
- 82-426 Studies in German Literature
- 82-427 Nazi & Resistance Culture
- 82-491 Studies In Latin American Literature & Culture
- 82-458/456 Topics in Hispanic Studies
- 82-492 Literature, Politics & Film in Russia Today
- 82-493 Joseph Brodsky in Context

**Notes:** Complete one course.

**DCR5, MATHEMATICAL REASONING** **9 units**

This requirement engenders an appreciation for the power and utility of mathematical reasoning.

- 21-110 Problem Solving in Recreational Mathematics
- 21-111 Calculus I
- 21-112 Calculus II
- 21-115 Differential Calculus (5 units)*
- 21-116 Integral Calculus (5 units)*
- 21-117 Integration & Diff. Equations (5 units)*
- 21-118 Calculus of Approximation (5 units)*
- 21-121 Calculus I*
- 21-127 Concepts of Mathematics
- 21-228 Discrete Mathematics
- 21-256 Multivariate Analysis and Approximation*
- 80-110 The Nature of Mathematical Reasoning
- 80-211 Arguments and Inquiry

**Notes:** Complete a minimum of 9 units. *Calculus Placement Test required.

**DCR6, SCIENCE AND TECHNOLOGY** **18 units**

This category introduces and provides an in-depth study of substance and methods in the natural and physical sciences, and the engineering technology and computer sciences.

- 03-121 Modern Biology
- 03-122 Organismic Botany
- 03-130 Biology of Organisms
- 03-125 Evolution and the History of Life
- 03-240 Cell Biology
- 09-103 Atoms, Molecules and Chemical Change
- 09-104 Fund. Aspects of Organic Chemistry & Biochemistry
- 09-105 Introduction to Modern Chemistry I
- 09-106 Modern Chemistry II
- 33-102 Concepts of Modern Physics
- 33-111 Physics for Science Students I
- 33-112 Physics for Science Students II
- 33-114 Physics of Musical Sound (non-major)
- 33-115 Energy and Environmental Issues
- 33-124 Introduction to Astronomy

**School of Computer Science**

- 15-211 Fundamental Data Structures & Algorithms
- 15-212 Principles of Programming

**Notes:** Complete two courses.

### 8th DCR, DCR 1 through 5 **9 units**

Complete one more course (minimum 9 units) from any course listed in DCR 1, 2, 3, 4, or 5. This course must be taken in addition to the course(s) taken to fulfill each DCR1, DCR2, DCR3, DCR4, and DCR 5. To fulfill this requirement and the DCR3 required, a minimum of 18 units must be completed.

### III. UNIVERSITY REQUIREMENT (UR)

A 3 unit mini-course, pass/no credit, completed in the first semester.


### IV. FRESHMAN SEMINAR REQUIREMENT (FSR)

This requirement is to be completed by the end of the first year by taken one course from a specific listing of course each semester. It seeks to insure that all entering H&SS freshmen have a highly interactive small-group course experience with a faculty member in Fall or Spring of the first year. These seminars are taught by selected members of the College’s faculty. Seminar topics stem from faculty research and teaching interests. Seminars 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. This program in H&SS is fortunate to be the beneficiary of gifts from alumni and friends.
H&SS College-Wide Services, Programs and Research Centers

The educational programs in H&SS are complemented by a number of services, special programs, research 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 prominent of these are described below.

Academic Advisory Center
Joseph E. Devine, Associate Dean
Office: Baker Hall 123
http://www.hss.cmu.edu/departments/deans_office/aac/default.htm

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 about the College General Education 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 environment, working their way through the H&SS General Education Program, and preparing for various academic and professional choices to follow. In addition, the AAC provides information about various relevant scholarships, internships, postgraduate 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 applications, 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 over 200 titles in contemporary poetry including Thomas and Beulah by Rita Dove, which won the 1987 Pulitzer Prize for Poetry. In recent years the Press offers 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 Africanamerican Urban Studies and the Economy (CAUSE)
Joe W. Trotter, Director
Baker Hall 240

Building upon scholarship in urban, labor, and African American history, CAUSE seeks to link the historian’s interest in change over time with contemporary discussions of race, cities, and employment opportunities. The Center aims to accomplish its objectives by developing programs of graduate and postdoctoral training, scholarly research, data collection, publications, and education. Most immediately, however, the Center will organize periodic scholarly conferences on specific areas of concern; conduct a regular speakers’ series; initiate a program of scholarly publications which will appeal to both scholars and the larger public; and build linkages between history and other units of the University, and African-American Studies programs at other institutions of higher education.

Center for Arts and Society
Director: Judith Modell
Baker Hall 242D

The Center for the Arts in Society is dedicated to energizing research and teaching that links 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.

Center for Automated Learning and Discovery (CALD)
Contacts: Thomas Mitchell, School of Computer Science, Stephen E. Fienberg, Statistics Department
http://www.cs.edu/~cald/

CALD draws together faculty, graduate and undergraduate students from a variety of departments at Carnegie Mellon, such as Computer Science, Statistics, Psychology, Philosophy, Robotics, the Graduate School of Industrial Administration, and the Pittsburgh Supercomputer Center, to pursue basic science in automated learning methods, including data mining, statistical methodology, and knowledge discovery, driven by applications to problems of societal importance. CALD collaborates with industrial and government partners to define
high-impact research problems, and provides educational programs to transfer the resulting technology. Ongoing research areas include data mining for manufacturing, mining the world wide web, searching by content, and data mining in multimedia databases, statistical and computational methods for disclosure limitation, visualization of massive data sets, causal inference, and learning in robotics.

CALD’s current industrial partners include ABB, Atraxis, Caterpillar, Giant Eagle, IBM, KeyBank, Microsoft Research, PNC Bank, and VSI Satech. CALD’s Software Affiliates include IBM, Oracle Corporation, SAS Institute, SGI and SPSS, Inc.

Center for Business, Technology, and the Environment
Joel A. Tarr, Director; David A. Hounshell, Associate Director
Baker Hall 240

The Center for Business, Technology, and the Environment fosters interdisciplinary research in these vital areas of economic development. It builds upon the strong belief in the Department of History, as is reflected in its graduate program in History and Policy, that history greatly enriches our understanding of current societal problems. The Center draws upon the strengths of the department in the history of technology, business history, and environmental history and brings focus to the work of its faculty and graduate students in these areas. In addition, the Center emphasizes interdisciplinary research, drawing upon the resources of CMU in such related disciplines as engineering, public policy, and business administration.

Initial projects address the economic impact of the railroad in western Pennsylvania; science and technology in the Cold War; the history of urban revitalization efforts in Pittsburgh; the history of the RAND Corporation; environmental problems stemming from the abandonment of industrial sites; and the creation of environmental indicators for the Pittsburgh region. Financial support has come from the Sloan Foundation, the U.S. National Park Service, the RAND Corporation, the National Science Foundation, the Heinz Foundation, and Duquesne Light and Power.

Center for Cultural Analysis
David Shumway, Director
Baker Hall 145D

The Center for Cultural Analysis groups faculty and students from English, History (including cultural anthropology), Modern Languages and Philosophy. The Center sponsors speakers and seminars, post-doctoral programs, and a summer school curriculum for undergraduates and talented high school juniors. In the activities, the Center emphasizes the interdisciplinary evolution of culture as sets of beliefs and values and their expression through various media. Thus the Center works on issues of comparing cultures, understanding the nature and cause of cultural change, and assessing the impact of cultures in shaping social institutions and American behaviors.

Center for History and Policy
Steven Schlossman, Director
Baker Hall 240

The Center for History and Policy has played an important role in expanding research opportunities for students in both the Social History and History and Policy programs. Students have participated in a wide variety of contract research projects on such topics as blacks, women, and gays in the military; implementation of environmental regulations; changes in rates of infant mortality; cocaine use, manufacture, and regulation; the change process in professional education; and innovative prison treatment programs. Financial support has come from such organizations as the RAND Corporation, the U.S. Department of Defense, the Graduate Management Admission Council, the American Educational Research Association, the National Center for Research in Vocational Education, the Jewish Healthcare Foundation, and several law firms and historical consulting firms.

Center for the Neural Basis of Cognition
Contact: James McClelland, Psychology Department
http://www.cnbc.cmu.edu/

CNBC is a joint project of Carnegie Mellon University and the University of Pittsburgh, including faculty and students from the Departments of Biological Sciences, Computer Science, Psychology, Statistics, and Robotics at Carnegie Mellon, and the Departments of Mathematics, Neurobiology, Neurology, Neuroscience, Psychiatry and Psychology at the University of Pittsburgh. CNBC is dedicated to the study of the neural basis of cognitive processes, including learning and memory, language and thought, perception, attention, and planning. Studies of the neural basis of normal adult cognition, cognitive development, and disorders of cognition all fall within the purview of CNBC. In addition, CNBC promotes the application of the results of the study of the neural basis of cognition to artificial intelligence, technology, and medicine. CNBC synthesizes the disciplines of basic and clinical neuroscience, cognitive psychology, and computer science, combining neurobiological, behavioral, computational and brain imaging methods. Clinical applications include major efforts to understand schizophrenia, Alzheimer’s disease, and disorders of language processing due to acquired or developmental disorders.

Center for Cognitive Brain Imaging (CCBI)
Contacts: Marcel Just, Psychology Department, William F. Eddy, Statistics Department
http://coglab.psy.cmu.edu

CCBI's research focuses on functional magnetic resonance imaging (fMRI) studies to investigate high-level cognition, using state-of-the-art scanners and techniques. The investigations also include several other approaches used in conjunction with fMRI studies, most notably, behavioral studies, computational modeling, eye fixation studies, and therapy studies of people with brain damage. The main types of thinking that CCBI investigates are high-level cognitive processes which include spatial thinking, language comprehension, problem solving, and executive processes. The general research goal is to develop a unified theory of cognition that is grounded in and accounts for the neural level of brain activity, at the level of large scale neural networks. CCBI is located at Carnegie Mellon, but its work is collaborative between Carnegie Mellon and the University of Pittsburgh. Undergraduates can become involved in CCBI through the Departments of Psychology and Statistics.

Educational Computing
Kimberly Jordan, Director of Computing
Office: Baker Hall A-60B

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 these 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 connections 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 computer resources; advising the College of the utilization of 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.

Environmental Institute
Edward S. Rubin, Institute Director
Carnegie Institute of Technology
Baker Hall 128A

The Environmental Institute at Carnegie Mellon was created in 1991 to focus attention through research and teaching on environmental concerns that are dramatically transforming the way we all do business. Issues such as global warming, acid rain, smog, toxic pollutants, and hazardous waste disposal have become major factors in technology and public policy developments, signaling a new era in the way we must think about the impacts of human activity, and the design and deployment of technology. The Environmental Institute coordinates and promotes new research and educational programs across a broad spectrum of technical, economic and policy-related studies. The Institute’s activities are organized into six major program areas: Air Quality Engineering and Science, Energy-Environmental Studies, Global Climate Change, Risk Analysis and Communication, Solid and Hazardous Waste Management, and Water Quality Engineering and Science. While based primarily in engineering and science, all of the Institute’s programs involve strong interdisciplinary
links with the social sciences. Faculty, research staff and students of the Institute are drawn from academic departments throughout the University. A faculty Steering Committee guides and coordinates all major program areas, and oversees the Institute’s emphasis on the integration of knowledge and perspectives across disciplines.

Fellowship Resource Advising Center
Director: Dr. Janet Stocks
Warner Hall 429
http://ost.studentfairst.cmu.edu/home.htm

The University’s Fellowship Resource and Advising Center acts as an advising unit and informational clearinghouse for Carnegie Mellon students to identify and compete for grants, fellowships, and academic awards for which they are eligible, competitive, and “good matches.” A number of these are particularly relevant for H&SS students, including the Harry S. Truman Scholarship Program, Luce Fellowship Program, Rhodes Scholar Program, Fulbright Fellowship Program, National Endowment for the Humanities Summer Fellowship Program, and Mellon Fellowship in the Humanities.

Heinz Accelerated Masters Program
H. John Heinz III School of Public Policy and Management
Office of Admissions: Hamburg Hall 1110

The Accelerated Masters Program is a cooperative program between the H. John Heinz III School of Public Policy and Management and Carnegie Mellon's undergraduate colleges. It provides a unique opportunity for qualified students to pursue both their undergraduate degree and a Master of Science degree in Public Management and Policy. Students apply during the junior year. If accepted, graduate course work begins in the fourth year, simultaneously with completion of undergraduate requirements. Accelerated Masters students obtain their bachelor's degree after four years and, if they elect to continue in the program, the master's degree after five years. This condenses five years what would otherwise take six years to complete.

The Heinz masters program curriculum consists of a common core, several concentration areas, a summer internship, and elective courses. Students choose one of the following concentration areas: policy analysis; financial management and analysis; information systems; management; urban planning; and economic development. The goal of the program is to prepare individuals for professional careers in management and public policy analysis. While the program is oriented toward the public sector, graduates have found their skills in high demand in both public and private sector positions. Alumni work in government, in non-profit organizations, in consulting firms, and in the private sector. Many have gone on to law school, medical school, or Ph.D. programs.

The Heinz School also offers joint degree programs with Carnegie Mellon's Graduate School of Industrial Administration, the Department of Architecture, the College of Fine Arts, and the University of Pittsburgh Law School. Students in the Heinz masters program are eligible for undergraduate financial aid during their fourth year and for graduate student financial aid during their fifth year. Students must apply for admission to the program during their junior year.

NOTE: H&SS students interested in the program must still complete all H&SS College General Education requirements for undergraduates. In addition, they must make arrangements with their undergraduate major department regarding the completion of major requirements.

H&SS Honors Program
Office of the Dean
Associate Dean's Office: Baker Hall A57
http://www.hss.cmu.edu/honors/index.htm

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 GPA 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 testify 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.

Institute for Statistics and its Applications (ISA)
Contact: Robert E. Kass, Statistics Department
http://www.stat.cmu.edu/cmhu-stat/sis

As a discipline, Statistics serves science and society through collaboration, where state-of-the-art techniques for collecting and analyzing data are applied, refined, or newly invented, and through communication of well-established methods to large numbers of future researchers and numerical consumers. The mission of the Institute is to foster the development of statistical methodology through vigorous cross-disciplinary collaborations, and to train undergraduate, pre-doctoral and post-doctoral statisticians in cross-disciplinary research and teaching. Current focus areas include the psycholgy of learning, functional magnetic resonance imaging, genetics, psychiatric statistics, statistical physics, criminology, governmental statistics, public policy, and environmental statistics. Many of the Institute’s research projects are collaborations in the Center for the Neural Basis of Cognition and the Center for Cognitive Brain Imaging. The mission and breadth of the Institute reflects Carnegie Mellon’s longstanding interests in understanding human behavior and decision making, in computing technology, and in research collaborations that break down barriers between the sciences.

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 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, United Way, Allegheny Conference on Community Development, Pittsburgh Council on Public Education, KDKA 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, and 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, Pittsburgh Plant, Sports Information, Ethics, the Newcomer Program, 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 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 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.

**Laboratory for Symbolic and Educational Computing**

Richard Scheines and Wilfried Sieg, Co-Directors
Baker Hall 139

The Laboratory for Symbolic and Educational Computing (LSEC) is administered by the Department of Philosophy. This laboratory is the locus for large computational projects of the department’s faculty and students. Currently, three research and education projects are respectively focused on causal inference, mathematical proof, and game theory. The department also provides support for undergraduates who are involved in these projects, LSEC Fellowships. For more information, see: [http://mss.cmu.edu/HTML/departments/philosophy/research/center.html](http://mss.cmu.edu/HTML/departments/philosophy/research/center.html)

**Modern Language Resource Center**

Christopher Jones, Director
Cesar Valencia, Coordinator
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.

**Phi Beta Kappa Society**

H&SS is one of the University’s colleges (along with Science, Computer Science, and the BHA/BSA/SHS Programs) that jointly shelter a chapter of the Phi Beta Kappa Society. Founded in 1776, 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. Membership in Phi Beta Kappa key has become a universally recognized mark of academic achievement in the liberal arts and sciences.

**Pittsburgh Center for Social History**

Contact: Donald Sutton, History Department
Baker Hall 240

The Pittsburgh Center for Social History is jointly managed by the Departments of History at Carnegie Mellon University and the University of Pittsburgh. It serves chiefly to coordinate several Departments of History at Carnegie Mellon University and the University of Pittsburgh. It serves chiefly to coordinate several Departments of History at Carnegie Mellon University and the University of Pittsburgh. It serves chiefly to coordinate several Departments of History at Carnegie Mellon University and the University of Pittsburgh. It serves chiefly to coordinate several Departments of History at Carnegie Mellon University and the University of Pittsburgh.

**Pre-Law Advising Program**

Director: Joseph Devine, Associate Dean
Office: H&SS Academic Advisory Center, Baker Hall A57

The University’s Pre-Law Advising Program is housed in the College of Humanities and Social Sciences. See the University section in the catalog “Undergraduate Options” for details of this program.

**Study Abroad**

Office of International Education
Eva Mergner, University Study Abroad Advisor
Warner Hall 219

Each year a number of H&SS students embark on Study Abroad programs. Such programs vary greatly in length, location, structure and timing in a student’s academic career. Some programs are for the summer, others for a full semester or a full academic year. While many are in English-speaking countries, many others are not. In the latter category, most programs offer the choice of studying in the native language, or studying in English while taking courses to learn the host country language. Some programs are sponsored and administered by American colleges and universities, while other programs require direct contact between student and host country institution. Information about such programs is available in the University’s Office of International Education, located in Warner Hall 219.

Carnegie Mellon’s Department of Modern Languages sponsors three summer programs of its own: one in Madrid and Puerto de Santa Maria, Spain, at the Estudio Internacional Sampere; one at the Goethe Institute in various cities in Germany; and one in southern France at Aix-en-Provence/Avignon. H&SS students pursuing such programs generally do so in their junior or senior year (or in the summer preceding one of these years), though earlier participation is possible depending on language needs and ability. Information available in the Office for International Education assists students in selecting accredited programs. Students must also work closely with their major or department advisor in attending to other steps and procedures, including selection of courses of study, obtaining recommendations and endorsements, etc. If students intend to apply any courses taken through such programs to College or major requirements, or even to have them count as electives, advance approval is required.

**Undergraduate Research Initiative**

Director: Dr. Janet Stocks
c/o Office of the Associate Provost for Academic Affairs
[http://ost.studentaffairs.cmu.edu/home.htm](http://ost.studentaffairs.cmu.edu/home.htm)

The Undergraduate Research Initiative orchestrates a variety of programs that support undergraduates in all academic disciplines across the university who want to pursue research projects. It gives small grants to help cover research expenses, stipends for full time research during the summer and funds to offset the expenses of presenting research at an academic conference. It organizes an annual campus-wide celebration of undergraduate research, the “meeting of the Minds” Undergraduate Research Symposium, on Spring reading day each May. It also offers support services to help students write grants, find appropriate mentors, and apply to professional conferences and an on-going seminar series to help build a sense of community among students on campus who are engaged in research.

**Washington Semester Program**

Stephanie Wallach, Advisor
Office: Baker Hall 240E

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; the Arts; Economic Policy; Education Policy and Special Education; Foreign Policy; International Business and Trade; International Environment and Development (requires an Overseas Practicum); Journalism; Justice; Peace and Conflict Resolution; Public Law; and Transforming Communities.
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 rather than into a specific department. 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 http://www.hss.cmu.edu/aac/).

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

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.

Probation Continued

A student who has had one semester on probation and is not yet meeting minimum requirements but whose records indicate 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 re-admission (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 student is dropped from, and not permitted to be enrolled again, in the College. 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

A normal schedule is considered to be five full courses or 45-51 factorable units of course work per semester (this unit number may vary slightly on occasion, due to courses with higher unit values).

The University’s policy for overloading is outlined in the University section of the catalog entitled “Undergraduate Academic Regulations.”

Physical Education and Military Science Courses

A maximum combination of nine units of credit for Physical Education and all Military Science courses may be counted for credit toward graduation as free electives in any H&SS program. Physical Education 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). 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)
3. No H&SS student may earn more than 18 units of internship credit during a semester.
4. No H&SS student may count more than 27 units of internship credits toward fulfilling graduation requirements.
5. 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.
6. 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 college 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 General Education categories CCR1, CCR2 or CCR3.

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 GPA.

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.

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 than 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 general education requirements, to major 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 College General Education 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 freshman 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. quality 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 will be recommended for graduation “With University Honors.”

Graduation with College Honors
H&SS students who successfully complete a senior honors thesis under the auspices of the H&SS Senior Honors Program qualify for graduation with “H&SS College Honors.”
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 departmental-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 emphasis concerns 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 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, 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 45-48 units

Required
- 66-210 Science and Technology for the Environment
- 12-251/252 Introduction to Environmental Engineering (including lab)
- 73-358 Economics of Natural Resources and Environment
- 79-345 American Environmental History: Critical Issues
- 79-346 International Environmental Affairs and Policy
- 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
- 24-424 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
- 76-522 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 QPA 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 EHPP 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&S General Education requirement.

- 21-257 Models & Methods for Optimization (Prerequisites 21-256)
- 36-303 Samplings, Surveys, & Society (Prerequisites include 36-201)
- 36-207 Probability & Statistics for Business (Prerequisites: 21-116 or 21-121)
- 36-208 Regression Analysis (Prerequisites: 36-207 or 21-116 or 21-121)
- 80-222 Measurement & Methodology (Prerequisite: 21-228)
- 80-305 Rational Choice (Prerequisites: none)
- 80-316 Probability & Artificial Intelligence (Prerequisites: none)
- Or: Any DCRS course option that is not used to fulfill the H&SS General Education DCRS 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

2) Complete one of the following courses.

- 79-242 African American History II
- 79-331 Crime and Punishment in American Society
- 79-336 Epidemic Disease & Public Health
- 79-337 Educational Policy: Historical Perspectives
- 79-373 Children & Youth in History & Policy

3) Complete one of the following courses.

- 79-205 20th Century Europe
- 79-207 Development of European Culture
- 79-253 Development of Caribbean Culture
- 79-270 Chinese Culture & 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: From Communism to Capitalism
- 79-290 Modern Latin America
- 79-356 African history: From the Earliest Times to the Origins of the Slave Trade
- 79-383 African history: From the Slave Trade to the Present

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.

- 80-136 Social Structure, Public Policy, & Ethical Dilemmas
- 80-236 Philosophy & Law
- 80-241 Professional Ethics
- 80-242 Conflict & Dispute Resolution
- 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

- 19-421 Law & Technology [See EPP catalog for prerequisites]
- 19-422 Radiation, Health, & Policy [See EPP catalog for prerequisites]
- 19-242 African American History II
- 19-244 Pittsburgh and the Transformation of Modern Urban America
- 19-246 Environmental Decision Making [See EPP catalog for prerequisites]
- 19-248 Science, Technology, & Ethics [See EPP catalog for prerequisites]
- 70-361 Foundations of Law
- 70-363 Law in Modern American Society
- 70-413 Conflict Resolution: Negotiation & Mediation
- 73-356 Political Economy of Public Institutions
- 73-357 Regulation: Theory & Policy
- 73-358 Economics of the Environment & Natural Resources
- 73-359 Benefit-Cost Analysis
- 73-476 American Economic History
- 79-230 Technology in American Society
- 79-231 Crime & Punishment in American Society
- 79-242 African American History II
- 79-330 The American Presidency
- 79-335 Drug Use & Drug Policy
- 79-336 Epidemic Disease & Health Policy
- 79-337 Educational Policy: Historical Perspectives
- 79-345 American Environmental History: Critical Issues
- 79-346 Children & Youth in History & Policy: Dialogues between Past & Present
- 79-368 Poverty, Charity, and Welfare
- 79-386 The Global Environment: Historical Perspectives and Policy Dilemmas
- 19-221 Philosophy of Social Science
- 19-321 Law & Technology [See EPP catalog for prerequisites]
- 19-322 Caution & Social Policy
- 19-235 Political Philosophy
- 19-323 Political Philosophy
- 19-236 Philosophy & Law
- 19-244 Management, Environment, & Ethics
- 19-245 Medical Ethics
- 19-246 The American Criminal Justice System: Realities & Ideals
- 19-340 Environmental Ethics & Decision Processes
- 19-342 Ethics & Oppression
- 19-343 Value, Fact, & Policy
- 88-104 Decision Processes in American Political Institutions
- 88-309 Altruism & Selfishness
- 88-313 Rationality & Values in Democracy
- 88-322 Elections, Interest Groups, & Public Policy
- 88-340 Law & Public Policy
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 specially 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.

**Business & Economic Policies Track**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>19-319</td>
<td>Law &amp; the Engineer [See EPP catalog for prerequisites]</td>
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<tr>
<td>19-424</td>
<td>Energy &amp; the Environment [See EPP catalog for prerequisites]</td>
</tr>
<tr>
<td>19-426</td>
<td>Environmental Decision Making [See EPP catalog for prerequisites]</td>
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<td>70-311</td>
<td>Organizational Behavior</td>
</tr>
<tr>
<td>70-332</td>
<td>Business &amp; Society</td>
</tr>
<tr>
<td>70-413</td>
<td>Conflict Resolution: Negotiation &amp; Mediation</td>
</tr>
<tr>
<td>70-430</td>
<td>International Management</td>
</tr>
<tr>
<td>73-351</td>
<td>Public Finance</td>
</tr>
<tr>
<td>73-356</td>
<td>Political Economy of Public Institutions</td>
</tr>
<tr>
<td>73-357</td>
<td>Regulation: Theory &amp; Policy</td>
</tr>
<tr>
<td>73-359</td>
<td>Benefit-Cost Analysis</td>
</tr>
<tr>
<td>73-365</td>
<td>Industrial Organization</td>
</tr>
<tr>
<td>73-371</td>
<td>International Trade</td>
</tr>
<tr>
<td>73-372</td>
<td>International Money &amp; Finance</td>
</tr>
<tr>
<td>73-476</td>
<td>American Economic History</td>
</tr>
<tr>
<td>79-230</td>
<td>Technology in American Society</td>
</tr>
<tr>
<td>79-341</td>
<td>War and Technology</td>
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<tr>
<td>79-342</td>
<td>Technology, Organization, and Information</td>
</tr>
<tr>
<td>79-345</td>
<td>American Environmental History: Critical Issues</td>
</tr>
<tr>
<td>79-358</td>
<td>Complex Technological Systems: Past, Present, and Future</td>
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<tr>
<td>79-386</td>
<td>The Global Environment: Historical Perspectives and Policy Dilemmas</td>
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<tr>
<td>79-440</td>
<td>The Rise of Industrial Research and Development</td>
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<tr>
<td>80-221</td>
<td>Philosophy of Social Science</td>
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<tr>
<td>80-321</td>
<td>Causation &amp; Social Policy</td>
</tr>
<tr>
<td>80-242</td>
<td>Conflict &amp; Dispute Resolution</td>
</tr>
<tr>
<td>80-243</td>
<td>Business Ethics</td>
</tr>
<tr>
<td>80-244</td>
<td>Management, Environment, &amp; Ethics</td>
</tr>
<tr>
<td>80-335</td>
<td>Philosophy, Politics, &amp; Economics</td>
</tr>
<tr>
<td>88-104</td>
<td>Decision Processes in American Political Institutions</td>
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<tr>
<td>88-223</td>
<td>Decision Analysis &amp; Decision Support Systems</td>
</tr>
<tr>
<td>88-309</td>
<td>Altruism &amp; Selfishness</td>
</tr>
<tr>
<td>88-313</td>
<td>Rationality &amp; Values in Democracy</td>
</tr>
<tr>
<td>88-343</td>
<td>Economics of Technological Change</td>
</tr>
<tr>
<td>88-425</td>
<td>Politics of Economic Deregulation</td>
</tr>
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**Law & Social Policy**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>70-361</td>
<td>Foundations of Law</td>
</tr>
<tr>
<td>70-363</td>
<td>Law in Modern American Society</td>
</tr>
<tr>
<td>80-236</td>
<td>Philosophy &amp; Law</td>
</tr>
<tr>
<td>88-340</td>
<td>Law &amp; Public Policy</td>
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**Environmental Policy**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>19-426</td>
<td>Environmental Decision Making [See EPP catalog for prerequisites]</td>
</tr>
<tr>
<td>73-358</td>
<td>Economics of the Environment &amp; Natural Resources</td>
</tr>
<tr>
<td>79-345</td>
<td>American Environmental History</td>
</tr>
<tr>
<td>80-244</td>
<td>Management Environment, &amp; Ethics</td>
</tr>
<tr>
<td>80-340</td>
<td>Environmental Ethics &amp; Decision Processes</td>
</tr>
</tbody>
</table>

**Criminal Justice Policy**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>79-331</td>
<td>Crime &amp; Punishment in America</td>
</tr>
<tr>
<td>79-335</td>
<td>Drug Use &amp; Drug Policy</td>
</tr>
<tr>
<td>80-236</td>
<td>Philosophy &amp; Law</td>
</tr>
<tr>
<td>80-246</td>
<td>The American Criminal Justice System: Realities &amp; Ideals</td>
</tr>
<tr>
<td>80-346</td>
<td>Value, Fact, &amp; Policy: Crime, Drug &amp; Gun Control</td>
</tr>
</tbody>
</table>

**Ethics, History, and Public Policy Sample Curriculum**

<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>Core Requirement</td>
<td>In History and Philosophy</td>
<td>Core Requirement</td>
<td>in History and Philosophy</td>
<td>Internship</td>
<td>Elective Track Course</td>
</tr>
<tr>
<td>79-202</td>
<td></td>
<td>79-202</td>
<td></td>
<td>79-605 or Elective Track Course</td>
<td></td>
</tr>
<tr>
<td>Introduction to Political Philosophy</td>
<td></td>
<td>Elective</td>
<td></td>
<td>Elective Track Course</td>
<td></td>
</tr>
<tr>
<td>80-135</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Elective</td>
<td></td>
<td>Elective</td>
<td></td>
<td>Elective</td>
<td></td>
</tr>
</tbody>
</table>

**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 prerequisites 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.

History
79-250 Two Revolutions: Dynamics of Change in Nineteenth Century Europe
79-261 Europe after the Black Death
79-263 Riots, Revolts, and Revolutions
79-307 The Anthropology of Europe

Modern Languages
French:
82-406 The European Union
82-415/416 Topics in French and Francophone Studies

German:
82-424 The New Germany
82-427 Nazi and Resistance Culture

Spanish:
82-441 Studies in Peninsular Literature and Culture

Art
60-350 Michelangelo and Renaissance Art
60-377 Picasso and the 20th Century

English
76-231 Studies in British Literature and Culture
76-331 Renaissance Literary and Cultural Studies
76-336 Irish Writers

New courses will be added as appropriate.

### European Studies (B.A.)

#### Sample Curriculum

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
<td>Senior Year</td>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>300-level Language Course 82-3xx</td>
<td>400-level Language Course 82-4xx</td>
<td>European Studies Elective</td>
<td>European Studies Elective</td>
<td>European Studies Elective</td>
</tr>
<tr>
<td>Pre-20th Century European Course 79-207</td>
<td>Pre-20th Century European Course 79-2xx/3xx</td>
<td>European Studies Elective</td>
<td>European Studies Elective</td>
<td>European Studies Elective</td>
</tr>
<tr>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
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<tr>
<td>Elective</td>
<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 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 220G
rweinberg@cmu.edu

Program Advisor: Stephen Pajewski
Office: Porter Hall 100B
sp4g@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 exciting 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 procedures 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

<table>
<thead>
<tr>
<th>Course(s)</th>
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</thead>
<tbody>
<tr>
<td>21-111 Calculus I*</td>
</tr>
<tr>
<td>or 21-121 Calculus I*</td>
</tr>
<tr>
<td>and 21-256 Multivariate Analysis and Approximation***</td>
</tr>
</tbody>
</table>

or 21-115/116 Differential Calculus/Integral Calculus (5 units each)*
and 21-117/118 Integration and Differential Equations/Calculus of Approximation (5 units each)***
and 36-201 Introduction to Statistical Methods**

* Counts toward General Education Program requirement DCR5.
** Counts toward General Education Program requirement CCR3.
*** Counts toward General Education Program’s 8th DCR requirement.

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)

Disciplinary Core 27 units

Organizations Complete one course.

70-311 Organizational Behavior
88-200 Organizations

Decision Science and Computability Complete one course.

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.

36-203 Sampling, Surveys, and Society
36/70-208 Regression Analysis
36-309 Experimental Design for Behavioral and Social Sciences
88-250 Regression Methods in the 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 (plus 76-488 Lab section) (prereqs: 76-270, 76-382)

Plus, complete one course.

76-318 Communication in Global Marketplace
76-373 Argument
76-385 Discourse Analysis
76-386 Language & Culture
76-387 Introduction to Sociolinguistics
76-389 Grammar of Standard Written English
76-391 Planning & Testing Documents
76-392 Rhetoric & Public Policy
76-397 Instructional Development & Design
76-451 Topics in Language Study
76-457 Topics in Rhetorical Study
76-470 Advanced Professional & Technical Writing
**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

73-372 International Money and Finance

79-310 Culture, Power, and Politics

79-330 The American Presidency

79-340 History of Modern Warfare

79-344 The Cold War and Beyond
Complete the course requirements listed below in sections A, B, & C.

Section A (18 units)
Complete two courses in a foreign language at the 300-level or higher, with a minimum grade of C.

Section B (27 units)
Complete three (3) courses in non-U.S. history, international politics, or literature in a country or region of the world in which the student's foreign language is widely spoken. 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.

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
- 79-356 African History: Earliest Times to the Origins of the Slave Trade
- 79-383 African History: From the Slave Trade to the Present

Asia
- 79-254 Pacific Islands: History and Culture
- 79-270 Chinese Culture and Society
- 79-271 Modern China
- 79-272 Modern Japan 1868 to Present
- 79-291 India: Anthropological and Historical Perspectives

Europe
- 79-205 20th Century Europe
- 79-221 Religion in European Society
- 79-250 Europe’s Two Revolutions: Dynamics of Change in 19th Century
- 79-255 Irish History
- 79-307 The Anthropology of Europe

Latin America/Caribbean
- 79-253 Development of Caribbean Culture
- 79-254 The Pacific Islands: History and Culture
- 79-260 Mayan America
- 79-290 Modern Latin America: 1789 to Present
- 79-297 Freedom Bound: Slavery/Emancipation in Brazil and the Caribbean, 1789-1940

Middle East
- 79-233 The United States and the Middle East Since 1945
- 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
- 79-291 Modern Soviet History: From Communism to Capitalism
- 79-282 The Soviet Union in World War II: Military, Political, and Social History
- 79-354 Stalin and Stalinism
- 79-357 Russian Today

Track 2: Comparative Cultures

Latin America/Caribbean
- 79-253 The Development of Caribbean Culture
- 79-254 Pacific Islands: History and Culture
- 79-260 Mayan America
- 79-290 Modern Latin America: 1789-Present
- 79-297 Freedom Bound: Slavery/Emancipation in Brazil and the Caribbean, 1789-1940

Europe
- 79-205 Twentieth-Century Europe
- 79-221 Religion in European Society
- 79-250 Europe’s Two Revolutions: Dynamics of Change in 19th Century
- 79-261 Europe after the Black Death
- 79-263 Riots, Revolts, and Revolutions
- 79-307 The Anthropology of Europe
- 79-310 Culture, Power, and Politics
- 79-396 Music and Society in 19th/20th Century Europe and the U.S.

Section A (18 units)
Complete two courses in a foreign language at the 300-level or higher, with a minimum grade of C.

Section B (27 units)
Complete three (3) courses in non-U.S. history, international politics, or literature in a country or region of the world in which the student's foreign language is widely spoken. 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
- 79-356 African History: Earliest Times to the Origins of the Slave Trade
- 79-383 African History: From the Slave Trade to the Present

Asia
- 79-254 Pacific Islands: History and Culture
- 79-270 Chinese Culture and Society
- 79-271 Modern China
- 79-272 Modern Japan 1868 to Present
- 79-291 India: Anthropological and Historical Perspectives

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- 79-205 20th Century Europe
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- 79-261 Europe after the Black Death
- 79-263 Riots, Revolts, and Revolutions
- 79-307 The Anthropology of Europe
- 79-310 Culture, Power, and Politics
- 79-396 Music and Society in 19th/20th Century Europe and the U.S.

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
- 79-356 African History: Earliest Times to the Origins of the Slave Trade
- 79-383 African History: From the Slave Trade to the Present

Asia
- 79-254 Pacific Islands: History and Culture
- 79-270 Chinese Culture and Society
- 79-271 Modern China
- 79-272 Modern Japan 1868 to Present
- 79-291 India: Anthropological and Historical Perspectives

Europe
- 79-205 20th Century Europe
- 79-221 Religion in European Society
- 79-250 Europe’s Two Revolutions: Dynamics of Change in 19th Century
- 79-261 Europe after the Black Death
- 79-263 Riots, Revolts, and Revolutions
- 79-307 The Anthropology of Europe
- 79-310 Culture, Power, and Politics
- 79-396 Music and Society in 19th/20th Century Europe and the U.S.

Latin America/Caribbean
- 79-253 Development of Caribbean Culture
- 79-254 The Pacific Islands: History and Culture
- 79-260 Mayan America
- 79-290 Modern Latin America: 1789 to Present
- 79-297 Freedom Bound: Slavery/Emancipation in Brazil and the Caribbean, 1789-1940

Middle East
- 79-233 The United States and the Middle East Since 1945
- 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
- 79-291 Modern Soviet History: From Communism to Capitalism
- 79-282 The Soviet Union in World War II: Military, Political, and Social History
- 79-354 Stalin and Stalinism
- 79-357 Russian Today

Track 2: Comparative Cultures

Latin America/Caribbean
- 79-253 The Development of Caribbean Culture
- 79-254 Pacific Islands: History and Culture
- 79-260 Mayan America
- 79-290 Modern Latin America: 1789-Present
- 79-297 Freedom Bound: Slavery/Emancipation in Brazil and the Caribbean, 1789-1940

Europe
- 79-205 Twentieth-Century Europe
- 79-221 Religion in European Society
- 79-250 Europe’s Two Revolutions: Dynamics of Change in 19th Century
- 79-261 Europe after the Black Death
- 79-263 Riots, Revolts, and Revolutions
- 79-307 The Anthropology of Europe
- 79-310 Culture, Power, and Politics
- 79-396 Music and Society in 19th/20th Century Europe and the U.S.

Middle East
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Russia
- 79-280 Russian History from the First to the Last Tsar
- 79-281 Modern Soviet History: From Communism to Capitalism
- 79-351 Cold War in Documents and Film
- 79-357 Russia Today

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 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 law, education, 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 departments of History and Modern Languages in the College of Humanities and Social Sciences. It is designed for students from all Carnegie Mellon undergraduate colleges. It may be taken as either 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
   79-283 Russian History from the First to the Last Tsar
   79-285 Modern Soviet History: From Lenin to Yeltsin
   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. **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.

A maximum of two courses (18 units) can be used to meet other requirements imposed by the University, the College, or a department with the limit of one course from the General Education Program's DCR 1 through DCR 4. No more than two courses (18 to 21 units) may be taken in satisfaction of both the Russian Studies double major requirements and those of another major, minor or College program. With the approval of the advisor, students can meet their language and program requirements at Carnegie Mellon, the University of Pittsburgh (limited to one course per semester), and approved sites 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>Senior Year</th>
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<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
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<tr>
<td>Intermediate Russian I 82-291</td>
<td>Intermediate Russian II 82-292</td>
</tr>
<tr>
<td>Core Course in History 79-280/281</td>
<td>Required Elective in History</td>
</tr>
<tr>
<td>Elective</td>
<td>Required Elective in History</td>
</tr>
<tr>
<td>Elective</td>
<td>Elective</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.

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.).
H&SS Interdepartmental Minors

H&SS 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&SS, 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&SS students. The full list of minors available to CMU 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&SS 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 courses taken to fulfill requirements for these interdepartmental minors may be 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 54-73 units

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 (equivalent to at least 18 Carnegie Mellon units) at the University of Pittsburgh (see faculty minor advisor) or approved environmentally-related science courses (equivalent to at least 18 Carnegie Mellon units) at the University of Pittsburgh (see faculty minor advisor)

Intermediate (Distributional) Requirements 27 units

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

12-101 Innovation and Design in Civil Engineering*
12-635 Water Quality Engineering
12-636 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
24-297 Energy-Environmental Systems
42-604 Biological Transport

Social Sciences Area

73-357 Regulation: Theory & Policy
73-358 Economics of the Environment and Natural Resources
73-359 Benefit-Cost Analysis
88-220 Policy Analysis I
88-221 Policy Analysis II
88-425 Politics of Economic Deregulation

Humanities Area

70-322 Reading the Built Landscape
79-345 American Environmental History: Critical History
79-384 Medicine and Society
80-340 Environmental Ethics and Decision Processes

Advanced Course (minimum) 9 units

Both courses listed in this category have prerequisites or, as an alternative, require instructor approval for entry.

88-222 Policy Analysis III (pre-approved sections)
or
79-410 History and Policy Project Course (pre-approved sections)

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

03-121 Modern Biology
09-105 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)

*These science courses may double count with other major and minor requirements.

Required Courses 18 units

66-210 Science and Technology for the Environment
80-244 Management, Environment, and Ethics

Index under “Minors.”

To discuss the possibilities of declaring other non-H&SS minors, contact the advisor listed for that particular minor.

To declare an H&SS 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.
The Minor in European Studies

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.
Faculty Advisor: Beryl Schlossman, Department of Modern Languages
Office: Porter Hall 125A

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

The Minor in Film and Media Studies

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.

Curriculum 54 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 300 and 400 level courses)

Required Intermediate Courses 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 9 Units
76-238 Introduction to Media Studies
79-247 East Asians in Film
82-187 French Cinema

2. Film and Anthropology 9 Units
79-210 Picturing Others: Ethnographic Film
79-303 Visual Anthropology

3. Filmmaking 9 Units
76-269 Study of Forms: Screenwriting
62-161/162 Filmmaking 2 (offered through Pittsburgh Filmmakers; prerequisite-Filmmaking 1)

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.
62-161/162 Filmmaking 3 (offered through Pittsburgh Filmmakers)
76-439 Advanced Seminar in Film and Media
76-469 Study of Forms: Screenwriting Workshop
82-491 Literature, Politics and Film in East Europe and Russia Today
The Minor in Gender Studies
Faculty Advisor: Kristina Straub
Office to declare minor: English, Baker Hall 245P

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.

Introductory Courses 18 units
Required Course
76-241 Introduction to Gender Studies
Plus complete one of the following courses:
76-311 Gender Roles and Social Change
or
79-379 Women in American History

Intermediate Courses 27 units
Complete 27 units of course work from the following:
73-340 Labor Economics
76-353 Advanced Gender Studies
79-311 Gender Roles and Social Change*
79-329 Sex, Population, and Birth Control
79-376 The Making of the Modern Family
79-379 Women in American History*
79-381 Male and Female in Japan
80-346 Value, Fact and Policy
88-221 Child Development

* If not taken as an Introductory Course.

Advanced Course 9-12 units
All students in the Gender Studies minor must complete one advanced course in which they complete an analytical project using gender as a primary focus. This project may be achieved as part of taking one of the following:
79-400 Research Seminar in Anthropology and History
79-420 Social and Cultural History Colloquium
85-446 Psychology of Gender

As an alternative, students may choose another 9-unit course from the “Intermediate Course” list above and by arrangement with the instructor, complete the gender-related project described above.

The Minor in Health Care Policy and Management
Faculty Advisor: Caroline Acker, Naum Kats, Stephanie Wallach
Brenda Peyser, H. John Heinz III School
Amy Kennedy, Mellon College of Science
Office: Baker Hall 246B
Office to declare minor: History, Baker Hall 240
Sponsored by: H. John Heinz III School of Public Policy and Management
College of Humanities and Social Sciences
Mellon College of Science

For a detailed description of this minor, please see page 87.
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 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
82-280 Learning about Language Learning
85-421 Language and Thought
11-582 Language Technologies

Note: The fourth course of this set may be taken to satisfy an elective.

Elective Courses
Students must complete three electives, of which two must be 300+ level courses. No 100 level courses are admissible as electives, with the exception of linguistics-related Freshman Seminars. A listing of possible electives is given below, but this list is not intended to be exhaustive. Other courses or seminars on linguistic topics will generally be approved for inclusion. (Students should consult with the Faculty Advisor). Note: courses taken to fulfill requirements in other major or minor programs may not be applied to the Linguistics Minor requirements (and vice versa).

Curriculum: 54 units

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
76-387 Introduction to Sociolinguistics
76-451 Topics in Language Study
80-181 Language and Thought
80-380 Philosophy of Language
80-481 Introduction to Formal Semantics
82-280 Learning about Language Learning
82-383 Second Language Acquisition
82-442 Analysis of Spoken Spanish
82-480 Social and Cognitive Aspects of Bilingualism
85-432 Nonverbal communicative behavior
11-511 Algorithms for Natural Language Processing
11-521 Grammars and Lexicons
11-531 Machine translation
11-541 Information Retrieval
11-552 Speech: Phonetics, Prosodics, Perception, and Synthesis

Sample Curricula

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 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
82-280 Learning about Language Learning
85-421 Language and Thought
11-582 Language Technologies

Note: The fourth course of this set may be taken to satisfy an elective.

Elective Courses
Students must complete three electives, of which two must be 300+ level courses. No 100 level courses are admissible as electives, with the exception of linguistics-related Freshman Seminars. A listing of possible electives is given below, but this list is not intended to be exhaustive. Other courses or seminars on linguistic topics will generally be approved for inclusion. (Students should consult with the Faculty Advisor). Note: courses taken to fulfill requirements in other major or minor programs may not be applied to the Linguistics Minor requirements (and vice versa).

Curriculum: 54 units

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
76-387 Introduction to Sociolinguistics
76-451 Topics in Language Study
80-181 Language and Thought
80-380 Philosophy of Language
80-481 Introduction to Formal Semantics
82-280 Learning about Language Learning
82-383 Second Language Acquisition
82-442 Analysis of Spoken Spanish
82-480 Social and Cognitive Aspects of Bilingualism
85-432 Nonverbal communicative behavior
11-511 Algorithms for Natural Language Processing
11-521 Grammars and Lexicons
11-531 Machine translation
11-541 Information Retrieval
11-552 Speech: Phonetics, Prosodics, Perception, and Synthesis

Sample Curricula
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 on 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*
79-201 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/Emanicipation in Brazil & the Caribbean, 1789-1940
79-356 African History: Earliest Times to the Origins of the Slave Trade
79-390 History of Immigration

*b 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 Caribean Culture
79-254 The Pacific Islands: History and Culture
79-290 Modern Latin America*
79-311 Gender Roles and Social Change
80-240 Contemporary Ethical Issues
85-241 Social Psychology

*b 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

*b 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 Modern Latin America*

*b unless chosen for another course category

Advanced Course 9 units
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 150 A

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 Intermediate/Advanced Programming (5 units)
16-270 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.

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.

Historical Approaches 9-221 Religion and European Society
9-222 Religion and American Society
9-225 Religions of Asia

Anthropological Approaches 79-301 Ritual, Cultural and Identity

Sociological Approaches 66-260 Religion and Star Trek: Approaches to the Study of Religion
79-388 Sociology of Religion

Philosophical Approaches 80-165 God in the West
80-276 Philosophy of Religion

Textual Approaches 60-670/79-325 Art and Religion

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
76-330 Medieval Literary and Cultural Studies
76-332 Renaissance Literary and Cultural Studies
79-219 The Holocaust in Historical Perspective
79-220 Early Christianity
79-397 Religion and Politics in the Middle East

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 dissolution 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 untold 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 law, education, 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.
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 Lenin to Yeltsin*
* 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 selected by choosing 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 Lenin to Yeltsin*
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 Katz, Stephanie Wallach
Office: Porter 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 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

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
79-340 History of Modern Warfare
79-341 War and Technology
79-342 Technology, Organization, and Information
79-344 The Cold War and Beyond
79-345 American Environmental History: Critical Issues
79-346 International Environmental Law and Policy
79-358 Complex Technological Systems: Past, Present and Future
79-384 Medicine and Society
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 requirement.

66-210 Science, Technology, and the Environment
76-344 Literature and the Environment
76-476 The Rhetoric of Science
79-335 Drug Use and Drug Policy
79-336 Epidemic Disease and Public Health
79-341 War and Technology
79-342 Technology, Organization, and Information
79-344 The Cold War and Beyond
79-345 American Environmental History: Critical Issues
79-346 International Environmental Law and Policy
79-358 Complex Technological Systems: Past, Present and Future
79-384 Medicine and Society
79-440 The Rise of Industrial Research and Development
80-244 Management, Environment, and Ethics
80-220 Topics in the Philosophy of Science
80-340 Environmental Ethics and Decision Processes
90-xxx Cities, Technology and the Environment*
*open only to qualified juniors and seniors

The Minor in Sociology
Faculty Advisor, Kathleen Carley
Office: Porter Hall 219A

The Sociology minor provides the student with a solid introduction to the central concepts in sociological theory and a grounding in the methods of empirical inquiry needed to understand societies, their histories, and their ability to change over time. Students choose among selected topics including social psychology, work and organizations, social networks, technology and society, medical sociology, gender and family, and computational social science. This background will help students understand and appreciate the processes by which families, groups, and organizations form and evolve over time, by which individuals affect and are affected by the society in which they live. This background in empirical tools and social theory will enable students to enter graduate studies in sociology, social history, and social science; to begin professional careers involving social analysis, network analysis, data analysis of teams, groups and organizations, social analysis within journalism, political institutions, the government; and to enter the corporate environment with a thorough understanding of organizational activity.
Curriculum  

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. Each Sociology minor must take a methodology course. Each Sociology minor must choose an area for depth from the categories listed. Three courses (27 units) must be taken in this category. The remaining two courses (18 units) must be taken from one or more of the categories remaining (i.e., any category other than the depth category) to complete the breadth requirement, and may include a second methodology course. Sociology minors should consult with the faculty advisor to plan a course schedule prior to registration.

NOTE: The Methodology 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 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.

Methodology  

Complete one course.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-381</td>
<td>Artificial Intelligence: Representation and Problem Solving</td>
</tr>
<tr>
<td>15-453</td>
<td>Formal Languages and Automata</td>
</tr>
<tr>
<td>21-241</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>36-309</td>
<td>Experimental Design for Behavioral and Social Sciences</td>
</tr>
<tr>
<td>85-340</td>
<td>Research Methods in Social Psychology</td>
</tr>
<tr>
<td>88-251</td>
<td>Empirical Research Methods</td>
</tr>
<tr>
<td>90-904</td>
<td>Social Network Analysis and Methods</td>
</tr>
</tbody>
</table>

Elective Courses  

Complete five courses (45 units) from the following list. Three courses (27 units) must be taken from one category to complete the depth requirement. The remaining two courses (18 units) must be taken from one or more of the other categories to complete the breadth requirement. 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

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>79-270</td>
<td>Chinese Culture and Society</td>
</tr>
<tr>
<td>79-301</td>
<td>Ritual, Culture, and Identity</td>
</tr>
<tr>
<td>79-311</td>
<td>Gender Roles &amp; Social Change</td>
</tr>
<tr>
<td>79-329</td>
<td>Sex Population and Birth Control</td>
</tr>
<tr>
<td>79-375</td>
<td>Children and Childhood in America</td>
</tr>
<tr>
<td>79-384</td>
<td>Medicine and Society</td>
</tr>
<tr>
<td>79-392</td>
<td>The Family</td>
</tr>
<tr>
<td>80-343</td>
<td>Race Gender &amp; Justice</td>
</tr>
<tr>
<td>85-241</td>
<td>Social Psychology</td>
</tr>
<tr>
<td>85-375</td>
<td>Cross-Cultural Psychology</td>
</tr>
</tbody>
</table>

2. Sociology of Work and Organizations

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-311</td>
<td>Organizational Behavior</td>
</tr>
<tr>
<td>79-342</td>
<td>Technology, Organization, and Information</td>
</tr>
<tr>
<td>88-222</td>
<td>Policy Analysis III</td>
</tr>
<tr>
<td>88-260</td>
<td>Organizations</td>
</tr>
<tr>
<td>88-305</td>
<td>Philosophy of Social Science</td>
</tr>
<tr>
<td>88-341</td>
<td>Organizational Communication</td>
</tr>
<tr>
<td>88-344</td>
<td>Organizational Intelligence in the Information Age</td>
</tr>
<tr>
<td>88-347</td>
<td>Complex Technological Systems</td>
</tr>
<tr>
<td>88-350</td>
<td>Computational Modeling of Organizations, Technology, Society</td>
</tr>
<tr>
<td>88-452</td>
<td>Organizational Theory</td>
</tr>
<tr>
<td>88-467</td>
<td>Computers in Organizations</td>
</tr>
<tr>
<td>90-796</td>
<td>Human Resources Policy and Planning</td>
</tr>
<tr>
<td>90-917</td>
<td>Organizations Theory</td>
</tr>
<tr>
<td>90-903</td>
<td>Social Network Theory</td>
</tr>
</tbody>
</table>

3. Sociology of Science and Technology

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-402</td>
<td>Telecommunications: Technology, Policy and Management</td>
</tr>
<tr>
<td>19-431</td>
<td>Technology and International Security</td>
</tr>
<tr>
<td>19-448</td>
<td>Science, Technology and Ethics</td>
</tr>
<tr>
<td>70-414</td>
<td>Technology-Based Entrepreneurship</td>
</tr>
<tr>
<td>79-230</td>
<td>Technology in American Society</td>
</tr>
<tr>
<td>79-342</td>
<td>Technology, Organization and Information</td>
</tr>
<tr>
<td>80-300</td>
<td>Minds, Machines, and Knowledge</td>
</tr>
<tr>
<td>88-347</td>
<td>Complex Technological Systems: Past, Present and Future</td>
</tr>
<tr>
<td>88-350</td>
<td>Computational Modeling of Organizations, Technology, and Society</td>
</tr>
<tr>
<td>88-366</td>
<td>Social Issues in Computing</td>
</tr>
<tr>
<td>88-467</td>
<td>Computers in Organizations</td>
</tr>
</tbody>
</table>
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 Graduate School of Industrial Administration, has been carefully designed to prepare students for careers as economics 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 Graduate School of Industrial Administration’s accelerated master’s degree program, which offers the opportunity to earn both a bachelor’s degree and a Master 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 three basic core sequences, as well as advanced theory electives, advanced economics/focus area electives, and a senior project.

**Mathematics Requirements**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-111/112</td>
<td>Differential/Integral Calculus*</td>
<td>10</td>
</tr>
<tr>
<td>21-117/118</td>
<td>Integral &amp; Differential Eqs. / Calc. of Approximation</td>
<td>10</td>
</tr>
<tr>
<td>21-256</td>
<td>Multivariate Analysis and Approximation**</td>
<td>9</td>
</tr>
</tbody>
</table>

* The two mini course sequence 21-115/116 is equivalent to the one semester course 21-121. An approved alternative to 21-115/116 is the two semester sequence 21-111/112.

** Statistics Requirement**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-217</td>
<td>Probability Theory and Random Processes</td>
<td>9</td>
</tr>
<tr>
<td>36-225</td>
<td>Introduction to Probability and Statistics I</td>
<td>9</td>
</tr>
<tr>
<td>36-325</td>
<td>Probability and Mathematical Statistics I</td>
<td>9</td>
</tr>
</tbody>
</table>

**Programming Requirement**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
</tbody>
</table>

**Economics Core Requirements**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-100</td>
<td>Principles of Economics+</td>
<td>9</td>
</tr>
<tr>
<td>73-200</td>
<td>Macroeconomics</td>
<td>9</td>
</tr>
<tr>
<td>73-226</td>
<td>Quantitative Economic Analysis</td>
<td>9</td>
</tr>
<tr>
<td>73-251</td>
<td>Economic Theory</td>
<td>9</td>
</tr>
<tr>
<td>73-261</td>
<td>Econometrics</td>
<td>9</td>
</tr>
</tbody>
</table>

**Advanced Electives**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-270</td>
<td>Professional Writing for Economists</td>
<td>9</td>
</tr>
<tr>
<td>73-271</td>
<td>Introduction to Professional and Technical Writing</td>
<td>9</td>
</tr>
</tbody>
</table>

**Senior Project**

<table>
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<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-497</td>
<td>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 Economics Department website ([http://econ.gsa.cmu.edu/undergrad](http://econ.gsa.cmu.edu/undergrad)). Students are strongly encouraged to meet with an economics advisor to tailor their courses to 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 prerequisites and corequisite requirements. Course descriptions, prerequisites, and corequisites can be found at the back of this catalog.
Sample Schedule
The following sample schedule illustrates how to satisfy the requirements of the Economics 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. The program is flexible enough to support many other possible schedules and to emphasize a wide variety of interests.

First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>21-115</td>
<td>Differential Calculus</td>
</tr>
<tr>
<td>21-116</td>
<td>Integral Calculus</td>
</tr>
<tr>
<td>36-201</td>
<td>Statistical Reasoning</td>
</tr>
<tr>
<td>73-100</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td>99-101 or 99-102 Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>elective</td>
</tr>
<tr>
<td>xx-xxx elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>49</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-117</td>
<td>Integration and Differential Calculus</td>
</tr>
<tr>
<td>21-118</td>
<td>Calculus of Approximation</td>
</tr>
<tr>
<td>73-101</td>
<td>1st Year Seminar in Economics*</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>elective</td>
</tr>
<tr>
<td>xx-xxx elective</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>47</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-256</td>
<td>Multivariate Analysis and Approximation</td>
</tr>
<tr>
<td>36-225</td>
<td>Introduction to Probability and Statistics I</td>
</tr>
<tr>
<td>73-200</td>
<td>Macroeconomics</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>elective</td>
</tr>
<tr>
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<td>Quantitative Economic Analysis</td>
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<td>Economic Theory</td>
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Third Year

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<td>73-261</td>
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<td>73-270</td>
<td>Writing for Economists</td>
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<th>Units</th>
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<td>Advanced Economics/Focus Area Track Elective</td>
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<tr>
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Fourth Year

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<td>Senior Project</td>
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<tbody>
<tr>
<td>xx-xxx</td>
<td>Advanced Economics/Focus Area Track Elective</td>
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<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>45</td>
</tr>
</tbody>
</table>

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 a mathematics requirement, statistics requirements, and six economics courses, as follows:

Mathematics Requirements

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>19</td>
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<table>
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<tr>
<th>Units</th>
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<tbody>
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Statistics Requirements

<table>
<thead>
<tr>
<th>Units</th>
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<td>18</td>
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Choose one:

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>9</td>
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</tbody>
</table>

or any course from the statistics requirement for B.S. in Economics.

Economics Requirements

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
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Complete all of following:

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<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
</tr>
</tbody>
</table>

Dual Degree in Economics
A student pursuing a primary degree outside of the department 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 complete 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.

B.S. in Managerial Economics
Student with Economics as their home department may instead obtain a degree in Managerial Economics by completing all of the requirements for a B.S. in Economics. This augments the B.S. in Economics requirements with three business courses. Interested students must meet with an economics advisor prior to selecting this option.

Added Requirements for Managerial Economics

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>27</td>
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Choose three:

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>9</td>
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</tbody>
</table>

Department of Economics 207
The Honors Program
The Honors Program in the College of Humanities and Social Sciences provides recognition of outstanding students in all H&SS departments, including the Economics Department. 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 73-500/501 (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 Graduate School of Industrial Administration’s 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://www.gisia.cmu.edu/msqe. 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
LINDA C. BABCOCK, James M. Walton Professor of Economics — Ph.D., University of Wisconsin at Madison; Carnegie Mellon, 1988—.

WESLEY COHEN, Professor of Economics and Social Science — Ph.D., Yale University; Carnegie Mellon, 1982—.

DANIELLE COEN PIRANI, Assistant Professor of Economics — Ph.D., University of Rochester; Carnegie Mellon, 2000—.

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MARGARET EPPLE, Assistant Professor of Economics — Ph.D., University of Wisconsin; Carnegie Mellon, 2002—.

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JOHN B. SHIM, Associate Professor of Economics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1997—.

PATRICK SIEG, Associate Professor of Economics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2001—.

RICHARD J. SILVER, Director, Undergraduate Economics Program and Senior Lecturer of Economics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000—.

ANTHONY A. SMITH, JR., Associate Professor of Economics — Ph.D., Duke University; Carnegie Mellon, 1992—.

FALLAW B. SOWELL, Associate Professor of Economics — Ph.D., Duke University; Carnegie Mellon, 1988—.

CHESTER S. SPATT, Mellon Professor of Finance — Ph.D., University of Pennsylvania; Carnegie Mellon, 1979—.

STEPHEN E. SPEAR, Professor of Economics — Ph.D., University of Pennsylvania; Carnegie Mellon, 1982—.

SANJAY SRIVASTAVA, Alumni Professor of Economics and Finance — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1982—.

MEL STEPHENS, Assistant Professor of Economics — Ph.D., University of Michigan; Carnegie Mellon, 2000—.

ROBERT P. STRAUSS, Professor of Economics and Public Policy — PhD, University of Wisconsin; Carnegie Mellon, 1979—.

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CHRIS I. TELMER, Associate Professor of Financial Economics — Ph.D., Queen’s University (Canada); Carnegie Mellon, 1992—.

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WILLIAM B. Vogt, Assistant Professor of Economics and Public Policy — Ph.D., Stanford University; Carnegie Mellon, 1996—.

CHENG WANG, Associate Professor of Economics — Ph.D., University of Western Ontario (Canada); Carnegie Mellon, 1994—.

ROBERTO WEBER, Assistant Professor of Economics — Ph.D., University of Western Ontario; Carnegie Mellon, 2000—.

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, multi-media, 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 directly with majors 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 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 Charles Simic.

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 receive advanced training in our Masters in Professional Writing (MAPW) program. Students who have interests in visual as well as verbal communication enroll in the Masters in Design in Communication Planning and Information Design (jointly administered with the School of Design in the College of Fine Arts). Students with more academic interests and those who are considering doctoral work look 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 6 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 the H&SS General Education 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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
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<tbody>
<tr>
<td>76-26x</td>
<td>Survey of Forms (Fiction, Poetry, or Screenwriting)</td>
</tr>
<tr>
<td>76-294</td>
<td>Interpretive Practices</td>
</tr>
</tbody>
</table>

- The English Department Core is designed to improve the range and quality of students’ skills by introducing them 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 course 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 6 courses, 45 to 54 units

- Complete five to six courses.

- The required Core Requirements differ for each major and are designed explicitly to provide both breadth and depth within the specific major the student has chosen.
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 complex web of historical conditions and relationships; by teaching major literary texts alongside public documents, and by teaching films, 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. Literary and Cultural Studies 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 audiences 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 work in literature, cultural studies, or rhetoric, and also for careers in law, business, or government, which require similar skills in interpretation, research, and writing.

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 focus on 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 their hypotheses against alternatives and present their research to audiences and by teaching films, 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. Literary and Cultural Studies 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 audiences 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 work in literature, cultural studies, or rhetoric, and also for careers in law, business, or government, which require similar skills in interpretation, research, and writing.

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**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 to fulfill General Education requirements within H&SS. Some semester offerings may include cross-listed courses 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.

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey of Forms 76-26x</td>
<td>300-level EBA course *</td>
<td>400-level Seminar **</td>
<td>76-3xx</td>
<td>76-4xx</td>
</tr>
<tr>
<td>Interpretive Practices 76-294</td>
<td>Rhetoric Course 76-3xx/4xx</td>
<td>300-level EBA course *</td>
<td>English Elective</td>
<td>76-3xx</td>
</tr>
<tr>
<td>Research English Studies 76-394</td>
<td>English Elective 76-2xx/3xx</td>
<td>English Elective</td>
<td>76-3xx/4xx</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

* 76-294 is a pre-requisite for 300-level EBA courses  
** 76-294 is a pre-requisite and 76-394 is a pre- or co-requisite for 400-level seminars.

**The B.A. in Creative Writing**

Carnegie Mellon is one of only a handful of English departments in the country where undergraduates can major in Creative Writing and work directly with established writers. 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 General Education 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 writing and analysis of poems, short 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 to *Dossier* (the literary supplement to the weekly student newspaper, *The Tartan*). Creative Writing majors also have served in editorial positions on *The Tartan* and the *Oakland Review*. 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 CMU 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 General Education Program and College 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

**Creative Writing Core**  
5 courses, 45 units

Complete five courses.

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.

76-260  
Survey of Forms: Fiction

76-265  
Survey of Forms: Poetry

76-269  
Survey of Forms: Screenwriting

Students must take the Survey of Forms course in each specific genre before proceeding to take writing workshops in that genre.

* 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.

**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 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 to meet H&SS General Education requirements. Additionally, English 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.

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.

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Fall</th>
<th>Spring</th>
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<tr>
<td>Survey of Forms 76-26x</td>
<td>Survey of Forms 76-26x</td>
<td>Creative Writing Workshop 76-3xx/4xx</td>
<td>Creative Writing Workshop 76-3xx/4xx</td>
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<tr>
<td>Interpretive Practices 76-294</td>
<td>Creative Writing Workshop 76-3xx/4xx</td>
<td>Creative Writing Workshop 76-3xx/4xx</td>
<td>English Elective 76-3xx/4xx</td>
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<tr>
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<td>English Elective 76-3xx/4xx</td>
<td>Elective 76-3xx/4xx</td>
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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 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 carefully 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. In particular, courses from other departments 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 US. These publications provide opportunities for students to publish their own written work and to gain experience in skills ranging from editing, to layout, 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 Siegel Awards in Professional Writing, and the Dawe Memorial Award to encourage creativity and innovation in publishing.

Professional Writing majors who maintain a B average in their English courses have the option of taking writing internships for academic credit during their junior or senior year. Available internships in advertising, newspaper and magazine writing, medical communications, publishing, technical writing, finance, 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, Pittsburgh Children's Museum, Pittsburgh Post Gazette, Creative Non-Fiction (a professional journal), the Heinz Family Foundation, and the Silver Eye Photography Studio.

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 internships, 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 General Education Program and College degree requirements for B.A. candidates, Professional Writing majors must fulfill 12 requirements in the following areas:

- **English Department Core** 2 courses, 18 units
  - 76-26x Survey of Forms (Fiction, Poetry, or Screenwriting)
  - 76-294 Interpretive Practices
- **Professional Writing Core** 6 courses, 54 units
  - Complete six courses.
  - 76-271 Introduction to Professional & Technical Writing
  - 76-373 Argument

**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, 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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>76-318</td>
<td>Communicating in the Global Marketplace</td>
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<tr>
<td>76-372</td>
<td>Introduction to Journalism</td>
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<td>76-375</td>
<td>Magazine Writing</td>
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<td>76-376</td>
<td>Community Literacy &amp; Intercultural Communication</td>
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<tr>
<td>76-385</td>
<td>Introduction to Discourse Analysis</td>
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<td>76-386</td>
<td>Language and Culture</td>
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<td>76-387</td>
<td>Sociolinguistics</td>
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<td>76-389</td>
<td>Grammar of Standard Written English</td>
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<td>76-390</td>
<td>Style</td>
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<td>76-391</td>
<td>Planning and Testing Documents</td>
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<td>76-392</td>
<td>Rhetoric and Public Policy</td>
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<td>76-395</td>
<td>Science Writing</td>
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<td>76-396</td>
<td>Writing and the Public Interest</td>
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<td>76-397</td>
<td>Instructional Development &amp; Design</td>
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<tr>
<td>76-451</td>
<td>Topics in Language Study</td>
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<td>76-452</td>
<td>Topics in Rhetorical Study</td>
</tr>
<tr>
<td>76-460</td>
<td>Literary Journalism</td>
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<tr>
<td>76-470</td>
<td>Advanced Professional and Technical Writing</td>
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<tr>
<td>76-472</td>
<td>Journalism Workshop</td>
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<tr>
<td>76-476</td>
<td>Rhetoric of Science</td>
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<td>76-479</td>
<td>Corporate Marketing and Communications</td>
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<td>76-480</td>
<td>Document Design</td>
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<td>76-481</td>
<td>Writing for Multimedia</td>
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<td>76-482</td>
<td>Comparative Rhetoric</td>
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<td>76-487</td>
<td>On-line Information Design</td>
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<td>76-494</td>
<td>Medical Communications</td>
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<tr>
<td>39-605/6</td>
<td>Product Design</td>
</tr>
</tbody>
</table>

* Courses that have pre-requisites. Check course descriptions for specific details.

**English Electives**

Complete four additional courses from the English Department’s offerings. Two of the four 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 to meet H&SS General Education requirements. 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.

**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. degree. The program is specifically designed to prepare students for successful careers involving scientific, technical, and computer-related communication.

The B.S. in Technical Writing has recently been revised to reflect changes taking place in the technical communication fields. 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 wordprocessing or personal finances 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 and vary on courses and electives as well as a shared set of pre-requisites 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 who maintain a B average in writing courses 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 Software, 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 recently recruiting and hiring Technical Writing graduates include Microsoft, Intel, AT&T, Digital Equipment, IBM, Data General, NCR Corporation, Apollo Computers, 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 TC/TC track 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 actually 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 visual, verbal, 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 SMC/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 General Education program 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 General Education Requirements or requirements for other majors or minors.

Mathematics Prerequisite 1 courses, 9-10 units
Complete one of the following, each of which also counts as DCR 5 for H&SS General Education requirements.

21-111 Calculus 1
21-121 Calculus I
21-115/116 Differential Calculus/Integral Calculus (5 units each)

Statistics Prerequisite 1 course, 9 units
Complete one course
36-201 Statistical Reasoning (also counts as H&SS CCR3 requirement)

Computer Science Prerequisites 1-2 courses, 10-19 units
Complete either:

15-100 Introductory/Intermediate Programming (10 units)
15-200 Advanced Programming/Practicum (9 units)
15-111 Intermediate/Advanced Programming (10 units) *

* The 15-100 and 15-200 sequence is specifically designed and paced for students in the Technical Communication degree 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 pre-requisite 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 12 courses, 114 units

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
76-480 Document Design *
76-487 On-Line Information Design **
* 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 *
76-383 Multimedia Authoring 2*
76-391 Planning & Testing Documents *
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
39-605/6 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 TWWC/TC degree and a major or minor in another department.

Math 05-410 Introduction to Human Computer Interaction Methods
05-413 Human Factors
05-499 Social Issues in Computing
15-xxx Computer Science courses beyond the 2 required
19-402 Telecommunications, Technology Policy & Management
19-422 New Technologies and Economic Growth
19-448 Science, Technology, and Ethics
36-203 Sampling, Surveys, and Society
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 0r 2 Communication Design Fundamentals
51-263 or 4 Industrial Design Fundamentals
51-421 Visual Interface Design
70-311 Organizational Behavior
70-322 Business and Society
70-342 Managing Across Cultures
73-343 Economics of Technological Change
79-209 Theory and Practice in Anthropology
79-230 Technology in American Society
79-358 Complex Technological Systems: Past, Present, Future
79-342 Technology, Organization, and Information
80-220 Philosophy of Science
80-221 Philosophy of Social Science
80-241 Ethical Judgments in Professional Life
80-243 Business Ethics
80-244 Environment, Management and Ethics
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<td>03-124</td>
<td>Modern Biology Lab</td>
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<td>09-105</td>
<td>Modern Chemistry I</td>
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<td>09-106</td>
<td>Modern Chemistry II</td>
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<td>09-131</td>
<td>Lab I: Intro to Chemical Analysis</td>
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<td>Physics for Science Students I</td>
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<td>Physics for Science Students II</td>
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<td>42-101</td>
<td>Introduction to Biomedical and Health Engineering</td>
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<td>42-301</td>
<td>Psychology</td>
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<td>42-377</td>
<td>Rehabilitation Engineering</td>
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<td>76-271</td>
<td>Introduction to Professional &amp; Technical Writing</td>
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<td>76-480</td>
<td>Document Design*</td>
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<td>On-Line Information Design **</td>
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<td>76-318</td>
<td>Communicating in the Global Marketplace *</td>
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<td>76-395</td>
<td>Science Writing *</td>
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<td>Introduction to Discourse Analysis</td>
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<td>Writing in the Public Interest *</td>
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<td>Experimental Design for Behavioral and Social Sciences</td>
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<td>79-230</td>
<td>Technology in American Society</td>
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<td>79-334</td>
<td>Health Policy: Historical Perspectives</td>
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<td>Drug Use and Drug Policy</td>
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<td>Complex Technological Systems: Past, Present, Future</td>
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<td>Medicine and Society</td>
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<td>Management, Environment, and Ethics</td>
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<td>88-373</td>
<td>Computers in Organizations</td>
</tr>
<tr>
<td>88-341</td>
<td>Organizational Communication</td>
</tr>
<tr>
<td>88-344</td>
<td>Organizational Intelligence in the Information Age</td>
</tr>
<tr>
<td>88-345</td>
<td>The Rise of Industrial Research and Development</td>
</tr>
<tr>
<td>88-354</td>
<td>Economics and Psychology of Organizational Communications</td>
</tr>
<tr>
<td>88-386</td>
<td>Social Issues in Computing</td>
</tr>
<tr>
<td>88-388</td>
<td>Introduction to Human Computer Interaction</td>
</tr>
<tr>
<td>88-452</td>
<td>Organizational Theory</td>
</tr>
<tr>
<td>76-470</td>
<td>Writing for Multi Media *</td>
</tr>
<tr>
<td>76-480</td>
<td>Document Design*</td>
</tr>
<tr>
<td>76-487</td>
<td>On-Line Information Design **</td>
</tr>
</tbody>
</table>

**Table: Technical Writing & Communication, 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 or 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>
<th>Junior Year</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
<td>Fall</td>
<td></td>
</tr>
<tr>
<td>Intro to Professional &amp; Technical Writing 76-271</td>
<td>Survey of Forms 76-26x</td>
<td>On-Line Information Design* 76-487</td>
<td>Advanced Professional &amp; Technical Writing 76-470</td>
</tr>
<tr>
<td>Interpretive Practices 76-294</td>
<td>Document Design* 76-480</td>
<td>Theory/ Specialization Course</td>
<td>Theory/ Specialization Course</td>
</tr>
<tr>
<td>TC Elective</td>
<td>TC Elective</td>
<td>TC Elective</td>
<td>TC Elective</td>
</tr>
</tbody>
</table>

* Because of pre-requisites 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.

**Table: Technical Writing & Communication, 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 or 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>
<th>Junior Year</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
<td>Fall</td>
<td></td>
</tr>
<tr>
<td>Intro to Professional &amp; Technical Writing 76-271</td>
<td>Survey of Forms 76-26x</td>
<td>On-Line Information Design* 76-487</td>
<td>Advanced Professional &amp; Technical Writing 76-470</td>
</tr>
<tr>
<td>Interpretive Practices 76-294</td>
<td>Document Design* 76-480</td>
<td>TC Elective</td>
<td>TC Elective</td>
</tr>
<tr>
<td>Natural Science/ Engineering Course</td>
<td>Natural Science/ Engineering Course</td>
<td>TC Elective</td>
<td>Natural Science/ Engineering Course</td>
</tr>
<tr>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

* Because of pre-requisites 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) the University’s Designated Writing 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 courses offered in a given term fulfill specific requirements in each of the minor concentrations.

Creative Writing Concentration

Complete 6 courses, including 76-101 as a prerequisite.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>76-101</td>
<td>Interpretation &amp; Argument (or credit for Designated Writing Course)</td>
</tr>
<tr>
<td>76-260 or 265</td>
<td>Survey of Forms: Fiction* or Poetry *</td>
</tr>
<tr>
<td>76-382</td>
<td>Multimedia Authoring II</td>
</tr>
<tr>
<td>76-385</td>
<td>Intro to Discourse Analysis</td>
</tr>
<tr>
<td>76-390</td>
<td>Style</td>
</tr>
<tr>
<td>76-397</td>
<td>Instructional Design</td>
</tr>
<tr>
<td>76-391</td>
<td>Planning &amp; Testing Documents</td>
</tr>
<tr>
<td>76-392</td>
<td>Rhetoric &amp; Public Policy</td>
</tr>
<tr>
<td>76-470</td>
<td>Advanced Prof &amp; Technical Writing</td>
</tr>
<tr>
<td>76-480</td>
<td>Document Design</td>
</tr>
<tr>
<td>76-487</td>
<td>On-Line Information Design</td>
</tr>
<tr>
<td>76-476</td>
<td>Rhetoric of Science</td>
</tr>
<tr>
<td>76-494</td>
<td>Medical Communication</td>
</tr>
<tr>
<td>76-3xx/4xx</td>
<td>One Rhetoric/Language Studies course</td>
</tr>
<tr>
<td>76-xxx</td>
<td>One 200-level or above English Elective **</td>
</tr>
</tbody>
</table>

* 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 Study 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 to meet H&S General Education Requirements.

English Studies Concentration

Complete 6 courses, including 76-101 as a prerequisite.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>76-101</td>
<td>Interpretation &amp; Argument (or credit for Designated Writing Course)</td>
</tr>
<tr>
<td>76-294</td>
<td>Interpretive Practices (pre-requisite for 300- and 400-level courses)</td>
</tr>
<tr>
<td>76-3xx</td>
<td>Two 300-level courses in Literature, Cultural Studies or Rhetoric</td>
</tr>
<tr>
<td>76-3xx/4xx</td>
<td>One additional 300-level course or a 400-level seminar in Literature, Cultural Studies, or Rhetoric *</td>
</tr>
<tr>
<td>76-xxx</td>
<td>One 200-level or above English Elective **</td>
</tr>
</tbody>
</table>

* 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 to meet H&S General Education Requirements.

Professional Writing Concentration

Complete 6 courses, including 76-101 as a prerequisite.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>76-101</td>
<td>Interpretation &amp; Argument (or credit for Designated Writing Course)</td>
</tr>
<tr>
<td>76-270</td>
<td>Writing in the Professions</td>
</tr>
<tr>
<td>76-271</td>
<td>Introduction to Professional &amp; Technical Writing</td>
</tr>
<tr>
<td>76-3xx/4xx</td>
<td>Two 300- or 400-level Writing courses *</td>
</tr>
<tr>
<td>76-3xx/4xx</td>
<td>One Rhetoric/Language Studies course</td>
</tr>
<tr>
<td>76-xxx</td>
<td>One 200-level or above English Elective **</td>
</tr>
</tbody>
</table>

* 76-270 or 76-271 is generally the prerequisite for these 300- and 400-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 to meet H&S General Education Requirements.

Technical Writing Concentration

Complete 6 courses, including 76-101 as a prerequisite.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>76-101</td>
<td>Interpretation &amp; Argument (or credit for Designated Writing Course)</td>
</tr>
<tr>
<td>76-271</td>
<td>Introduction to Professional &amp; Technical Writing</td>
</tr>
<tr>
<td>76-3xx/4xx</td>
<td>Two 300- or 400-level Writing courses from these options:</td>
</tr>
<tr>
<td>76-318</td>
<td>Comm in the Global Marketplace</td>
</tr>
<tr>
<td>76-383</td>
<td>Multimedia Authoring II</td>
</tr>
<tr>
<td>76-385</td>
<td>Intro to Discourse Analysis</td>
</tr>
<tr>
<td>76-390</td>
<td>Style</td>
</tr>
<tr>
<td>76-397</td>
<td>Instructional Design</td>
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<td>Planning &amp; Testing Documents</td>
</tr>
<tr>
<td>76-392</td>
<td>Rhetoric &amp; Public Policy</td>
</tr>
<tr>
<td>76-470</td>
<td>Advanced Prof &amp; Technical Writing</td>
</tr>
<tr>
<td>76-480</td>
<td>Document Design</td>
</tr>
<tr>
<td>76-487</td>
<td>On-Line Information Design</td>
</tr>
<tr>
<td>76-476</td>
<td>Rhetoric of Science</td>
</tr>
<tr>
<td>76-481</td>
<td>Writing for Multi Media</td>
</tr>
<tr>
<td>76-494</td>
<td>Medical Communication</td>
</tr>
<tr>
<td>76-3xx/4xx</td>
<td>One Rhetoric/Linguistics course</td>
</tr>
<tr>
<td>76-xxx</td>
<td>One 200-level or above English Elective **</td>
</tr>
</tbody>
</table>

* 76-271 is a pre-requisite for these courses. Additionally, 76-480 is a prerequisite for 76-481 and 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 to meet H&S General Education Requirements.
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 but may, with permission, be extended on occasion to 12 - 18 units. 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 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 —.

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SHARON DILWORTH, Associate Professor of English and Creative Writing — M.F.A., University of Michigan; Carnegie Mellon, 1989 —.

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PAUL GRIPP, Senior Lecturer in English — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000 —.

CAROL V. HAMILTON, Assistant Professor of English — Ph.D., University of California, Berkeley; Carnegie Mellon, 1996 —.

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TERRANCE HAYES, Assistant Professor of Creative Writing — M.F.A, University of Pittsburgh; Carnegie Mellon, 2001 —.

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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 —.

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YAMENG LIU, Associate Professor of English and Rhetoric — Ph.D., University of Southern California, Carnegie Mellon, 1993 —.

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 —.

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MICHAEL WITMORE, Assistant Professor of English and Literary and Cultural Studies — Ph.D., University of California—Berkeley; Carnegie Mellon, 1999 —.

Adjunct Faculty
JAMES DAVIDSON, Adjunct Associate Professor of English and Editor of FOCUS — M.A., Boston College; Carnegie Mellon, 1996 —.
Department of History

Joe W. Trotter, Department Head
Department Office: Baker Hall 240
http://www.cmumc.edu/departments/history

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 (Steven Schlossman, Director); the Center for Business, Technology, and the Environment (Joel A. Tarr, Director; David A. Hounshell, Associate Director); and the Center for Africanamerican 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 Modell, 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 promotes 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 gains 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 Anthropology and History major focuses on cultural patterns and social changes. Research experience is combined with work in interdisciplinary social science theory.

The History and Policy major focuses on policy-relevant history, along with solid training in other types of history. History and Policy majors do specialized work in one or more policy areas including technology and environment, industrial development, criminal justice, international relations, education policy, and health policy.

The Social and Cultural History major promotes exposure to history as a source of new knowledge and provides essential research training. It also encourages exploration of other types of history and work in diverse geographical fields.

The Department also offers a minor in History. Several other minors, described throughout this catalog, can be combined with any of the History majors to provide additional depth. These include H&SS 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 interdisciplinary 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. An advanced interdisciplinary colloquium examines texts that best exemplify an exchange between the two disciplines. 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

The Anthropology and History major is offered as either a B. A. or B. S. degree. Anthropology and History majors satisfy requirements in the following areas:

Mathematics & Statistics

Prerequisites (B.S. only) 19-20 units

Required of B.S. majors only. If at all possible, both courses are to be completed by the end of the sophomore year.

21-111 Calculus I

*Counts toward H&S General Education Program requirement, DCR5.

PLUS complete one of the following for the B.S. degree.

21-112 Calculus II

or

36-202 Introduction to Statistical Methods*

(prerequisite: 36-201; recommended by the Department over 21-112)

Survey Courses (2) 18 units

79-104 Introduction to World History

79-201 Introduction to Anthropology*

*Counts towards H&S General Education Program requirement DCR4.

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 History and Policy and the Social and Cultural History majors.

Theory and Practice in Anthropology (1) 9 units

79-209 Theory and Practice in Anthropology

Regional Courses 18 units

Choose two from among the following courses in African, Asian, European, and Latin American/Caribbean history. At least one of the courses must be a non-European course.

79-207 Development of European Culture

79-253 Development of Caribbean Culture

79-255 Irish History

79-260 Mayan America

79-270 Chinese Culture and Society

79-271 Modern China

79-290 Modern Latin America: 1789 to the Present

79-291 India: Anthropological and Historical Perspectives

79-305 Representing Pacific Cultures

79-307 The Anthropology of Europe

79-356 African History: Earliest Times to the Origins of the Slave Trade

79-364 Art, Anthropology, and Empire

Issues in Anthropology and History (1) 9 units

79-385 Issues in Anthropology and History*

*prerequisite: one Anthropology course

Research Seminar in Anthropology and History (1) 12 units

79-400 Research Seminar in Anthropology and History*

*prerequisites: 79-200 and 79-209

Anthropology and History, B.A. and B.S.

Sample Curriculum*

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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.

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
History and Policy is a major with a more professional focus than the Social and Cultural History and Anthropology and History majors. 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. The History and Policy major may involve courses in business, law, the social and decision sciences, statistics, computer science, and the application of quantitative techniques to history, as well as a thorough grounding in historical studies. The major will strengthen a student’s qualifications for a variety of management-oriented and research positions.

Majors in History and Policy use historical reasoning in conjunction with social science research tools in order to evaluate policy problems. Students 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.

Historical perspective enriches policy analysis in several ways. The History and Policy major develops skills in data management and communication that are vital to any policy research area, whether in the public or private sector. 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 also develops an ability to assess social trends, in order to establish both continuities and discontinuities as the context for determining appropriate policy.

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
The History and Policy major is available as either a B.S. or B.A. degree. History and Policy majors satisfy requirements in the following areas:

Mathematics & Statistics
Prerequisites (B.S. only) 19-20 units
Required of B.S. majors only. If at all possible, both courses are to be completed by the end of the sophomore year.

21-111 Calculus I

*Counts toward General Education Program requirement, DCR5.

PLUS complete one of the following for the B.S. degree.

21-112 Calculus II or
36-202 Introduction to Statistical Methods* (prerequisite: 36-201; recommended by the Department over 21-112)

Survey Courses (2) 18 units
79-104 Introduction to World History
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
79-270 Chinese Culture and Society
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
79-356 African History: From the Earliest Times to the Origins of the Slave Trade
79-383 Slave Trade
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.

79-280 Historical Evidence and Interpretation (1) 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 Social and Cultural History majors.

79-280 Historical Evidence and Interpretation (1) 12 Units

Public Agenda History Courses (6) 54 units
Choose six courses from among the following: at least one of the six courses must have an international orientation.
79-223 Protest and Dissent in American History
79-230 Technology in American Society
79-231 American Foreign Policy: 1945-Present
79-232 Vietnam: America’s Lost War
79-233 The United States and the Middle East Since 1945
79-241 African-American History I
79-242 African-American History II
79-243 A History of American Urban Life
79-244 Pittsburgh and the Transformation of Modern Urban America
79-268 Racial Violence in America
79-282 The Soviet Union in World War II: Military, Political and Social History
79-285 Military History of World War II
79-297 Freedom Bound: Slavery/Emancipation in Brazil and the Caribbean, 1789-1940
79-329 Sex, Population and Birth Control
79-331 Crime and Punishment in American History
79-335 Drug Use and Drug Policy
79-336 Epidemic Disease and Public Health
79-337 Educational Policy: Historical Perspectives
79-340 History of Modern Warfare
79-341 War and Technology
79-342 Technology, Organization and Information
79-344 The Cold War and Beyond
79-345 American Environmental History: Critical Issues
79-346 International Environmental Law and Policy
79-350 Theories of International Relations
79-351 The Cold War in Documents and Film
79-352 The Arab-Israel Condition: War and Peace
79-358 Complex Technological Systems: Past, Present, and Future
79-366 Children and Youth in History and Policy: Dialogues between Past and Present
79-368 Poverty, Charity and Welfare
79-384 Medicine and Society
79-386 The Global Environment: Historical Perspectives and Policy Dilemmas
79-390 History of Immigration
79-397 Religion and Politics in the Middle East
79-412 History and Policy Research Seminar
79-440 The Rise of Industrial Research and Development

History and Policy Project Course (1) 12 units
79-410 History and Policy Project Course* 12 units
*prerequisite: 79-200

History and Policy, B.A. and B.S.
Sample Curriculum

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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.

Curriculum

The Social and Cultural History major is offered as either a B.A. or B.S. degree. Social and Cultural History majors satisfy requirements in the following areas:

Mathematics & Statistics

Prerequisites (B.S. only) 19-20 units

Required of B.S. majors only. If at all possible, both courses are to be completed by the end of the sophomore year.

21-111 Calculus I* 7 units

*Counts toward General Education Program requirement, DCR5.

PLUS complete one of the following for the B.S. degree.

21-112 Calculus II or 7 units

36-202 Introduction to Statistical Methods* (prerequisite: 36-201; recommended by the Department over 21-112)

Survey Courses (3) 27 units

79-104 Introduction to World History

79-206 Development of American Culture

79-207 Development of European Culture

*Counts towards General Education Program requirement DCR4

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 History and Policy and the Anthropology and History majors.

Social & Cultural History Distribution Requirements 45 units

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

Social and Cultural History Colloquium 12 units

79-420 Social and Cultural History Colloquium*

*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.

Social and Cultural History, B.A. and B.S.

Sample Curriculum

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Additional Major

Social and Cultural History may be scheduled as an additional major in consultation with the departments concerned.

Interdepartmental Majors Involving History

The History Department co-sponsors the Ethics, History, and Public Policy Major with the Philosophy Department, the European Studies Major with the Modern Languages Department, the International Relations Major with the Social and Decision Science Department and the Modern Languages Department, and the Russian Studies Major with the Modern Languages Department. For further information please see Interdepartmental Majors under the H&SS section of this catalog.

The Minor in History

The minor in History involves a minimum of 54 units of course work (not including the 9-unit prerequisite), as described below.

Curriculum (minimum) 54 units

Prerequisite 9 units

79-104 Introduction to World History

(or the equivalent as approved by the Department)

Introductory Courses 18 units

Complete two courses.

79-206 Development of American Culture

79-207 Development of European Culture

79-253 Development of Caribbean Culture

79-270 Chinese Culture and Society

79-280 Russian History from First to Last Tsar

79-290 Modern Latin America: 1789-Present

79-356 African History: Earliest Times to the Origins of the Slave Trade

79-383 African History: From the Slave Trade to the Present

Advanced Courses 36 units

Complete four 200- or 300-level History courses

Internship Program

The History Department offers internships (or supervised off-campus work experiences) designed for qualified junior and senior majors in History or Ethics, History, and Public Policy. In general, a GPA of 3.0 or better is required. Internships carry 9-18 units. Each internship is arranged, approved, and overseen by the Department’s Internship Coordinator. Students have been placed at a wide variety of internship sites including: Carnegie Museums, WQED, United Way, Pittsburgh Post Gazette, ACLU, Senator John Heinz Pittsburgh Regional History Center, and Pittsburgh Council on Public Education.
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 by his or her department to become a participant.

Faculty
CAROLINE ACKER, Associate Professor of History – Ph.D., University of California, San Francisco; Carnegie Mellon, 1993–.

SUSAN AMBROSE, Adjunct Professor of History; Director, The Eberly Center for Teaching Excellence – D.A., Carnegie Mellon University; Carnegie Mellon, 1986–.

EDWARD W. CONSTANT, Associate Professor of History – Ph.D., Northwestern University; Carnegie Mellon, 1976–.

JOSEPH E. DEVINE, Adjunct Professor of History; Associate Dean, College of Humanities and Social Sciences – D.A., Carnegie Mellon University; Carnegie Mellon, 1979–.

PAUL EISS, Assistant Professor of Anthropology and History – Ph.D. University of Michigan; Carnegie Mellon, 2000–.

EDDA FIELDS, 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., University of Pennsylvania; Carnegie Mellon, 1990–.

DAVID A. HOUNSHELL, 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–.

ROBERT W. KIGER, Adjunct Professor of History; Director, Hunt Institute for Botanical Documentation – Ph.D., University of Maryland; Carnegie Mellon, 1974–.

BARBARA LAZARUS, Adjunct Professor of History; Associate Provost – Ed.D., University of Massachusetts; Carnegie Mellon, 1985–.

MARY LINDEMANN, Professor of History – Ph.D. University of Cincinnati; Carnegie Mellon, 1987–.

KATHERINE A. LYNCH, Professor of History – Ph.D., Harvard University; Carnegie Mellon, 1980–.

RICHARD MADDOX, Associate 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–.

JUDITH MODELL, Professor of Anthropology and History – Ph.D., University of Minnesota; Carnegie Mellon, 1984–.

SCOTT SANDAGE, Associate Professor of History – Ph.D. Rutgers University; Carnegie Mellon, 1995–.

STEVEN SCHLOSSMAN, Professor of History – Ph.D. Columbia University; Carnegie Mellon 1988–.

KIRON SKINNER, Assistant Professor of History and Political Science – Ph.D. Harvard University; Carnegie Mellon, 1999–.

JOHN SOLURI, Assistant 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 Professor of Urban Studies – 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–.
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, German, Japanese and Spanish

Modern Languages majors are available in French, German, Japanese and Spanish 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 studies 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 all 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 and Spanish as well as English as a Second Language, European Studies and Russian Studies.

Language-specific faculty advisors for these specializations are:

- **Faculty Advisors For Students in Majors**
  - French: Beryl Schlossman, Professor of French
  - German: Stephen Brockmann, Associate Professor of German
  - Japanese: Keiko Koda, Associate Professor of Japanese
  - Spanish: Kenya C. Dworin y Mendez, Associate Professor of Spanish
  - English as a Second Language: Barbara Freed, Professor of French and Second Language Acquisition

The Majors in French

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**

- **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**

   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**

   (Complete one 9 unit course* plus the Senior Seminar)

   **8-280** Learning about Language Learning  
   **62-281** Tutoring for Community Outreach  
   **82-333** 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 Interdisciplinary Electives**

   Complete 45 units from List A and 9 units from List B.

**List A. French Electives**

   **82-401** Quebec Society  
   **82-402** The French in Love  
   **82-403** The French at War  
   **82-404** Francophone Realities: Ousmane Sembène  
   **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
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 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

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.

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.

French (B.A.) Sample Curriculum

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>French Culture</td>
<td>French in Social Contexts 82-305</td>
<td>French Elective List A</td>
<td>French Elective List A</td>
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<tr>
<td>The Francophone World</td>
<td>French Elective List A</td>
<td>French Elective List A</td>
<td>Senior Seminar 82-580</td>
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</tr>
<tr>
<td>Learning about Language and Cultural Contexts</td>
<td>Interdisciplinary Elective List B</td>
<td>French Elective List A</td>
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<td></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.
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 Fall</th>
<th>Spring</th>
<th>Senior Year Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany, Austria, and Switzerland in the 20th Century 82-323</td>
<td>Contemporary Germany, Austria and Switzerland 82-324</td>
<td>German Elective List A</td>
<td>German Elective List A</td>
</tr>
<tr>
<td>Core History Course 82-325</td>
<td>Introduction to German Studies 82-325</td>
<td>German Elective List A</td>
<td>Required Elective List A or List B</td>
</tr>
<tr>
<td>Learning about Language Learning 82-280</td>
<td>Elective</td>
<td>Required Elective List A or List B</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective 82-275</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
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<tr>
<td>Elective 82-275</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

Senior Seminar 82-580  

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 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**  
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**  
Complete 27 units from List A and 9 units from List B or 27 units from List A and 18 units from List B. (May be required of a student with advanced placement in Japanese).  

**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
57-321 Music and the Literary Imagination
57-322 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>Junior Year</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Japanese Language and Culture</td>
<td>Core History Course</td>
<td>Required Elective List A</td>
<td>Required Elective List A</td>
</tr>
<tr>
<td>Advanced Japanese I 82-371</td>
<td>Advanced Japanese II 82-372</td>
<td>Required Elective List A</td>
<td>Required Elective List B</td>
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<tr>
<td>Learning about Language Learning 82-280</td>
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<td>Elective/ Required Elective List B</td>
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<tr>
<td>Senior Seminar 82-580</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.

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 Spanish 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 Spanish 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. Spanish and Interdisciplinary Electives  54 units
Complete 45 units from List A and 9 units from List B.

List A: Spanish 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, Modernismos and Underdevelopment  
82-454  The Hispanic Caribbean: Rhyme, Reason and Song  
82-456/456  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  
79-292/82-452  The Latin American Fin de Siglo: Modernity, Modernismos 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
82-393  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
57-205  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  

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.

Spanish (B.A.)
Sample Curriculum

<table>
<thead>
<tr>
<th>Junior Year Fall</th>
<th>Spring</th>
<th>Senior Year Fall</th>
<th>Spring</th>
</tr>
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<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>
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<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>
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</tbody>
</table>

| Learning about Language 82-280 | Elective | Spanish or Interdisciplinary Elective List A or List B | Senior Seminar 82-580 Elective |

| Elective | Elective | Elective | Elective |

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&S 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&S 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&S 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
Complete all courses:
82-280 Learning About Language Learning  
82-281 Tutoring for Community Outreach  
82-383 Introduction to Second Language Acquisition  
82-485 ESL Practicum  

General Course 3 units
Complete one course.
82-580 Senior Seminar (3 units)  

2. Core Courses in English 18 units
Complete both courses.
76-385 Introduction to Discourse Analysis  
76-389 Grammar of Standard Written English  

3. Core Course in Philosophy 9 units
Complete one course.
80-280 Linguistic Analysis  

Department of Modern Languages
4. Required Electives (minimum) 27 units
Complete three courses from the following courses.

**English**
- 76-387 Introduction to Sociolinguistics
- 76-421 Language and Thought

**History**
- 79-390 History of Immigration: Asian Americans in the United States

**Philosophy**
- 80-180 The Nature of Language
- 80-380 Philosophy of Language
- 80-480 Linguistic Theory
- 80-481 Formal Semantics

**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
- 85-390 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>Fall</th>
<th>Spring</th>
<th>Senior Year</th>
<th>Fall</th>
<th>Spring</th>
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<tr>
<td>Linguistic</td>
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<td>80-280</td>
<td>Tutoring for Community Outreach 82-281</td>
<td>Introduction to Discourse Analysis 76-385</td>
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<td>Analysis</td>
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<td>ESL Practicum 82-485</td>
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<td>Learning about</td>
<td>Language 82-280</td>
<td>Required Elective</td>
<td>Required Elective</td>
<td>82-383</td>
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<tr>
<td>Grammar of Standard Written English 76-399</td>
<td>Required Elective</td>
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<td>Senior Seminar 82-580</td>
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### 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.

#### 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*

New courses will be added as appropriate.

* University of Pittsburgh Course

** This course is counted only when it has a China-related topic.
The Minor in French  
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  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 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 Society  
- 82-402 The French in Love  
- 82-403 The French at War  
- 82-404 Francophone Realities: Ousmane Sembène  
- 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

- 82-383 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 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 Structure, Public Policy and Ethical Dilemmas  
- 80-251 Modern Philosophy  
- 80-252 19th Century Philosophy  
- 80-253 Continental Philosophy  
- 80-254 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.

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 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 of 12 additional units must 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, or one course from List A and one course from List B.

List A: Japanese Electives
79-265 Japan's Social History Since 1945
79-272 Modern Japan, 1868 to the Present
79-280 Learning about Language Learning
82-383 Introduction to Second Language Acquisition

List B: Interdisciplinary Electives
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 Topics in Japanese Studies: Social Issues in Contemporary Japan
82-478 Topics in Japanese Studies: Contemporary Japanese Literature
82-479 Topics in Japanese Studies: Japanese Reading and Translation
82-480 Topics in Japanese Studies: Japanese Sociolinguistics
82-470 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 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.

The Minor in Spanish 54 units

Prerequisites 0-42 units
Intermediate level proficiency in the appropriate 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 is strongly recommended.

1. Core Courses in Spanish 27 units
Complete two courses.
82-324 Spanish Language and Literature
82-325 Latin America: Language and Culture
82-326 U.S. Latinos: Language and Culture

Complete required course.
82-345 Introduction to Hispanic Literary and Cultural Studies

2. Spanish and Interdisciplinary Electives 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 1 course (9 units) from List B.

List A: Spanish 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
79-292/82-452 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 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

The Minor in English as a Second Language (ESL)  54 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 accepted to be the core or foundation courses in the field. Students who elect to pursue the ESL minor are required to complete the following courses, which total 54 units.

Prerequisites  0 - 24 units
Two semesters (or the equivalent) of college instruction (any level) in at least one foreign language or demonstrable proficiency in a second language acquired in another context.

1. Required Courses  36 units
Complete four courses.
76-389  Grammar of Standard Written English
82-280  Learning About Language Learning
82-383  Introduction to Second Language Acquisition
82-485  ESL Practicum

2. Core Electives  18 units
Complete two courses after consultation with the Minor Advisor.
76-385  Introduction to Discourse Analysis
76-387  Introduction to Sociolinguistics
80-180  The Nature of Language
80-280  Linguistic Analysis
80-387  Introduction to Sociolinguistics
85-211  Cognitive Psychology
85-389  Grammar of Standard Written English
85-421  Language and Thought

New courses will be added as appropriate.

Note: Only 9 units in the minor can double count with the General Education Requirement or any other major or minor. Should a student have received credit for more than one of the required courses listed above in pursuit of another program, a course may be selected as a substitute from among the electives with the permission of the advisor.

The Minor in Second Language Acquisition (SLA)
The minor in Second Language Acquisition is intended for students who are interested in language learning and who wish to understand the language learning process. The minor provides students with knowledge and skills that will serve subsequent careers in academia, business or government, and which will complement many other majors. Requirements for the minor total 54 units.

Prerequisites  0 - 24 units
Two semesters (or the equivalent) of college instruction (any level) in at least one foreign language or demonstrable proficiency in a second language acquired in another context.

1. Required Courses  36 units
Complete five courses.
82-280  Learning About Language Learning
82-383  Introduction to Second Language Acquisition
82-485  ESL Practicum
85-421  Language and Thought

2. Core Elective  18 units
Complete one course 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 its 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
STEPHEN BROCKMANN, Associate Professor of German with courtesy appointments in English and History — Ph.D., University of Wisconsin-Madison; Carnegie Mellon, 1993—.

CHARLENE CASTELLANO, Senior Lecturer in Russian with a courtesy appointment in English — Ph.D., Cornell University; Carnegie Mellon, 1990—.
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BARBARA FREED, Professor of French and Second Language Acquisition — Ph.D., University of Pennsylvania; Carnegie Mellon, 1990—.

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SUSAN G. POLANSKY, Principal Lecturer in Spanish, Associate Head of Modern Languages — Ph.D., Boston College; Carnegie Mellon, 1986—.
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 majors from other disciplines who are interested in reflecting on the foundation of their own subjects. 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 non-traditional 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.S. 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), 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  Intermediate/Advanced Programming (10 units)
21-127  Concepts of Mathematics**
36-201  Statistical Reasoning ***

*Only the 10 units for 15-111 are unique to the major.

**Can also be used to fulfill the DCR5, Mathematical Reasoning requirement in the H&SS General Education program.

***This course fulfills the CCR3, Statistical Reasoning requirement in the H&SS General Education program.

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: 80-318 Mechanized Reasoning; or: 80-319 Machine Learning)
80-316  Probability and Artificial Intelligence
85-411  Cognitive Processes and Problem Solving

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  Mechanized Reasoning: proof search by machine (or: 80-319 Machine Learning)
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  Machine Learning (or: 80-312 Philosophy of Mathematics)
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 in 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 easily 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) or
80-101 (Mathematics in Context)

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 Logic and Philosophical Analysis
   Area 4  80-150 Nature of Reason
   Area 5  80-250 Ancient Philosophy
   Area 6  80-255 Pragmatism
   Area 7  80-246 The Criminal Justice System in America: Ideals and Realities
   Area 8  80-335 Philosophy, Politics, and Economics
   Area 9  80-346 Values, Fact, and Policy

2. For an emphasis on Metaphysics and Epistemology a student might take:
   Area 1  80-260 Philosophy of Art
   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  82-251 Modern Philosophy
   Area 7  80-201 Epistemology
   Area 8  80-254 Analytic Philosophy
   Area 9  80-312 Philosophy of Mathematics

3. For an emphasis on Ethics and Social Philosophy a student might take:
   Area 1  80-230 Ethical Theory

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  80-254 Analytic Philosophy
   Area 7  80-300 Minds, Machines, and Knowledge
   Area 8  80-371 Philosophy and Psychology
   Area 9  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: [http://hss.cmu.edu/philosophy/](http://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 Introduction to Formal Logic
- 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: http://hss.cmu.edu/philosophy.

Faculty
HORACIO ARLO-COSTA, Assistant 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, Senior Lecturer in Philosophy— Ph.D., Duquesne University; Carnegie Mellon, 1987—.
PRESTON K. COVEY JR., Associate Professor of Philosophy — Ph.D., Stanford University; Carnegie Mellon, 1974—.
CLARK GLYMOUR, Alumni University Professor of Philosophy — Ph.D., Indiana University; Carnegie Mellon, 1984—.
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, Senior Lecturer in Philosophy — Ph.D., Duquesne University; Carnegie Mellon, 1989—.
RICHARD SCHEINES, Associate Professor of Philosophy, Human-Computer Interaction, and Automated Learning and Discovery, Director HGI Undergraduate Major — Ph.D., University of Pittsburgh; Carnegie Mellon, 1987—.
DANA S. SCOTT, Hillman University Professor of Mathematical Logic, Computer Science and Philosophy — 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 SIGE, Professor of Philosophy — Ph.D., Stanford University; Carnegie Mellon, 1985—.
MANDY SIMONS, Assistant Professor of Philosophy — Ph.D., Cornell University; Carnegie Mellon, 1998—.
PETER L. SPIRTES, 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—.
Department of Psychology

Roberta Klatzky, Department Head
Department Office: Baker Hall 346-C

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 these insights possible? How do disturbances of brain chemistry in schizophrenia affect 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 neuroscience, 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.

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. Some of the sub-fields within psychology are cognitive, social, personality, developmental, educational, clinical, physiological, health, and industrial. In all of these areas, knowledge is established 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 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 course, 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 [link](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 an area of psychology. Both the B.A. and the B.S. degrees are offered in Psychology. Candidates for both degrees must complete two semesters of calculus. There are three options in completing this requirement: 21-111/112, 21-121/256, 21-115/116 and either 21-117/118 or 21-256. Students are also required to complete a statistics sequence consisting of 36-201 or it’s 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, B.S. candidates must take two additional semesters of a single science outside the department (see below).

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. (NOTE: 85-102 may also be applied to the “Cognition, Choice and Behavior” requirement in the H&SS General Education 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.

The breadth requirement, including 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 Clinical 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, the breadth requirement and 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

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<tr>
<th>Course</th>
<th>Prerequisite/Description</th>
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<tr>
<td>21-111 Calculus I</td>
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<td>21-112 Calculus II</td>
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<td>21-121 Calculus I</td>
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<td>21-256 Multivariate Analysis and Approximation</td>
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<td>21-115/116 Differential Calculus/Integral Calculus (5 units each)*</td>
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<td>21-256 Multivariate Analysis and Approximation</td>
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<td>21-115/116 Differential Calculus/Integral Calculus (5 units each)</td>
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<tr>
<td>21-117/118 Integration and Differential Equations/Calculus of Approximation (5 units each)</td>
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<td>36-201 Statistical Reasoning, Statistical Practice</td>
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<td>36-309 Experimental Design for Behavioral and Social Sciences (Prerequisite: 36-201 or equivalent)</td>
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*Counts toward General Education Program requirement, DCR5.

**Breadth Requirement** 9 units

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<th>Course</th>
<th>Prerequisite/Description</th>
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<tr>
<td>85-102 Introduction to Psychology or a fourth Survey Course</td>
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One of these courses can be double counted as a general education program course.

**Survey Courses** 24 units

<table>
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<tr>
<th>Course</th>
<th>Prerequisite/Description</th>
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<tr>
<td>85-211 Cognitive Psychology</td>
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<td>85-213 Human Information Processing and Artificial Intelligence</td>
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<td>85-219 Biological Foundations of Behavior</td>
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<td>85-221 Principles of Child Development</td>
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<td>85-241 Social Psychology</td>
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<td>85-251 Personality</td>
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**Research Methods** 18 units

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<tr>
<th>Course</th>
<th>Prerequisite/Description</th>
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<tr>
<td>85-310 Research Methods in Cognitive Psychology*</td>
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<td>85-320 Research Methods in Child Development*</td>
<td></td>
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<tr>
<td>85-340 Research Methods in Social Psychology*</td>
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*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

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<tr>
<th>Course</th>
<th>Prerequisite/Description</th>
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<tr>
<td>85-351 or higher</td>
<td>Any advanced content course 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</td>
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**Computer Science Requirement** 10 units minimum

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<th>Course</th>
<th>Prerequisite/Description</th>
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<tr>
<td>15-100 Introductory/Intermediate Programming</td>
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**Science Requirement (B.S. only)** (minimum) 18 units

The Psychology major requires (for B.S. candidates) two additional science courses (in the same science) beyond the College’s two-course Science and Technology General Education requirement. Although the College’s requirement can be met by a year of statistics, courses in statistics do not count toward this Science Requirement.

Both courses should come from the same area (biology, chemistry, or physics):

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<tr>
<th>Course</th>
<th>Prerequisite/Description</th>
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<tr>
<td>03-xxx Biology*</td>
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<td>09-xxx Chemistry</td>
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<tr>
<td>33-xxx Physics</td>
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*Those interested in a cognitive neuroscience focus are recommended to take biology courses, including if possible, 03-360, The Biology of the Brain.

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**Sample Curriculum**

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<thead>
<tr>
<th>Year</th>
<th>Spring Course</th>
<th>Fall Course</th>
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<tr>
<td>Junior</td>
<td>Survey Course</td>
<td>36-309</td>
<td>Senior</td>
<td>Elective</td>
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<td>Fall</td>
<td>Survey Course</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.

**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 sequence or equivalent and 36-309). In addition, B.S. candidates must take the two-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, 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 (see page 180 or 82). 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**

<table>
<thead>
<tr>
<th>Course</th>
<th>Prerequisite/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-115/116 Differential Calculus and Integral Calculus</td>
<td></td>
</tr>
<tr>
<td>21-117-118 Integration &amp; Differential Equations and Calculus of Approximations</td>
<td></td>
</tr>
<tr>
<td>36-247 Statistics for Laboratory Sciences*</td>
<td></td>
</tr>
<tr>
<td>36-309 Experimental Design Statistics</td>
<td></td>
</tr>
</tbody>
</table>

* 36-201 can be used as an alternative, but 36-247 is strongly encouraged.

**Sciences:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Prerequisite/Description</th>
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</thead>
<tbody>
<tr>
<td>09-105 Introduction to Modern Chemistry</td>
<td></td>
</tr>
<tr>
<td>09-106 Modern Chemistry II</td>
<td></td>
</tr>
<tr>
<td>33-111 Physics for Science Students I</td>
<td></td>
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<tr>
<td>09-217 Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>09-218 Organic Chemistry II</td>
<td></td>
</tr>
</tbody>
</table>
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 five 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 21-115/116/256 (or alternatively 21-115/116/117/118)* 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 study 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

37-38 units
21-115/116 Differential Calculus/Integral Calculus (5 units each)* and 21-256 Multivariate Analysis and Approximation or 21-115/116 and 21-117/118 Integration and Differential Equations/Calculus of Approximation (5 units each)
21-127 Concepts of Mathematics*+ 36-201 Statistical Reasoning, Statistical Practice or equivalent 36-309 Experimental Design for the Behavioral and Social Sciences
*Counts toward General Education Program requirement, DCR5.
+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 Production System Models of Thought or 85-419 Introduction to Parallel Distributed Processing
*The 15-211/212 sequence can be double-counted toward the two course requirement in General Education Program, DCR6.

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 (or another Psychology Research Methods 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
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 85-412, 85-419, 15-199, 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
15-453 Formal Languages and Automata
15-681 Machine Learning

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
85-393 Human Factors
85-408 Visual Cognition
85-412 Production System Models of Thought
85-414 Cognitive Neuropsychology
85-417 Cognitive Modeling & Intelligent Tutoring System
85-419 Introduction to Parallel Distributed Processing
85-421 Language and Thought
85-422 Infancy
85-423 Cognitive Development
85-429 Seminar on Higher Level Cognition and Brain Function
85-490 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
80-300 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
80-371 Philosophy and Psychology
80-410 Recursion and Hierarchies
80-421 Cognitive Architecture and Bayesian Networks
80-510 Seminar in Logic and Computation
80-518 Seminar on Epistemology

Linguistics:
78-385 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 Theory
88-366 Social Issues in Computing
88-367 Computers in Organizations

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):

NROSCI1000 Introduction to Neuroscience
NROSCI1011 Functional Neuroanatomy
NROSCI1012 Neuropsychology
NROSCI1030 Psychiatric Disorders and Brain Function
NROSCI1034 Neural Basis of Cognition
NROSCI1040 Biological Basis of Learning and Memory

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.

Cognitive Science, 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>Fundamental Structures of Computer Science</td>
<td>Fundamental Structures of Computer Science</td>
</tr>
<tr>
<td>15-211</td>
<td>15-212</td>
</tr>
<tr>
<td>Cognitive Psychology Core Course</td>
<td>Cognitive Psychology Core Course</td>
</tr>
<tr>
<td>85-211 or 85-213</td>
<td>85-419 or 85-423</td>
</tr>
<tr>
<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 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 (15-113), the Mathematics and Statistics prerequisites, the A. J. 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 currently four curricular "tracks" in the Psychology Department. These are: cognitive psychology, developmental psychology, social-personality psychology, and cognitive-neuroscience. A number of sets of courses can form meaningful survey/research methods/advanced course groupings within the four tracks.

Curriculum

I. Introductory courses 9 units
Complete only one of these courses.
85-100 Cognitive Processes: Theory & Practice
85-102 Introduction to Psychology

II. Area Survey courses 18 units
Complete two courses.
85-211 Cognitive
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 Statistical Reasoning, Statistical Practice equivalent
36-309 Experimental Design for the Behavioral and Social Sciences

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 co-requisite) for all Research Methods courses: 36-309 and the appropriate survey course.

V. Advanced courses (minimum 9 units)
These courses exist within four areas (cognitive, cognitive-neuroscience, developmental and social psychology), and carry course numbers from 85-351 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, Associate Professor— 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, Adjunct Associate 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—.

SHELTON COHEN, Professor of Psychology — Ph.D., New York University; Carnegie Mellon, 1962—.

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, 1985—.

VICKI S. HELGESON, Professor of Psychology — Ph.D., University of Denver; Carnegie Mellon, 1990—.

LORI L. HOLT, Assistant 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, Head, Psychology Department — Ph.D., Stanford University; Carnegie Mellon, 1993—.

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, Associate 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 — 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—.
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 the intellectual ideals with the realities of human and organizational behavior and apply successfully 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 are 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 a 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. Applications of Decision Science research abound. For example, research insights are being used to improve medical decision making (e.g., conveying the costs and benefits of alternative treatment options to patients), legal decision making (e.g., understanding the effects of anger on attributions of responsibility), large-scale risk assessments (e.g., assessing the risks of nuclear power), marketing (e.g., understanding the effects of emotion), and managerial decision making (e.g., correcting common errors and biases in the assessment of risk). Carnegie Mellon is one of the leading centers in the world for the study of Decision Science.

Behavioral decision theories provide the theoretical core for the Decision Science major. These theories draw on insights from a diverse set of disciplines, including cognitive and social psychology, as well as economics, statistics, and philosophy. Course content in the Decision Science major fosters an understanding of: (a) the cognitive, emotional, social, and institutional factors that influence judgment and choice, (b) normative (economic) models of rational choice, and (c) how judgment and decision making can be predicted and/or improved.

The Decision Science major prepares students for decision-making and management roles in government, the non-profit sector, business, and consulting. The major emphasizes basic skills and concepts that enhance a graduate’s ability to understand why individuals and organizations behave the way they do, as well as to choose rationally among competing courses of action and to organize the actions of those who will carry out decisions.

In addition to gaining a broad education in economic and psychological principles of judgment and decision making, Decision Science majors gain valuable skills in research design and analysis. Upon completion of the Decision Science major, each student will be able to design, conduct, and analyze studies on human judgment and decision making. Moreover, each student will be able to evaluate critically empirical research findings. Taken together, these skills enable Decision Science graduates to evaluate extant knowledge and to generate new knowledge as problems arise.

The core courses in Decision Science cluster into two categories, one addressing disciplinary perspectives and the other addressing research methods. The first cluster is substantive courses presenting the 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 is a two-course sequence that introduces students to a variety of methods for collecting and analyzing data that can be used to make informed judgments and decisions. Students learn to perform sample surveys (e.g., uncovering consumer or managerial preferences) and to conduct experiments to evaluate theories and test the effectiveness of different interventions for improving judgment and decision making.

The elective courses are organized into five categories. The first category addresses biological and behavioral aspects of decision making. Courses in this cluster provide essential knowledge about the connection between brain and behavior. The second cluster addresses managerial and organizational The third cluster addresses philosophical and ethical perspectives of judgment and decision making. Finally, the fourth cluster addresses advanced statistical and technological tools for judgment and decision making.

Prerequisites
All Decision Science majors must satisfy the H&SS General Education Program requirements for the B.S. degree. In addition to College General Education Program requirements, Decision Science majors must complete mathematics and statistics prerequisites (see below), by the end of the sophomore year.

Mathematics and Statistics Prerequisites 28-29 units
21-111 Calculus I
and
21-112 Calculus II
or
21-121 Calculus I*
and
21-256 Multivariate Analysis and Approximation**
or
21-115/116 Differential Calculus/Integral Calculus (5 units each)*
and
21-117/118 Integration and Differential Equations/Calculus of Approximation (5 units each)
36-201 Statistical Reasoning, Statistical Practice
*Counts toward General Education Program requirement, DCR5.

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
89-302 Behavioral Decision Making
* 88-120 recommended in the freshman or sophomore year. The course can be double-counted for one General Education Program (DCR1) course and one major or minor course.
+ One of these courses may be double counted for H&SS General Education Requirement DCR1.
Research Methods 18 units
88-250 Regression Methods in the Social Sciences
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. In order to develop depth of knowledge, two of the selected courses must be from the same category. 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
03-399 Biology of the Brain
or
42-301 Physiology
or
85-219 Biological Foundations of Behavior
19-426 Environmental Decision Making
85-241 Social Psychology (may substitute Intro. to Social Psychology at University of Pittsburgh PSY 0160)
85-451 Psychology of Purpose
88-353 Human Judgment
88-373 Mental Health Ideologies in the US: From Psychoanalysis to Prozac

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
70-332 Business and Society
70-381 Marketing
73-340 Labor Economics
73-359 Benefit-Cost Analysis
80-346 Value, Fact, & Policy
88-222 Policy Analysis III
88-260 Organizations
88-341 Organizational Communication
88-354 Economics and Psychology of Organizational Communication

3. Philosophical and Ethical Perspectives on Decision Making
19-426 Environmental Decision Making
19-448 Science, Technology and Ethics
80-130 Introduction to Ethics
80-150 Nature of Reason
80-241 Ethical Judgments in Professional Life
80-254 Environment, Management, and Ethics
88-305 Philosophy of Social Science
88-356 Rational Choice

4. Statistical and Technological Tools for Decision Analysis
15-381 Artificial Intelligence: Representation and Problem Solving
36-203 Sampling, Surveys, & Society
73-251 Econometrics
80-316 Probability and Artificial Intelligence: Computability and Incompleteness

Note: Some courses have additional prerequisites.

<table>
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<tr>
<th>Sophomore Year</th>
<th>Junior Year</th>
<th>Senior Year</th>
</tr>
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<tr>
<td>Spring</td>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>Reason, Passion, &amp; Decision Making 88-120</td>
<td>Policy Analysis I 88-220</td>
<td>Decision Science Elective</td>
</tr>
<tr>
<td>Elective</td>
<td>Empirical Research Methods 88-251</td>
<td>Elective or Honors Thesis</td>
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<tr>
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<tr>
<td>Open Prerequisite</td>
<td>Behavioral Decision Making 88-302</td>
<td>Elective or Honors Thesis</td>
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<td>Elective</td>
<td>Cognitive Psychology 85-211</td>
<td>Decision Science Elective</td>
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</table>

*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 88-220, 88-250, 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 88-220, 88-223, 88-250, 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. 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 Research Methods cluster is a two-course sequence 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.

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, coordination failure, and bureaucratic infighting.

Finally, the Management, Decision Making, and Technology cluster consists of five elective courses chosen by the student, in coordination with an adviser, 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 managerial 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 satisfy the H&SS General Education Program requirements for the B.S. degree. In addition to College General Education Program requirements, Policy and Management majors must complete mathematics and statistics prerequisites (see below), by the end of the sophomore year.

Mathematics and Statistics Prerequisites 28-29 units

21-111 Calculus I*
and
21-121 Calculus I*
and
21-256 Multivariate Analysis and Approximation**

or
21-115/116 Differential Calculus/Integral Calculus (5 units each)*
and
21-117/118 Integration and Differential Equations/Calculus of Approximation (5 units each)
36-201 Statistical Reasoning, Statistical Practice

*Counts toward General Education Program requirement, DCRS.

Curriculum 111 units

Analytical Methods 39 units
88-220 Policy Analysis I
88-221 Policy Analysis II
88-222 Policy Analysis III
88-223 Decision Analysis and Decision Support Systems
Research Methods 18 units
88-250 Regression Methods in the Social Sciences
88-251 Empirical Research Methods
Organizational Context 9 units
88-260 Organizations
Policy Making, Management, and Technology 45 units

At least three of these courses (27 units) must be Social and Decision Sciences courses (88-xxx).

1. Policy Making
73-328 Health Economics
73-340 Labor Economics
73-357 Regulation: Theory and Policy
73-420 Monetary Theory and Policy
79-328 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 and Policy
88-301 Macroeconomic 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
88-382 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 Electronic Commerce
80-241 Ethical Judgments in Professional Life
80-242 Conflict and Dispute Resolution
80-244 Environment, Management, and Ethics
88-302 Behavioral Decision Making
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
79-342 Technology, Organization and Information
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
88-350 Computational Modeling of Organizations, Technology and Society
88-452 Organizational Theory

NOTE: Some courses have additional prerequisites.

Policy and Management, B.S.
Sample Curriculum*

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<tr>
<th>Junior Year Fall</th>
<th>Spring</th>
<th>Senior Year Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy Analysis I 88-220</td>
<td>Policy Analysis II 88-221</td>
<td>Policy Analysis III 88-222</td>
<td>Policy and Management Elective</td>
</tr>
<tr>
<td>Regression Methods in the Social Sciences 88-250</td>
<td>Empirical Research Methods 88-251</td>
<td>Policy and Management Elective</td>
<td>Policy and Management Elective</td>
</tr>
<tr>
<td>Organizations 88-260</td>
<td>Decision Analysis &amp; Decision Support Systems 88-223</td>
<td>Policy and Management Elective</td>
<td>Policy and Management Elective</td>
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<tr>
<td>Elective</td>
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<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.
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 88-220, 88-223, 88-250, and 88-251 toward the completion of both majors.

Students pursuing Political Science with an additional major in Policy and Management may only count 88-220, 88-221, 88-250, 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

William R. Keech, Director
Office: Porter Hall 20B

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 seven 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 satisfy the H&SS General Education Program requirements for the B.S. degree. The mathematics and statistics prerequisites (see below) must be completed by the end of the sophomore year. In addition to College General Education Program requirements, Political Science majors must satisfy requirements in the following areas (some of these prerequisites—Decision Processes in American Political Institutions, for example—may fulfill H&SS General Education Program requirements):

<table>
<thead>
<tr>
<th>Mathematics and Statistics Prerequisites</th>
<th>28-29 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-111 Calculus I*</td>
<td></td>
</tr>
<tr>
<td>and</td>
<td></td>
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<tr>
<td>21-112 Calculus II</td>
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<tr>
<td>or</td>
<td></td>
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<tr>
<td>21-121 Calculus I*</td>
<td></td>
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<tr>
<td>and</td>
<td></td>
</tr>
<tr>
<td>21-256 Multivariate Analysis and Approximation**</td>
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<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>21-115/116 Differential Calculus/Integral Calculus (5 units each)*</td>
<td></td>
</tr>
<tr>
<td>and</td>
<td></td>
</tr>
<tr>
<td>21-117/118 Integration and Differential Equations/Calculus of Approximation (5 units each)</td>
<td></td>
</tr>
<tr>
<td>36-201 Statistical Reasoning, Statistical Practice</td>
<td></td>
</tr>
</tbody>
</table>

*Counts toward General Education Program requirement, DCR5.

Curriculum

<table>
<thead>
<tr>
<th>Political Core</th>
<th>102 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>88-104 Decision Processes in American Political Institutions*</td>
<td>18 units</td>
</tr>
<tr>
<td>88-324 Electoral Systems and Processes</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>88-358 Policy Making Institutions</td>
<td></td>
</tr>
</tbody>
</table>

*May be used as the one General Education course from DCR1-4 to double count for a major or minor. It is recommended to take this course before 88-324 or 88-358.

Theoretical Perspectives

<table>
<thead>
<tr>
<th>30 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>88-220 Policy Analysis I</td>
</tr>
<tr>
<td>88-221 Policy Analysis II</td>
</tr>
<tr>
<td>88-222 Policy Analysis III</td>
</tr>
</tbody>
</table>

Research Methods

<table>
<thead>
<tr>
<th>18 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>88-250 Regression Methods in the Social Sciences</td>
</tr>
<tr>
<td>88-251 Empirical Research Methods</td>
</tr>
</tbody>
</table>

Theories and Applications

<table>
<thead>
<tr>
<th>36 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>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).</td>
</tr>
</tbody>
</table>

1. Law

| 66-181 Topics in Law: 1st Amendment |
| 66-184 Topics in Law: The Bill of Rights |
| 70-364 Business Law |
| 70-365 International Trade and International Law |
| 73-357 Regulation: Theory and Policy |
| 79-331 Crime and Punishment in American History |
| 80-236 Philosophy and Law |
| 80-244 Environment, Management, and Ethics |
| 80-340 Environmental Ethics & Decision Processes |
| 80-343 Race Gender and Justice |
| 88-352 International Environmental Law and Policy |
| 88-382 Climate Change, Energy Policy, and Environmental Protection |

2. American Politics

| 70-332 Business and Society |
| 70-232 Vietnam: America's Lost War |
| 70-241 African-American History I |
| 70-242 African-American History II |
| 79-268 Racial Violence in America |
| 79-331 Crime and Punishment in American History |
| 79-335 Drug Use and Drug Policy |
| 79-345 American Environmental History: Critical Issues |
| 80-244 Management, Environment, & Ethics |
| 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 |
**Political Science, B.S.**

Sample Curriculum*

### Senior Year

**Fall**
- Decision Processes in American Political Institutions 88-104

**Spring**
- Policy Analysis I 88-220

### Junior Year

**Fall**
- Political Core (88-324 or 88-358) or Political Science Elective

**Spring**
- Regression Methods in the Social Sciences 88-250
- Empirical Research Methods 88-251

### Sophomore Year

**Fall**
- Decision Processes in American Political Institutions 88-104

**Spring**
- Policy Analysis I 88-220
- Policy Analysis II 88-221

**Elective**
- Policy Making Institutions***

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88-220 Policy Analysis I (or 73-250 Intermediate Microeconomics)
88-223 Decision Analysis and Decision Support Systems
88-302 Behavioral Decision Making

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### Core Courses 36 units

- Political Economy of Public Institutions
- Political Philosophy
- Philosophy of Social Science
- Philosophy, Politics and Economics
- Political Economy of Inequality and Redistribution
- Computational Modeling of Organizations, Technology, and Society
- Rational Choice
- Policy Making Institutions***
- Political Economy
- Government Response to Market Failures
- Formal Models of Political Economics

**Note:** Some courses have additional prerequisites.

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**Elective Courses 18 units**

Complete any two courses from the following categories.

1. **Biological and Behavioral Aspects of Decision Making**
   - 03-360 Biology of the Brain
   - or
   - 42-301 Physiology
   - or
   - 85-219 Biological Foundations of Behavior
   - 85-246 Environmental Decision Making
   - 85-241 Social Psychology (may substitute Intro. to Social Psychology at University of Pittsburgh PSY 0160)
   - 85-451 Psychology of Purpose
   - 88-353 Human Judgment
   - 88-373 Mental Health Ideologies in the US: From Psychoanalysis to Prozac

---

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 option. Contact the Decision Science faculty director for more information.

2. **Managerial and Organizational Aspects of Decision Making**
   - 70-332 Business and Society
   - 70-381 Marketing
   - 73-340 Labor Economics
   - 73-359 Benefit-Cost Analysis
   - 80-342 Value, Fact, & Policy
   - 88-222 Policy Analysis III
   - 88-260 Organizations
   - 88-341 Organizational Communication
   - 88-354 Economics and Psychology of Organizational Communication

3. **Philosophical and Ethical Perspectives on Decision Making**
   - 19-426 Environmental Decision Making
   - 19-448 Science, Technology and Ethics
   - 80-130 Introduction to Ethics
   - 80-150 Nature of Reason
   - 80-241 Ethical Judgments in Professional Life
   - 80-244 Environment, Management, and Ethics
   - 88-305 Philosophy of Social Science
   - 88-356 Rational Choice

4. **Statistical and Technological Tools for Decision Analysis**
   - 15-381 Artificial Intelligence: Representation and Problem Solving
   - 38-203 Sampling, Surveys, & Society
   - 73-261 Econometrics
   - 80-316 Probability and Artificial Intelligence: Computability and Incompleteness

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**Additional Major**

Students who elect Political Science as part of an additional major must fulfill all of the requirements of the Political Science major.

Students pursuing Decision Science with an additional major in Political Science may only count 88-220, 88-250, 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 Political Science program.

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**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 judgment 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 (or 73-250 Intermediate Microeconomics)
- 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**
   - 03-360 Biology of the Brain
   - or
   - 42-301 Physiology
   - or
   - 85-219 Biological Foundations of Behavior
   - 88-353 Human Judgment
   - 88-373 Mental Health Ideologies in the US: From Psychoanalysis to Prozac

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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

- 36 units
- 88-220 Policy Analysis I
- 88-221 Policy Analysis II
- 88-223 Decision Analysis and Decision Support Systems
- 88-293 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

- 73-328 Health Economics
- 73-340 Labor Economics
- 73-357 Regulation: Theory and Policy
- 73-420 Monetary Theory and Policy
- 78-329 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 and Policy
- 88-301 Macroeconomic 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
- 88-382 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 Electronic Commerce
- 80-241 Ethical Judgments in Professional Life
- 80-242 Conflict and Dispute Resolution
- 80-244 Environment, Management, and Ethics
- 86-302 Behavioral Decision Making
- 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
- 79-342 Technology, Organization and Information
- 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
- 88-350 Computational Modeling of Organizations, Technology and Society
- 88-452 Organizational Theory

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: 88-104, Decision Processes in American Political Institutions; 88-220, Policy Analysis I; and 88-324, Electoral Systems and Processes or 88-358, Policy Making Institutions.

The remainder are electives. Note that one of these courses, 88-104, Decision Processes in American Political Institutions, is an option in one of the H&SS General Education distributional categories ("Social, Political and Economic Institutions"), and should therefore be taken as part of the General Education Program by H&SS students interested in the Political Science minor.

Curriculum

Required Courses

- 27 units
- 88-104 Decision Processes in American Political Institutions
- 88-220 Policy Analysis I
- 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

- 66-181 Topics in Law: 1st Amendment
- 66-184 Topics in Law: The Bill of Rights
- 70-364 Business Law
- 70-365 International Trade and International Law
- 73-357 Regulation: Theory and Policy
- 79-331 Crime and Punishment in America
- 80-236 Philosophy and Law
- 80-244 Management, Environment, & Ethics
- 80-340 Environmental Ethics & Decision Processes
- 80-343 Race and Justice
- 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
- 79-288 Racial Violence in America
- 79-331 Crime and Punishment in American History
- 79-335 Drug Use and Drug Policy
- 79-345 American Environmental History: Critical Issues
- 80-244 Environment, Management, & Ethics
- 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
- 79-367 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
Politics of Economic Development
Political Economy of Inequality and Redistribution
Transitions to Democracy in Eastern Europe and Latin America
International Environmental Law and Policy
Comparative Foreign Policy: China, Russia, and the US
Policy Making Institutions***
Globalization

4. Political Theory and Methodology
Political Economy of Public Institutions
Social Structure, Public Policy, & Ethical Dilemmas
Political Philosophy
Conflict and Dispute Resolution
Modern Moral Philosophy
Philosophy of Social Science
Philosophy, Politics and Economics
Political Economy of Inequality and Redistribution
Computational Modeling of Organizations, Technology, and Society
Rational Choice
Policy Making Institutions***
Political Economy
Government Response to Market Failures
Formal Models of Political Economics

***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, Lecturer — Ph.D., University of Pittsburgh; Carnegie Mellon, 2001—.
KATHLEEN M. CARLEY, Professor of Sociology — Ph.D., Harvard University; Carnegie Mellon, 1984—.
WESLEY M. COHEN, Professor of Economics and Social Science — Ph.D., Yale University; Carnegie Mellon, 1980—.
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—.
PAUL S. FISCHBECK, Associate Professor of Social and Decision Sciences and Engineering and Public Policy — Ph.D., Stanford University; Carnegie Mellon, 1990—.
BARUCH FISCHHOFF, University Professor of Social and Decision Sciences and Engineering and Public Policy — Ph.D., The Hebrew University of Jerusalem; Carnegie Mellon, 1987—.
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, Professor of Economics and Social Science — Ph.D., Cornell University; Carnegie Mellon, 1980—.
JENNIFER S. LERNER, Assistant Professor of Social and Decision Sciences — 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—.
JOHN W. PATTY, Assistant Professor of Political Science — Ph.D., California Institute of Technology; Carnegie Mellon, 2000—.
KIRON K. SKINNER, Assistant Professor of History and of Political Science — Ph.D., Harvard University; Carnegie Mellon, 1999—.
PETER THOMPSON, Associate Professor of Economics — Ph.D., University of Florida; Carnegie Mellon, 2002—.
ROBERTO A. WEBER, Assistant Professor of Social and Decision Sciences — Ph.D., California Institute of Technology; Carnegie Mellon, 1999—.

Faculty by Courtesy Appointment
LINDA ARGOTE, David and Barbara Kirr Professor of Organizational Behavior — Ph.D., University of Michigan; Carnegie Mellon, 1979—.
LINDA BABCOCK, James Mellon Walton Professor of Economics — Ph.D., University of Wisconsin-Madison; Carnegie Mellon, 1988—.

DENNIS N. EGGLE, Professor of Economics — Ph.D., Princeton University; Carnegie Mellon, 1974—.
JOSEPH B. KADANE, Leonard J. Savage University Professor of Statistics and Social Science — Ph.D., Stanford University; Carnegie Mellon, 1969—.
MARK S. KAMLET, Provost and Professor of Economics and Public Policy — Ph.D., University of California, Berkeley; Carnegie Mellon, 1978—.
SARAH B. KIESLER, Professor — Ph.D., The Ohio State University; Carnegie Mellon, 1979—.
DAVID M. KRACKHARDT, Professor of Organizations and Public Policy — Ph.D., University of California, Irvine; Carnegie Mellon, 1991—.
ROBERT E. KRAUT, Hebert A. Simon Professor of Human Computer Interaction — Ph.D., Yale University; Carnegie Mellon, 1993—.
PATRICK D. LARKEY, Professor of Public Policy and Decision Sciences — Ph.D., The University of Michigan; Carnegie Mellon, 1977—.
DON MOORE, Assistant Professor of Organizational Behavior and Theory — Ph.D., Northwestern University; Carnegie Mellon, 2000—.
PETER P. VANDERSCHRAAF, Assistant Professor of Philosophy — Ph.D., University of California, Irvine; Carnegie Mellon, 1997—.
Department of Statistics

Robert E. Kass, 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 and 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 Neurosciences 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 closely 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 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 Statistical and Mathematical Sciences Program (Science and Humanities Scholars, see pages 83 in this catalog) 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 page 192 for more information.

• The Minor in Statistics is a useful complement to a 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.

• A variety of joint majors and minors with other programs on campus are available or in the planning stages. Please contact the Statistics Undergraduate Advisor for more information.

• 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.

Mathematical Foundations

Mathematics is the language in which statistical models are described and analyzed, so some experience with basic calculus is an important component for anyone pursuing a program of study in Statistics. There are four sequences of mathematics courses at Carnegie Mellon that provide sufficient preparation.

Sequence 1
21-111 Calculus I
21-112 Calculus II

Sequence 2
21-115 Differential Calculus (5 units)*
21-116 Integral Calculus (5 units)*
21-117 Integration and Differential Equations (5 units)
21-118 Calculus of Approximation (5 units)**

Sequence 3
21-121 Calculus I*
21-256 Multivariate Analysis and Approximation

*Counts towards General Education requirement DCR5.

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 (36-208), engineering and architecture (36-220), and the laboratory sciences (36-247). Note that 36-207 is the prerequisite for 36-208, although a score of 4 or 5 on the Statistics AP Exam may be used to waive this prerequisite.

The Intermediate Data Analysis courses draw on students' previous experience with data analysis and understanding of statistical theory to develop advanced methods. These core courses involve extensive analysis of real data and a substantial component of independent research.

**Beginning**

- 36-201 Statistical Reasoning, Statistical Methods*
- 36-208 Regression Analysis**
- 36-220 Engineering Statistics and Quality Control
- 36-247 Statistics for the Laboratory Sciences

**Intermediate**

- 36-202 Topics in Introductory Statistics
- 36-303 Sampling, Surveys, and Society***
- 36-309 Experimental Design for Behavioral and Social Sciences
- 36-315 Statistical Graphics and Visualization
- 36-350 Data Mining

**Advanced**

- 36-401 Modern Regression
- 36-402 Advanced Data Analysis

* Counts towards College General Education Requirement CCR3.
** 36-207 is a prerequisite for this course.
*** Counts towards College General Education Requirement DCR2.

**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. For students taking Statistical Theory Sequences 2 or 3 (see below), a course in probability theory is necessary as a prerequisite.

Typically, students take corresponding pairs 36-225/36-226 or 36-325/36-326, but it is possible to substitute 36-217 for 36-225 or 36-325. 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. 36-325 is an honors-level course which covers the theory in greater mathematical depth. All of the probability courses listed below qualify as both Statistical Electives and Quantitative Science Electives, and thus taking these prerequisites can satisfy additional Major and Minor requirements.

- 36-217 Probability Theory and Random Processes
- 36-225 Introduction to Probability and Statistics I
- 36-325 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 to 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. Both require a prerequisite in Probability Theory (see above).

**Special Topics**

The Statistics Department offers a varying menu of seminar courses that focus on specific statistical applications or advanced statistical methods. At least one of these Special Topics seminars will be offered every year; others are offered intermittently according to interest and demand.

- 36-461 Topics in Statistics
- 36-462 Topics in Statistics
- 36-463 Statistical Genetics
- 36-464 Applied Multivariate Methods
- 36-465 Statistical Methods in Epidemiology

**Statistical Electives**

Any course in the Probability Theory, Intermediate Data Analysis, or Special Topics categories above, beyond those taken to satisfy the requirements of a Statistics Major or Minor, may be counted as a Statistical Elective.

**Quantitative Science Electives**

The quantitative science electives are intended to provide intellectual infrastructure that will advance the student's understanding of statistics and its applications. Quantitative science electives may not be applied toward any other requirements.

**Courses within Statistics**

Any course in the Probability Theory, Intermediate Data Analysis, or Special Topics categories that does not satisfy any other requirement may be counted as a Quantitative Science Elective.

**Courses outside Statistics**

The following is a partial list of courses that qualify as a Quantitative Science Elective. 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
- 21-241 Matrix Algebra
- 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
- 80-222 Philosophy of Economics
- 80-310 Logic and Computability I
- 85-310 Research Methods in Cognitive Psychology
- 88-223 Decision Analysis and Decision Support Systems
- 88-302 Behavioral Decision Making

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- 80-220 Philosophy of Science
- 80-221 Philosophy of Social Science
- 80-222 Philosophy of Economics
- 80-310 Logic and Computability I
- 85-310 Research Methods in Cognitive Psychology
- 88-223 Decision Analysis and Decision Support Systems
- 88-302 Behavioral Decision Making

**Note:** Additional prerequisites are required for some of these courses. Students 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.
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 3.25 overall may also apply to participate in the H&SS Senior Honors Program (see page 184 in this catalog for details).

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 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.

Requirements
Basic Curriculum Category* Requirement
Mathematical Foundations 18-20 units via Sequence 1,2,3, or 4
Beginning Data Analysis 9 units or
Intermediate Data Analysis extra Quantitative Science Elective
Advanced Data Analysis 18 units**
Probability Theory preqreq for Statistical Theory
Statistical Theory Sequence 2 or 3
Special Topics 9 units via Sequence 1,2, or 3
Statistical Elective 9 units
Quantitative Science Elective 9 units
Concentration Area 36 units
Total 144 units

* See Basic Curriculum description on Page 248.
** Students wishing to study advanced probability may substitute a Probability Theory course for one Intermediate Data Analysis course with the permission of the Statistics Undergraduate Advisor

Sample Programs
The following sample programs illustrate two 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 15-100 as the Quantitative Science Elective.

The second schedule below has a heavier emphasis on statistical theory and probability; it substitutes an extra Quantitative Science Elective (36-325) for Beginning Data Analysis, includes Mathematical Foundations Sequence 3, and uses 21-214 as the Quantitative Science Elective. In both, C.A. refers to Concentration Area courses.

Schedule 1

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<th>Year</th>
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<td>Sophomore</td>
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<td>15-125 (Q.S.E.)</td>
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Schedule 2

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<td>36-410</td>
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<td>C.A</td>
<td>C.A</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, particularly true if the other major has a complex set of requirements and prerequisites.

Recommendations
Students in the College of Humanities and Social Sciences who wish to major or minor in Statistics are advised to complete both the calculus requirement (one Mathematical Foundations sequence) and the course 36-201 (Statistical Reasoning, Statistical Methods) Beginning Data Analysis by the end of Freshman year.

Statistics Majors with concentrations in Computer Science, Operations Research, or Mathematics or who are considering graduate study in Statistics should carefully consider the sequence 36-325 and 36-326 in consultation with their advisor. It is also recommended that these students take linear algebra, 21-241, which can count as a Quantitative Science Elective.
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

Basic Curriculum Category* Requirement
Mathematical Foundations Basic Curriculum Category Requirement 18-20 units via Sequence 1, 2, 3, or 4
Beginning Data Analysis 9 units or extra Quantitative Science Elective
Intermediate Data Analysis 9 units
Advanced Data Analysis perereq for Statistical Theory
Probability Theory Sequence 2 or 3
Statistical Theory 9 units via Sequence 1, 2, or 3
Special Topics none
Quantitative Science Elective 9 units
Concentration Area none
Total 72 units

*See Basic Curriculum description on Page 248.

Sample Program
The following sample program illustrates one way to satisfy the requirements of the Statistics Minor. Keep in mind that the program is flexible and can support many other possible schedules. The particular schedule below includes Mathematical Foundations Sequence 1 and 15-100 as the Quantitative Science Elective.

Year Fall Spring
Freshman 21-111 21-112
Sophomore 36-201
Junior 36-309 36-310
Senior 36-401 36-402

Faculty

ANTHONY BROCKWELL, Assistant Professor - Ph.D., The University of Melbourne, Australia; Carnegie Mellon, 1999-
BERNIE DEVLIN, Adjunct Associate Professor - Ph.D., Pennsylvania State University; Carnegie Mellon, 1994-
MICHELE DIPETRO, Instructor and Assistant 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, Associate Department Head and Professor of Statistics -Ph.D., University of Illinois; Carnegie Mellon, 1990-
JOSEPH B. KADANE, Leonard J. Savage Professor of Statistics and Social Sciences -Ph.D., Stanford University; Carnegie Mellon, 1969-
ROBERT E. KASS, Department Head and Professor of Statistics - Ph.D., University of Chicago; Carnegie Mellon, 1981-
NICOLE LAZAR, Associate Professor of Statistics - Ph.D., University of Chicago; Carnegie Mellon, 1996-
JOHN P. LEHOCZKY, Thomas Lord Professor of Statistics - Ph.D., and Dean College of Humanities and Social Sciences; Stanford University; Carnegie Mellon, 1969-
ODED MEYER, Lecturer - Ph.D. University of Pittsburgh; Carnegie Mellon, 1999
KATHRYN ROEDER, Associate Department Head and Professor of Statistics - Ph.D., Pennsylvania State University; Carnegie Mellon, 1994-
KIM SELLERS, Visiting Assistant Professor of Statistics - Ph.D., George Washington University; Carnegie Mellon, 2001-
THOMAS MINKA, Visiting Assistant Professor - Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2001-
MARK J. SCHERVISH, Professor of Statistics - Ph.D., University of Illinois; Carnegie Mellon, 1979-
HOWARD SELTMAN, Research Scientist - Ph.D., Carnegie Mellon University; Medical College of Pennsylvania - M.D. Carnegie Mellon, 1999-
TEDDY SEIDENFELD, Herbert A. Simon Professor of Philosophy and Statistics - Ph.D., Columbia University; Carnegie Mellon, 1985-
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-
Graduate School of Industrial Administration
The Graduate School of Industrial Administration (GSIA) 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, GSIA 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. GSIA’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 GSIA gain a solid foundation in the fundamental and applied sciences, 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. GSIA is not content with teaching traditional approaches but develops innovative courses and programs.

At GSIA, research and education are closely related. The outstanding faculty of GSIA 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. GSIA has a strong and active faculty that confronts both fundamental and applied problems. The faculty is particularly renowned for cutting-edge work in operations research, economics, management information systems, finance, accounting, marketing, operations management, and production. GSIA 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 America’s top academic institutions. Moreover, GSIA 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 Graduate School of Industrial Administration for GSIA’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 GSIA Admissions Office (GSIA Room 149-C). They should also talk with their individual departments concerning completion of their undergraduate requirements.

Full-Time Faculty

LINDA ARGOTE, David M. Kirr and Barbera A. Kirr Professor of Organizational Behavior — Ph.D., University of Michigan; Carnegie Mellon, 1979—.

EGON BALAS, University Professor of Industrial Administration and Applied Mathematics: The Thomas Lord Professor of Operations Research — D.Sc.Ec., University of Brussels; D.U. (Math), University of Paris; Carnegie Mellon, 1968—.

ILKER BAYBARS, Senior Deputy Dean for Academic Programs, and Professor of Operations Management — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1979—.

BAHAR BILLER, Assistant Professor of Operations Management and Manufacturing — Ph.D., Northwestern University; Carnegie Mellon, 2002—.

PETER BOATWRIGHT, Assistant Professor of Marketing — Ph.D., University of Chicago, Started 1997—.

PEI-YU CHEN, Assistant Professor in Information Systems — Ph.D., University of Pennsylvania; Carnegie Mellon, 2002—.

GIAN LUCA CLEMENTI, Assistant Professor of Finance — Ph.D., University of Rochester; Carnegie Mellon, 2000—.

DANIELE COEN PIRANI, Assistant Professor of Economics — Ph.D., University of Rochester; Carnegie Mellon, 2000—.

MILTON L. COFIELD, Executive Director, BS in Business Administration Program and Senior Lecturer of Business Strategy — Ph.D., University of Illinois; Carnegie Mellon, 2001—.

PIERRE COLLIN-DUFRESNE, Assistant Professor of Finance — Ph.D. HEC School of Management, Paris; Carnegie Mellon, 1998—.

GERARD P. CORNUEJOLS, IBM University Professor of Operations Research — Ph.D., Cornell University; Carnegie Mellon, 1978—.

W. ROBERT DALTON, Senior Lecturer of Economics — Ph.D., University of Missouri; Carnegie Mellon, 1985—.

ROBERT M. DAMMON, Professor of Financial Economics — Ph.D., University of Wisconsin, Madison; Carnegie Mellon, 1984—.

LAURENS G. DEBO, Assistant Professor of Operations Management and Manufacturing — Ph.D., INSEAD, Fontainebleau, France; Carnegie Mellon, 2002—.

ISMAEL REGIS DE FARIAS, JR., Visiting Assistant Professor of Operations Research — Ph.D. Georgia Institute of Technology; Carnegie Mellon, 2002-03.

ANTHONY DUKES, Visiting Assistant Professor of Marketing — Ph.D., University of Pittsburgh – Carnegie Mellon, 2001—.

KENNETH B. DUNN, Dean and Professor of Financial Economics — Ph.D., Purdue University; Carnegie Mellon, 1979-1989; 2002—.

S. THOMAS EMERSON, Director, Donald H. Jones Center for Entrepreneurship and Senior Lecturer in Entrepreneurship – Ph.D., Rice University; Carnegie Mellon, 2000—.

DENNIS N. EPPLE, Thomas Lord Professor of Economics — Ph.D., Princeton University; Carnegie Mellon, 1974—.

MARIA MARTA FERREYRA, Assistant Professor of Economics — Ph.D., University of Wisconsin-Madison – Carnegie Mellon, 2002—.

MARK FICHMAN, Associate Professor of Organizational Behavior and Theory — Ph.D., University of Michigan; Carnegie Mellon, 1980—.

LISA K. FLEISCHER, Associate Professor of Operations Research — Ph.D., Cornell University; Carnegie Mellon, 2000—.

MARK FICHMAN, Associate Professor of Organizational Behavior and Theory — Ph.D., University of Michigan; Carnegie Mellon, 1980—.

LISA K. FLEISCHER, Associate Professor of Operations Research — Ph.D., Cornell University; Carnegie Mellon, 2000—.

MICHAEL F. GALLMEYER, Assistant Professor of Finance — Ph.D., The University of Pennsylvania; Carnegie Mellon, 1998—.

JONATHAN C. GLOVER, Associate Professor of Accounting — Ph.D., The Ohio State University; Carnegie Mellon, 1992—.

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—.
PAUL S. GOODMAN, Richard M. Cyert Professorship and Professor of Organizational Psychology; Director, Institute of Strategic Development; Co-Director, Center for the Management of Technology — Ph.D., Cornell University; Carnegie Mellon, 1972—.

RICHARD C. GREEN, Richard M. and Margaret S. Cyert Professor of Economics and Management — Ph.D., University of Wisconsin; Carnegie Mellon, 1982—.

ZHAOYANG LIU, Assistant Professor of Accounting — Ph.D., Tulane University; Carnegie Mellon, 1999.

KORHAN GURKAN, Assistant Professor in Information Systems — Ph.D., Stanford University; Carnegie Mellon, 2002—.

THOMAS J. HAJDUK, Senior Lecturer in Management Communication and Director, Center for Business Communication — Ph.D., Carnegie Mellon; Carnegie Mellon, 1992—.

IL-HORN HANN, Assistant Professor in Information Systems — Ph.D., University of Pennsylvania; Carnegie Mellon, 1999—.

CHAD R. HERMANN, Lecturer in Management Communication — Ph.D., University of Maryland (expected 2003); Carnegie Mellon, 1997—.


DALE HERSHEY, Senior Lecturer of Law — LL.B., Harvard Law School; Carnegie Mellon, 1997—.

JOHN N. HOOKER, T. Jerome Holleran Professor of Business Ethics and Social Responsibility and Professor of Operations Research — Ph.D., Vanderbilt University — Ph.D., University of Tennessee; Carnegie Mellon, 1984—.

YUJI IUJI, Robert M. Trueblood Professor University of Accounting and Economics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1987—.

JONATHAN W. JAFFE, Assistant Professor of Strategy — Ph.D., University of California, Berkeley; Carnegie Mellon, 2001—.

JOSEPH B. KADANE, Leonard J. Savage University Professor of Statistics and Social Sciences (Statistics) — Ph.D., Stanford University; Carnegie Mellon, 1989—.

AJAY KALRA, Associate Professor of Marketing — Ph.D., Duke University; Carnegie Mellon, 1992—.

ITIR Z. KARAESMEN, Assistant Professor of Operations Management and Manufacturing, Ph.D., Columbia University; Carnegie Mellon, 1999—.

SUNDER KEKRE, Professor of Operations Management and Manufacturing — Ph.D., University of Rochester; Carnegie Mellon, 1984—.

THOMAS M. KERR, Emeritus Associate Professor of Law and Industrial Administration — J.D., George Washington University; Carnegie Mellon, 1964—.

CLAUDIA A. KIRKPATRICK, Senior Lecturer in Management Communication — D.A., Carnegie Mellon University; Carnegie Mellon, 1981—.

STEVEN KLEPPER, Professor of Economics and Social and Decision Sciences — Ph.D., Cornell University; Carnegie Mellon, 1980—.

ADAM S. KOCH, Assistant Professor of Accounting — Ph.D., University of Texas at Austin; Carnegie Mellon, 1999—.

DAVID KRACKHARDT, Professor of Organizations (Heinz School and GSIA) — Ph.D., University of California, Irvine; Carnegie Mellon, 1991—.

ROBERT E. KRAUT, Professor of Human/Computer Interaction (School of Computer Science and GSIA) — Ph.D., Yale University; Carnegie Mellon, 1993—.

CHARLES H. KRIEBEL, Emeritus Professor of Industrial Administration (Information Systems) — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1964—.

MARGARET KYLE, Assistant Professor of Strategy — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2002—.

FINN KYDLAND, Professor of Economics Ph.D., Carnegie Mellon University; Carnegie Mellon, 1977—.

DAVID L. LAMONT, Senior Lecturer in Business Strategy and Co-Director, GSIA Management Game — M.S.I.A., Carnegie Mellon University; Carnegie Mellon, 1984—.

LESTER B. LAVE, Harry B. and James H. Higgins University Professor of Economics; Director, Carnegie Mellon Green Design Initiative; Co-Director, Carnegie Mellon Electricity Industry Center — Ph.D., Harvard University; Carnegie Mellon, 1963—.

F. JAVIER LERCH, Senior Research Scientist in Information Systems and Director, Center for Interactive Simulations — Ph.D., University of Michigan; Carnegie Mellon, 1986—.

ADAM LERRICK, The Friends of Allan H. Meltzer Chair; Senior Lecturer of Economics; and Director of The Galliot Center for Public Policy — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2001—.

CAROLYN B. LEVINE, Assistant Professor of Accounting Ph.D., Carnegie Mellon; Carnegie Mellon, 2001—.

PIERRE JINGHONG LIANG, Assistant Professor of Accounting — Ph.D., University of Florida; Carnegie Mellon, 1998.

ROBERT A. LOWE, Assistant Professor of Strategy — Ph.D., University of California, Berkeley; Carnegie Mellon, 2002—.

MARK D. MANUSZAK, Assistant Professor of Economics — Ph.D., Northwestern University; Carnegie Mellon, 2000—.

JOHN H. MATHER, Executive Director, MBA Programs and Principal Lecturer of Marketing — Ph.D., University of Arizona; Carnegie Mellon, 1992—.

BENNETT T. McCALLUM, H. J. Heinz Professor of Economics — Ph.D., Rice University; Carnegie Mellon, 1981—.

WILLIAM J. McEVLY, Jr., Assistant Professor of Organizational Behavior and Theory — Ph.D., University of Minnesota; Carnegie Mellon 1997—.

ALLAN H. MELTZER, The Allan H. Meltzer University Professor of Political Economy — Ph.D., University of California, Los Angeles; Carnegie Mellon, 1957—.

ROBERT A. MILLER, Professor of Economics and Strategy — Ph.D., University of Chicago; Carnegie Mellon, 1982—.

ALAN MONTGOMERY, Associate Professor of Marketing — Ph.D. University of Chicago; Carnegie Mellon, 1999—.

DON A. MOORE, Assistant Professor of Organizational Behavior and Theory — Ph.D., Northwestern University; Carnegie Mellon, 2000—.

TRIDAS MUKHOPADHYAY, Deloitte Consulting Chair Professor of e-Business and Director, MS in Electronic Commerce Program — Ph.D., University of Michigan; Carnegie Mellon, 1986—.

MILDRED S. MYERS, Principal Lecturer in Management Communication — D.A., Carnegie Mellon University; Carnegie Mellon, 1984—.

JOHN R. O'BRIEN, Associate Professor of Accounting and Experimental Economics — Ph.D., University of Minnesota; Carnegie Mellon, 1984—.

CHRISTINE PARLOUR, Assistant Professor of Finance — Ph.D., Queen's University; Carnegie Mellon, 1995—.

JAVIER F. PENA, Assistant Professor of Operations Research — Ph.D., Cornell University; Carnegie Mellon, 1999—.

EVELYN M. PIERCE, Senior Lecturer in Management Communication — M.F.A., University of Pittsburgh; Carnegie Mellon, 1993—.

UDAY RAJAN, Associate Professor of Economics and Finance — Ph.D., Stanford University; Carnegie Mellon, 1995—.

R. RAVI, Associate Professor of Operations Research — Ph.D., Brown University; Carnegie Mellon, 1995—.

RAY E. REAGANS, Assistant Professor of Organizational Behavior and Theory — Ph.D., University of Chicago; Carnegie Mellon, 1998—.

DENISE M. ROUSSEAU, H. J. Heinz II Professor of Organizational Behavior and Theory (Heinz School and GSIA) — Ph.D., University of California at Berkeley; Carnegie Mellon, 1994—.

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—.

DUANE J. SEPPU, Professor of Financial Economics — Ph.D., University of Chicago; Carnegie Mellon, 1986—.

KATHRYN L. SHAW, Professor of Economics and Ford Distinguished Research Chair — Ph.D., Harvard University; Carnegie Mellon, 1981—.

HOLGER SIEG, Associate Professor of Economics — Ph.D., Carnegie Mellon; Carnegie Mellon, 2001—.

PATRICK SILEO, Director, BA/BS in Economics Program and Senior Lecturer 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, 1989—.

SANDRA A. SLAUGHTER, Associate Professor in Information Systems — Ph.D., University of Minnesota; Carnegie Mellon, 1995—.

ANTHONY ALAN SMITH, Jr., Associate Professor of Economics — Ph.D., Duke University; Carnegie Mellon, 1992—.

MICHAEL D. SMITH, Assistant Professor of Management Information Systems (Heinz School and GSIA) — 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 and Director, Center for Financial Markets—Ph.D., University of Pennsylvania; Carnegie Mellon, 1979—.

STEPHEN E. SPEAR, Chair, Ph.D. Program and Professor of Economics — Ph.D., University of Pennsylvania; Carnegie Mellon, 1982—.

KANNAN SRINIVASAN, H. J. Heniz 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, 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 Communications Management and Senior Lecturer — Ph.D., University of Minnesota; Carnegie Mellon, 1996—.

BACHONG SUN, Assistant Professor of Marketing — Ph.D., University of Southern California; Carnegie Mellon, 1997—.

THOMAS D. TALLARINI, JR., Assistant Professor of Economics — Ph.D., University of Chicago; Carnegie Mellon, 1995—.

SRIDHUR R. TAYUR, 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, David T. and Lindsay J. Morgenthaler Professor of Entrepreneurship— M.S.I.A., Carnegie Institute of Technology; Carnegie Mellon, 1972—.

MICHAEL A. TRICK, Professor of Operations Research and President, Carnegie Bosch Institute for Applied Studies in International Management — Ph.D., Georgia Institute of Technology; Carnegie Mellon, 1988—.

CHENG WANG, Associate Professor of Economics — Ph.D., University of Western Ontario; Carnegie Mellon, 1994—.

ERJEN VAN NIEROP, Visiting Assistant Professor of Marketing — Ph.D., Erasmus University, Rotterdam; Carnegie Mellon, 2002-03.

LAURIE R. WEINGART, Associate 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—.

ERIC D. WOLFF, Assistant Professor of Accounting — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1998—.

RICHARD O. YOUNG, Senior Lecturer 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—.

ARTHUR A. BONI, Adjunct Professor of Entrepreneurship — Ph.D., University of California, San Diego — Carnegie Mellon, 2001—.

RICHARD L. BRYANT, Director, MS in Computational Finance Program and Adjunct Professor of Industrial Administration — MSIA, Carnegie Mellon; Carnegie Mellon, 1999—.

THOMAS N. CANFIELD, Adjunct Professor of Entrepreneurship — M.B.A., Harvard University; Carnegie Mellon, 1983—.

BABS BAILEY CARRYER, Adjunct Professor of Entrepreneurship — MPA, Carnegie Mellon; Carnegie Mellon, 1983—.

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—.

L. FRANK DEMMLER, Adjunct Professor of Entrepreneurship — MBA, University of California at Los Angeles; Carnegie Mellon, 1987—.

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 G. FAUGHT, JR., Adjunct Professor of Business Strategy — MBA, Harvard Business School; Carnegie Mellon, 2001—.

KYLE E. FISHER-MORABITO, Adjunct Professor of Public Relations — B.A., Carnegie Mellon; Carnegie Mellon, 1989—.

JOHN E. GRAF, Adjunct Professor of Law — J.D., University of Pittsburgh; Carnegie Mellon, 1998—.

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 Law — 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—.

J. PATRICK MCGINNIS, Adjunct Professor in Management Communication — M.A., University of Pittsburgh; Carnegie Mellon, 1998—.

RAMESH MEHTA, Adjunct Professor of Entrepreneurship — MBA, University of Idaho; Carnegie Mellon, 2002—.

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 Economics — Ph.D., University of Western Ontario; 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, 1988—.

STEVEN B. SILVERMAN, Adjunct Professor of Law — J.D., University of Pittsburgh; Carnegie Mellon, 1998—.

RICHARD P. SIMMONS, 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—.

DAVID E. TUNGATE, Adjunct Professor of Law — J.D., University of Illinois School of Law; Carnegie Mellon, 1991—.

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—.
The Business Administration Program, a unit of the Graduate School of Industrial Administration, is intended for undergraduate students interested in a broadly-based business management program. The academic requirements are flexible enough to accommodate students pursuing a wide variety of goals. A broad field like Business Administration calls for a flexible curriculum. 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. GSIA has relationships with several business schools abroad, and Carnegie Mellon's Office of International Education maintains an extensive library of other programs. Students should seriously consider foreign language study during their first and second years to ensure that they will enjoy a wide selection of study-abroad programs.

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, mathematics, and business.

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. These opportunities are offered only if students meet the academic standards of the BA Program and space is available in the required major courses. Further information can be obtained from the BA office, located in the Graduate School of Industrial Administration, 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>Requirement</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><strong>Total</strong></td>
<td><strong>364</strong></td>
</tr>
</tbody>
</table>

These requirements break down as follows:

### Functional Business Core

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-100</td>
<td>Introduction to Business</td>
<td>9</td>
</tr>
<tr>
<td>70-122</td>
<td>Introduction to Accounting</td>
<td>9</td>
</tr>
<tr>
<td>70-201</td>
<td>Professional and Service Projects</td>
<td>9</td>
</tr>
<tr>
<td>70-311</td>
<td>Organizational Behavior</td>
<td>9</td>
</tr>
<tr>
<td>70-332</td>
<td>Business and Society</td>
<td>9</td>
</tr>
<tr>
<td>70-340</td>
<td>Business Communications</td>
<td>9</td>
</tr>
<tr>
<td>70-345</td>
<td>Oral Communications</td>
<td>9</td>
</tr>
<tr>
<td>70-371</td>
<td>Production and Operations Management</td>
<td>9</td>
</tr>
<tr>
<td>70-381</td>
<td>Marketing</td>
<td>9</td>
</tr>
<tr>
<td>70-391</td>
<td>Finance</td>
<td>9</td>
</tr>
<tr>
<td>70-401</td>
<td>Management Game</td>
<td>12</td>
</tr>
<tr>
<td>70-451</td>
<td>Management Information Systems</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong>:</td>
<td><strong>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>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-100</td>
<td>Principles of Economics</td>
<td>9</td>
</tr>
<tr>
<td>73-250</td>
<td>Intermediate Microeconomics</td>
<td>9</td>
</tr>
<tr>
<td>73-300</td>
<td>Intermediate Macroeconomics</td>
<td>9</td>
</tr>
<tr>
<td>70-208</td>
<td>Regression and Forecasting</td>
<td>9</td>
</tr>
</tbody>
</table>

**or Laboratory Economics (73-110)

**or Econometrics I (73-260) and Econometrics II (73-360).

### Mathematics/Computing Core

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-100</td>
<td>Intro/Inter Programming</td>
<td>10</td>
</tr>
<tr>
<td>21-121</td>
<td>Calculus</td>
<td>9</td>
</tr>
<tr>
<td>21-256</td>
<td>Multivariate Analysis and Approximation</td>
<td>9</td>
</tr>
<tr>
<td>21-257</td>
<td>Models and Methods of Optimization</td>
<td>9</td>
</tr>
<tr>
<td>70-207</td>
<td>Probability and Statistics for Business</td>
<td>9</td>
</tr>
<tr>
<td>99-101</td>
<td>Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong>:</td>
<td><strong>50</strong></td>
<td></td>
</tr>
</tbody>
</table>

*or Operations Research I (21-292).

### 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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>79-104</td>
<td>Introduction to World History</td>
<td>9</td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument</td>
<td>9</td>
</tr>
</tbody>
</table>

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. It is the responsibility of the student to make sure he or she understands all program requirements and meets the requirements for graduation. Students are strongly encouraged to meet with a BA advisor to plan ahead and ensure that all requirements are met. Students must also 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. Students planning on studying abroad should make every effort to begin language studies as early as possible, and should start working early with a BA advisor to plan course sequences.

First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-121</td>
<td>Calculus</td>
</tr>
<tr>
<td>70-100</td>
<td>Introduction to Business</td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument *</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
<tr>
<td>99-101 or 102</td>
<td>Computing Skills Workshop</td>
</tr>
</tbody>
</table>

Total units required: 49

Spring

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-256</td>
<td>Multivariate Analysis and Approximation</td>
</tr>
<tr>
<td>73-100</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td>79-104</td>
<td>Introduction to World History *</td>
</tr>
<tr>
<td>15-100</td>
<td>Intro/Inter Programming</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
</tbody>
</table>

Total units required: 46

Sophomore Year

* 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.

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-257*</td>
<td>Models and Methods of Optimization</td>
</tr>
<tr>
<td>70-122</td>
<td>Introduction to Accounting</td>
</tr>
<tr>
<td>70-207</td>
<td>Probability &amp; Statistics for Business</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
</tbody>
</table>

Total units required: 45

<table>
<thead>
<tr>
<th>Spring **</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>73-250</td>
<td>Intermediate Microeconomics</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Breadth course</td>
</tr>
</tbody>
</table>

Minor in Business Administration

Requirements (See Business Administration Department for substitutions):

<table>
<thead>
<tr>
<th>Prerequisite Courses:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two semester courses in Calculus</td>
</tr>
<tr>
<td>Two semester courses in Statistics (or 70-207 or 36-220)</td>
</tr>
<tr>
<td>73-100</td>
</tr>
</tbody>
</table>

Choose 2:

| 70-122 | Introduction to Accounting |
| 70-311 | Organizational Behavior |
| 70-451 | Management Information Systems* |

Choose 2:

| 371-371 | Production and Operations Management [prerequisites: (21-257 or 21-292), (70-207 or 36-220 or 36-226 or 36-247 or 36-310)] |
| 381-381 | 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)] |

Choose 1:

| 21-257 | Models and Methods of Optimization |
| 292-292 | Operations Research I |

*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):

<table>
<thead>
<tr>
<th>Prerequisite Courses:</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-100</td>
</tr>
<tr>
<td>70-101</td>
</tr>
<tr>
<td>70-311</td>
</tr>
</tbody>
</table>

*Students must take either Business Leadership and Strategy (70-440, offered in the Fall) or Management Game (70-401, offered in the Spring); one (but not both) of these classes may be replaced by an elective.

Total units required: 364
Choose 1 of the following:
70-122 Introduction to Accounting
70-332 Business and Society
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.

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:
79-104 Introduction to World History

Writing/Expression:
76-101 Interpretation and Argument
80-085 Reading and Writing in a Multi-Cultural Setting (for non-native speakers)

Science and Technology:
Mellon College of Science courses:
(check pre- and co-requisites)
03-124 Modern Biology Laboratory
03-125 Evolution and the History of life
03-121 Modern Biology
03-122 Organismic Botany
03-130 Biology of Organisms
03-240 Cell Biology
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
33-102 Concepts of Modern Physics
33-111 Physics for Science Students I
33-112 Physics for Science Students II
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

Carnegie Institute of Technology courses:
(check pre- and co-requisites)
08-100 Introduction to Chemical Engineering
12-100 Introduction to Civil and Environmental Engineering
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

School of Computer Science courses:
(check pre- and co-requisites)
15-211 Fundamental Structures of Computer Science I
212-212 Fundamental Structures of Computer Science II

Cognition, Choice and Behavior:
79-266 Times of Feast/Famine
80-110 Nature of Mathematical Reasoning
80-136 Ethics and Public Policy
80-150 Nature of Reason
80-180 Nature of Language
80-181 Language and Thought
80-242 Conflict & Dispute Resolution
85-100 Cognitive Processes: Why People Are So Smart & How They Can Get Smarter
85-102 Introduction to Psychology
85-150 Introduction to Social Problems
85-211 Cognitive Psychology
85-221 Child Development
85-241 Social Psychology
85-251 Personality
85-261 Abnormal Psychology
88-120 Reason, Passion and Cognition

Political and Social Institutions:
36-203 Sampling, Surveys, and Society (prerequisite: 36-202 or 70-208)
79-231 American Foreign Policy: 1945-Present
80-135 Introduction to Political Philosophy
88-104 Decision Processes in American Political Institutions
88-105 Introduction to World Politics
88-109 Institutions and Individuals
88-205 Comparative Politics
88-314 Politics Through Film

Creative Production and Reflection
NOTE: Some of the courses on this list are offered for fewer than nine units. Students must take a minimum of nine units to fulfill the requirement. For each course in this category, BA students are encouraged to select language courses to meet this requirement.

76-201 Literature and the Social
76-227 Comedy
79-110 Dynamics of Cultural Change
79-111 Cultural and Cross-Cultural Perspectives on the Environment
79-112 Race, Nationality and Culture in American Society
79-113 Culture and Identity in American Social Life
79-201 Introduction to Anthropology
79-204 Twentieth Century America
79-206 Development of American Culture
79-216 Music and Counter Culture in the 1950’s/1960’s
79-219 The Holocaust in Historical Perspective
79-220 Early Christianity
79-223 Protest and Dissent in American History
79-224 The Civil War
79-225 Religions of Asia
79-230 Technology in American Society
79-241 African-American History I
79-242 African-American History II
79-252 The Latin-American Experience: 1500-2000
79-255 Irish History
79-258 History of the Jews
79-259 Native American History: 19th and 20th Centuries
79-260 Mayan America
79-262 Women in Asia
79-270 Chinese Culture and Society
79-271 Modern China
79-290 Modern Latin America
79-302 The Arts in Society:French Modernism
79-307 The Anthropology of Europe
79-325 Other People’s Lives: Biography, Autobiography, Microhistory
79-329 Sex, Population, Birth Control
79-330 Crime and Punishment in American History
79-340 History of Modern Warfare
79-341 Technology, Organization and Information
79-347 Coming to America: A History of Immigration
79-348 Gifts, Commodities and Money
79-352 The Arab-Israeli Conflict: War and Peace
79-356 African History: Earliest Times to the Origins of the Slave Trade
79-357 Russia Today
79-362 New Patterns in American Labor Relations
79-370 Gender and Science
79-375 Children and Childhood in America
79-379 Women in American History
79-392 The Family
79-397 Religion and Politics in the Middle East
80-100 What Philosophy is
80-180 The Nature of Language
80-181 Language and Thought
80-181 Language and Culture
80-182 Language, Culture and Thought
82-4xx Any upper-level Modern Language course
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 down 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 make minimal progress toward their degree. Minimal progress is defined as achieving a semester QPA of at least a 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 is 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.

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. We do not accept transfer students from other universities.

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.
The H. John Heinz III School of Public Policy and Management
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 a joint program with the Graduate School of Industrial Administration, and a dual degree program with the University of Pittsburgh School of Law)
• Master of Arts Management
• Master of Science in Health Care Policy and Management
• Master of Medical Management
• Master of Public Management
• Master Science in Educational Technology 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
90-650 Introduction to Health Care Policy and Management
90-735 Health Economics
79-384 Medicine and Society

Elective Courses: 27 units
See page 87 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 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, the Center for Economic Development, the National Census Research Data Center, 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 Corporation
- 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/faculty/.

ARORA, ASHISH, Associate 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—.
BAJAJ, AKHILESH, Assistant Professor of Information Systems Management — Ph.D., University of Arizona; Carnegie Mellon, 1997—.
BARR, EDWARD, Senior Lecturer in Professional Writing — 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, Lecturer, 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 — 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—.
DAPONTE, BETH, Senior Research Scientist (joint with departments of Statistics and History) — Ph.D., Carnegie Mellon University; 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—.
DOMINIZT, JEFFREY, Assistant Professor of Economics and Public Policy — Ph.D., University of Wisconsin at Madison; Carnegie Mellon, 2000—.
DUNCAN, GEORGE, Professor of Statistics and Associate Dean of Faculty — Ph.D., University of Minnesota; Carnegie Mellon, 1974—(On leave, 2000–).
EPGLE, DENNIS, (Affiliated) Thomas Lord Professor of Economics — Ph.D., Princeton University; Carnegie Mellon, 1974—.
FARROW, SCOTT, Principal Research Engineer and Director, Center for the Study and Improvement of Regulation — Ph.D., Washington State University; Carnegie Mellon, 1982—.
FERREIRA, PENELONE, Distinguished Service Professor of Environmental Policy and Law — J.D., Duquesne University; Carnegie Mellon, 1998—.
FLORIDA, RICHARD, H. John Heinz III Professor of Regional Economic Development — Ph.D., Columbia University; Carnegie Mellon, 1986—.
GAYNOR, MARTIN, E.J. Barone Professor of Economics and Health Policy — Ph.D., Northwestern University; Carnegie Mellon, 1995—.
GORG, WILPEN, Professor of Public Policy and Management Information Systems — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1985—.
HUNG, ANGELA, Assistant Professor of Economics and Public Policy — Ph.D., California Institute of Technology; Carnegie Mellon, 2000—.
JOHNSON, MICHAEL, Assistant Professor of Management Science and Urban Affairs — Ph.D., Northwestern University; Carnegie Mellon, 1997—.
KLEPPER, STEVEN, (Affiliated) Professor of Economics and Social Science— Ph.D., Cornell University; Carnegie Mellon, 1980—.
KRAACKHARDT, DAVID, Professor of Organizations and Public Policy — Ph.D., University of California at Irvine; Carnegie Mellon, 1991—(On leave, 2000–).
KRISHNAN, RAMAYYA, William W. and Ruth F. Cooper Professor of Management Science and Information Systems — Ph.D., University of Texas at Austin; Carnegie Mellon, 1987—.
KURLAND, KRISTIN, Senior Lecturer in Information Systems (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 Public Affairs — Ph.D., Harvard University; Carnegie Mellon, 1963—.
LEWIS, GORDON, Associate Professor of Sociology — Ph.D., Stanford University; Carnegie Mellon, 1969—.
LEWIS, PAMELA, Senior Lecturer in 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, 1992—.
MCCARTHY, MICHAEL, Senior Lecturer in Information Systems Management — M.S., University of Pittsburgh; Carnegie Mellon, 1999—.
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, Associate Professor of Operations Research and Information Management — 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—(On leave, 2000—).

ROUSSEAU, DENISE, H. J. Heinz II Professor of Organizational Behavior (joint with Graduate School of Industrial Administration) and Director, Master of Science of Public Policy and Management Program — Ph.D., University of California at Berkeley; Carnegie Mellon, 1994—.

SHAW, KATHRYN, (Affiliated) Professor of Economics — Ph.D., Harvard University; Carnegie Mellon, 1981—

SKINNER, KIRON, (Courtesy) Assistant Professor of History and Political Science — Ph.D., Harvard University; Carnegie Mellon, 1999—.

SMITH, DONALD, Professor of Practice — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1995—.

SMITH, KATHLEEN, Senior Lecturer in Finance — 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—.

STEPHENS, 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 — Ph.D., University of Wisconsin; Carnegie Mellon, 1979—.

Sweeney, latanya, Assistant Professor of Computer Science and Public Policy (joint with School of Computer Science) — Ph.D. candidate, Massachusetts Institute of Technology; Carnegie Mellon, 1999—.

SzczyPula, Janusz, Senior Lecturer in Information Systems, and Director, (University) Master of Information Systems Management Program — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1997—.

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 and Director, Ph.D. Program — Ph.D., University of Michigan; Carnegie Mellon, 1990—.

Vogt, William, Assistant Professor of Economics — Ph.D., Stanford University; Carnegie Mellon, 1996—(On leave, 2000—).

Weedn, Victor, Principal Research Scientist (principal appointment with Mellon College of Science) — M.D., Southwestern Medical School, and J.D., South Texas College of Law; Carnegie Mellon, 1999—.

Wessel, Mark, Lecturer in Economics and Finance, M.S., University of Wisconsin; Carnegie Mellon, 1992—.

For further information about the Heinz School, contact:
Director of Admissions
H. John Heinz III School of Public Policy and Management
Carnegie Mellon University
Pittsburgh, PA 15213

Telephone: (412) 268-2164
Toll-free (U.S.): 1-800-877-3498
Fax: (412) 268-6718
Email: hnzadmit@andrew.cmu.edu
Web site: http://www.heinz.cmu.edu
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 enable a student to choose a major from any of the programs offered in MCS.

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.

**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 49 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 65.

**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 77 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 structured general education core, but have the flexibility to choose a primary major in either of the two colleges. See page 82 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 Degree Program in Mathematical Sciences (leads to both the B.S. and M.S.)

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 Degree Program in Mathematical Sciences
- Accelerated Master’s Program in the Heinz School of Public Policy and Management

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 64 for details on the Health Professions Program.

Pre-Law Advising Program
Faculty Contact: Joseph Devine
Please see page 66 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 67 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 66 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 (http://www.cmusearch.cmu.edu) 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.

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 Light Microscope Imaging and Biotechnology 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 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 Pittsburgh NMR Center for Biomedical Research involves 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 Environmental Institute’s mission is to develop innovations in environmental education at the undergraduate and graduate levels, to promote interdisciplinary environmental research that will enable Carnegie Mellon to continue its leadership in developing new knowledge, and to foster a sense of community and develop outreach activities by bringing together individuals with diverse environmental interests both on and off campus.

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 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.

The W.M. Keck Center for Advanced Training in Computational Biology is a collaboration among Carnegie Mellon University, the University of Pittsburgh, and the Pittsburgh Supercomputing Center.

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 a departmental honors program (see the section Honors Degree Programs in MCS above).

OR

2. Earned a cumulative grade point average of 3.2 or greater and carried out significant, successful research. This will be indicated by nomination by the student’s research advisor or academic advisor (with endorsement by the research advisor), plus completion of one of the following:

   - Authoring or co-authoring an article in a refereed journal that is in print or that has been submitted for publication.
   - Presenting work at an organized and public research symposium or national/regional meeting, such as the Sigma Xi poster competition at Carnegie Mellon’s annual research symposium. (Presentations at group research meetings or undergraduate departmental seminars will not satisfy this requirement.)
Final approval of nominations for MCS research honors will come from the Dean of MCS and the Associate Dean for Undergraduate Affairs.

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>21-115</td>
<td>Differential Calculus *</td>
<td>5</td>
</tr>
<tr>
<td>21-116</td>
<td>Integral Calculus *</td>
<td>5</td>
</tr>
<tr>
<td>21-117</td>
<td>Integration and Differential Equations **</td>
<td>5</td>
</tr>
<tr>
<td>21-118</td>
<td>Calculus of Approximation **</td>
<td>5</td>
</tr>
<tr>
<td>33-111</td>
<td>Physics for Science Students I</td>
<td>9</td>
</tr>
<tr>
<td>33-112</td>
<td>Physics for Science Students II</td>
<td>10</td>
</tr>
<tr>
<td>03-121</td>
<td>Modern Biology</td>
<td>6</td>
</tr>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
<td>3</td>
</tr>
</tbody>
</table>

In the first year, students take the four mini-courses (half-semester courses) 21-115 Differential Calculus, 21-116 Integral Calculus, 21-117 Integration and Differential Equations, and 21-118 Calculus of 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 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>21-115</td>
<td>Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-116</td>
<td>Integral Calculus</td>
<td>5</td>
</tr>
<tr>
<td>xx-xxxx</td>
<td>Science Core Course</td>
<td>9-12</td>
</tr>
<tr>
<td>xx-xxxx</td>
<td>Departmental Elective from Intended Major</td>
<td>9-10</td>
</tr>
<tr>
<td>xx-xxxx</td>
<td>Humanities, Social Sciences or Fine Arts Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxxx</td>
<td>Optional Free Elective Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxxx</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>21-117</td>
<td>Integration and Differential Equations</td>
<td>5</td>
</tr>
<tr>
<td>xx-xxxx</td>
<td>Science Core Course</td>
<td>9-12</td>
</tr>
<tr>
<td>xx-xxxx</td>
<td>Departmental Elective from Intended Major</td>
<td>9-10</td>
</tr>
<tr>
<td>xx-xxxx</td>
<td>Humanities, Social Sciences or Fine Arts Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxxx</td>
<td>Optional Free Elective Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxxx</td>
<td>Optional First-Year Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

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: The Excitement of Scientific Discovery
- Proteins in Disease
- Polymers and the Modern World
- Macromolecules for Nanotechnology
- Astrophysics - Black Holes, Cosmology and Supernovae
- 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

B. Distributional Course Requirements (27 units)

Category 1: Cognition, Choice and Behavior

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>80-150</td>
<td>The Nature of Reason</td>
<td>1</td>
</tr>
<tr>
<td>80-180</td>
<td>The Nature of Language</td>
<td>1</td>
</tr>
<tr>
<td>80-181</td>
<td>Language and Thought</td>
<td>1</td>
</tr>
<tr>
<td>80-242</td>
<td>Conflict and Dispute Resolution</td>
<td>1</td>
</tr>
<tr>
<td>85-100</td>
<td>Intro. to Intelligence in Humans, Animals and Machines</td>
<td>1</td>
</tr>
<tr>
<td>85-102</td>
<td>Introduction to Psychology</td>
<td>1</td>
</tr>
<tr>
<td>85-211</td>
<td>Cognitive Psychology</td>
<td>1</td>
</tr>
<tr>
<td>85-211</td>
<td>Principles of Child Development</td>
<td>1</td>
</tr>
<tr>
<td>85-251</td>
<td>Social Psychology</td>
<td>1</td>
</tr>
<tr>
<td>85-251</td>
<td>Introduction to Personality</td>
<td>1</td>
</tr>
<tr>
<td>88-120</td>
<td>Reason, Passion &amp; Cognition</td>
<td>1</td>
</tr>
</tbody>
</table>

Category 2: Economic, Political and Social Institutions

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-303</td>
<td>Sampling, Surveys, and Society</td>
<td>1</td>
</tr>
<tr>
<td>73-100</td>
<td>Principles of Economics</td>
<td>1</td>
</tr>
<tr>
<td>73/88-110</td>
<td>Experiments with Economic Principles</td>
<td>1</td>
</tr>
<tr>
<td>79-266</td>
<td>Times of Feast/Famine: Population and Family in History</td>
<td>1</td>
</tr>
<tr>
<td>80-135</td>
<td>Introduction to Political Philosophy</td>
<td>1</td>
</tr>
<tr>
<td>80-136</td>
<td>Social Structure, Public &amp; Ethical Dilemmas</td>
<td>1</td>
</tr>
<tr>
<td>88-104</td>
<td>Decision Processes in American Political Institutions</td>
<td>1</td>
</tr>
<tr>
<td>88-205</td>
<td>Comparative Politics</td>
<td>1</td>
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</table>

Category 3: Cultural Analysis

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>76-201</td>
<td>Literature &amp; the Social</td>
<td>1</td>
</tr>
<tr>
<td>76-227</td>
<td>Comedy</td>
<td>1</td>
</tr>
<tr>
<td>79-112</td>
<td>Race, Nationality, and Culture in American Society</td>
<td>1</td>
</tr>
<tr>
<td>79-113</td>
<td>Culture &amp; Identity in American Society</td>
<td>1</td>
</tr>
<tr>
<td>79-201</td>
<td>Introduction to Anthropology</td>
<td>1</td>
</tr>
<tr>
<td>79-206</td>
<td>Development of American Culture</td>
<td>1</td>
</tr>
<tr>
<td>79-207</td>
<td>The Development of European Culture</td>
<td>1</td>
</tr>
<tr>
<td>79-309</td>
<td>Who Shall Serve? Blacks, Women &amp; Gays in Military</td>
<td>1</td>
</tr>
<tr>
<td>79-368</td>
<td>Poverty, Charity &amp; Welfare</td>
<td>1</td>
</tr>
<tr>
<td>80-100</td>
<td>What Philosophy Is</td>
<td>1</td>
</tr>
<tr>
<td>80-250</td>
<td>Ancient Philosophy</td>
<td>1</td>
</tr>
<tr>
<td>80-251</td>
<td>Modern Philosophy</td>
<td>1</td>
</tr>
<tr>
<td>80-253</td>
<td>Continental Philosophy</td>
<td>1</td>
</tr>
<tr>
<td>80-254</td>
<td>Analytic Philosophy</td>
<td>1</td>
</tr>
<tr>
<td>80-255</td>
<td>Pragmatism</td>
<td>1</td>
</tr>
<tr>
<td>80-261</td>
<td>Aesthetics of Mass Art</td>
<td>1</td>
</tr>
<tr>
<td>82-304</td>
<td>Francophone World</td>
<td>1</td>
</tr>
<tr>
<td>82-415/416</td>
<td>Topics in French &amp; Francophone Studies</td>
<td>1</td>
</tr>
<tr>
<td>82-420</td>
<td>German Classical Literature</td>
<td>1</td>
</tr>
<tr>
<td>82-423</td>
<td>Postwar German Literature</td>
<td>1</td>
</tr>
<tr>
<td>82-426</td>
<td>Studies in German Literature</td>
<td>1</td>
</tr>
<tr>
<td>82-427</td>
<td>Nazi &amp; Resistance Culture</td>
<td>1</td>
</tr>
</tbody>
</table>
C. Elective Course Requirements (36 units)

Complete courses totaling 36 units from H&SS, CFA or Business Administration. These can include language and music courses, for instance.

Check our web site for up-to-date lists of courses in each category. You’ll also find courses in 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 http://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 of 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 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 GPA or the cumulative GPA (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 GPA.

• The semester GPA 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 GPA 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 GPA 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 267 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

Minor in Health Care Policy & Management
Faculty Contacts:
Amy Burkert, Mellon College of Science
Caroline Acker, College of Humanities and Social Sciences
Brenda Peyser, Heinz School

The Mellon College of Science provides a rigorous scientific foundation which many of our students have applied in medical training and practice. With the changing environment of health care today, students often need an even broader preparation. To complement their training in natural sciences, many pre-health students have pursued curricular alternatives like additional majors and minors in the social sciences and humanities.

A program of particular interest to future health professionals is the interdisciplinary minor in health care policy and management. Through this minor, students become aware of the policy and management aspects of the current health care environment.

Students pursuing the minor have three core courses in common: an overview course (Introduction of Health Care Policy and Management), a historical perspective course (Medicine and Society, or Health Care in Historical Perspective), and an economics course (Health Economics). To complete the minor, students choose three additional courses from an approved elective listing.

Six courses (a minimum of 60 units) are required to complete this minor. Entry into the minor requires completion of 73-250 Intermediate Microeconomics, 88-220 Policy Analysis I, or the equivalent by approval.

Required Courses (33 units)
Students are required to take the following courses:
90-650 Introduction to Health Care Policy and Management
90-735 Health Economics
79-384 Medicine and Society

Elective Courses (27-36 units)
There are a variety of elective courses in the Heinz School and H&SS which can be used to fulfill the elective requirements of the minor. For a complete list, see page 87.

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) Biochemistry I

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).

Note: Courses taken in these categories cannot also be counted toward requirements for a primary major.

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
73-358 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
or
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. A list of appropriate courses will be maintained by the administrator of the minor. 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 now occurring in the field of biological sciences. Biology is undergoing unprecedented technological advances in biochemistry, biophysics, cell biology, genetics, molecular biology, developmental biology, neurobiology and computational biology. The 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 degree in biological sciences. This degree program has a distinctive core curriculum that provides a foundation in biology, computer science, chemistry, mathematics and physics. In addition to the core courses, the program includes six biology electives, five free electives and eight hours of physical education. 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 additional major degree with the College of Humanities and Social Sciences is also available. 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. degree in Biological Sciences and Psychology for students with interdisciplinary life sciences interests.

For students who have an interest in a particular field of biology and wish to have additional specialized education, the department offers options in biochemistry, biophysics, cell biology, computational biology, developmental biology, genetics, and molecular biology, which provide the applicable training in each area. The programs 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 and other graduate schools in the health professions. About one-third of the biology undergraduates enroll in medical school. 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 fields. See page 64 for more information on the HPP.

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 to be involved at the forefront of emerging new fields, markets and policy changes. The Biological Sciences at Carnegie Mellon are working at these new interfaces through interdisciplinary research and educational programs. Some of these programs that students typically avail themselves of include the extensive selection of minors in all disciplines at the university, the pursuit of additional majors with other departments not just within the Mellon College of Science, exploration of interdisciplinary studies through the Science and Humanities Scholars program, and interests at the interface between the arts and sciences through the Bachelors of Science and Arts degree between Biological Sciences and schools in the College of Fine Arts.

One of the most important features of the Department of Biological Sciences is the opportunity that undergraduate students have to interact with faculty. The faculty members are prominent research scientists who also teach beginning as well as 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 introduction to research for eligible students. During the past four years, over 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. in Biological Sciences
The B.S. degree in biological sciences is built around a core program and elective units as detailed in the following section.

#### Core Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</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 (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 Experimental Biochemistry</td>
<td>12</td>
</tr>
<tr>
<td>03-345 Experimental Cell and Developmental Biology</td>
<td>3</td>
</tr>
<tr>
<td>03-411-412 Topics in Research</td>
<td>2</td>
</tr>
<tr>
<td>03-201-202 Colloquium</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Mathematics, Physics, and Computer Science

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-115, -116 Differential Calculus/Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-117, -118 Integration and Differential Equations/Calculus of Approximation</td>
<td>10</td>
</tr>
<tr>
<td>33-111, -112 Physics for Science Students I and II</td>
<td>24</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>99-101 or -102 Computer Skills Workshop</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Chemistry

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105, -108 Introduction to Modern Chemistry, Modern Chemistry II</td>
<td>20</td>
</tr>
<tr>
<td>09-217, -218 Organic Chemistry I and II</td>
<td>18</td>
</tr>
<tr>
<td>09-221, -222 Chemistry Laboratory I and II</td>
<td>24</td>
</tr>
<tr>
<td>09-214 Physical Chemistry</td>
<td>9</td>
</tr>
</tbody>
</table>

**Total** 192

#### Elective Units

**Free Electives** 42

**H&SS and Fine Arts Electives** 72

**Biological Sciences Electives** 54

**Minimum number of units required for degree:** 360

#### Biological Sciences Electives

The following specifications apply to Biological Sciences electives:

- At least 18 units must be at the 03-3xx level or above, exclusive of 03-445 Undergraduate Research,
- Up to three interdisciplinary electives may count as biology electives.
- Up to 18 units of 03-445 Undergraduate Research may count as biology electives; a maximum of 36 units can count toward graduation.
- Courses in biology taken through cross-registration at another university may count as electives if prior permission has been obtained from the Carnegie Mellon Biological Sciences Department adviser.

#### Departmental Electives Group

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-122 Organismic Botany</td>
<td></td>
</tr>
<tr>
<td>03-124 Modern Biology Laboratory</td>
<td></td>
</tr>
<tr>
<td>03-125 Evolution and the History of Life</td>
<td></td>
</tr>
<tr>
<td>03-130 Biology of Organisms</td>
<td></td>
</tr>
<tr>
<td>03-310 Introduction to Computational Biology</td>
<td></td>
</tr>
<tr>
<td>03-311 Introduction to Computational Molecular Biology</td>
<td></td>
</tr>
<tr>
<td>03-315 Magnetic Resonance Imaging in Neuroscience</td>
<td></td>
</tr>
<tr>
<td>03-350 Developmental Biology</td>
<td></td>
</tr>
<tr>
<td>03-360 Biology of the Brain</td>
<td></td>
</tr>
<tr>
<td>03-380 Virology</td>
<td></td>
</tr>
</tbody>
</table>
### Interdisciplinary Electives Group

Up to three of the following courses may count as biology electives.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-343</td>
<td>Physical Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-439</td>
<td>Introduction to Biophysics</td>
<td>9</td>
</tr>
<tr>
<td>03-441</td>
<td>Molecular Biology of Prokaryotes</td>
<td>9</td>
</tr>
<tr>
<td>03-442</td>
<td>Molecular Biology of Eukaryotes</td>
<td>9</td>
</tr>
<tr>
<td>03-445</td>
<td>Undergraduate Research</td>
<td>9</td>
</tr>
<tr>
<td>03-510</td>
<td>Computational Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-611</td>
<td>Computational Genomics and Molecular Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-533</td>
<td>NMR in Biomedical Sciences</td>
<td>9</td>
</tr>
<tr>
<td>03-534</td>
<td>Biological Imaging and Fluorescence Spectroscopy</td>
<td>9</td>
</tr>
<tr>
<td>03-545</td>
<td>Honors Research</td>
<td>9</td>
</tr>
<tr>
<td>03-550</td>
<td>Developmental Genetics</td>
<td>9</td>
</tr>
<tr>
<td>03-571</td>
<td>Structural Biophysics</td>
<td>9</td>
</tr>
<tr>
<td>03-620</td>
<td>Techniques in Electron Microscopy</td>
<td>9</td>
</tr>
<tr>
<td>03-711</td>
<td>Computational Genomics and Molecular Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-730</td>
<td>Advanced Genetics</td>
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</tr>
<tr>
<td>03-740</td>
<td>Advanced Biochemistry</td>
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<tr>
<td>03-741</td>
<td>Advanced Cell Biology</td>
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</tr>
<tr>
<td>03-742</td>
<td>Molecular Biology of Eukaryotes</td>
<td>9</td>
</tr>
<tr>
<td>03-751</td>
<td>Advanced Developmental Biology</td>
<td>9</td>
</tr>
</tbody>
</table>

### Typical Schedule

The following is a suggested schedule for the B.S. in Biological Sciences but may vary depending on your interests and background.

#### Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>03-121</td>
<td>Modern Biology</td>
</tr>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry</td>
</tr>
<tr>
<td>21-115</td>
<td>Differential Calculus*</td>
</tr>
<tr>
<td>21-116</td>
<td>Integral Calculus*</td>
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<tr>
<td>76-101</td>
<td>Interpretation and Argument</td>
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<tr>
<td>99-101 or -102</td>
<td>Computer Skills Workshop</td>
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<td><strong>Total</strong></td>
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#### Spring

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-106</td>
<td>Modern Chemistry II</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
</tr>
<tr>
<td>21-117</td>
<td>Integration and Differential Equations**</td>
</tr>
<tr>
<td>21-118</td>
<td>Calculus of Approximation**</td>
</tr>
<tr>
<td>33-111</td>
<td>Physics for Science Students I</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>51</td>
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</tbody>
</table>

#### Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>03-201</td>
<td>Undergraduate Colloquium</td>
</tr>
<tr>
<td>03-231</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>09-217</td>
<td>Organic Chemistry I</td>
</tr>
<tr>
<td>09-221</td>
<td>Laboratory I: Introduction to Chemical Analysis</td>
</tr>
<tr>
<td>33-112</td>
<td>Physics for Science Students II</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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</tbody>
</table>

#### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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</thead>
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<tr>
<td>03-343</td>
<td>Experimental Genetics and Molecular Biology</td>
</tr>
<tr>
<td>03-330</td>
<td>Genetics</td>
</tr>
<tr>
<td>03-xxx</td>
<td>Biology Elective 1</td>
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<tr>
<td><strong>Total</strong></td>
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### 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. The curriculum in the department provides the opportunity for choosing elective courses in biology in the junior and senior years. Options need not be declared. A student who fulfills the required biology electives for any option can have up to two noted on his or her transcript upon completion of the B.S. degree.

The elective courses required for each of the options are listed below.

#### Biochemistry Option

**Required Biology electives:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-343</td>
<td>Physical Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-518</td>
<td>Bio-organic Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-215</td>
<td>Bio-inorganic Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-221</td>
<td>Laboratory I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-230</td>
<td>Laboratory II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-232</td>
<td>Physical Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-233</td>
<td>Organic Chemistry</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td>52</td>
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</tbody>
</table>

#### Biophysics Option

**Required Biology electives:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-343</td>
<td>Physical Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-215</td>
<td>Bio-inorganic Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-221</td>
<td>Laboratory I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-230</td>
<td>Laboratory II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-232</td>
<td>Physical Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-233</td>
<td>Organic Chemistry</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td>52</td>
</tr>
</tbody>
</table>

#### Cell Biology Option

**Required Biology electives:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-350</td>
<td>Developmental Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-441</td>
<td>Molecular Biology of Prokaryotes</td>
<td>9</td>
</tr>
<tr>
<td>03-741</td>
<td>Advanced Cell Biology</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>27</td>
</tr>
</tbody>
</table>

#### Recommended Biology electives:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-130</td>
<td>Biology of Organisms</td>
<td>9</td>
</tr>
<tr>
<td>03-360</td>
<td>Biology of the Brain</td>
<td>9</td>
</tr>
<tr>
<td>03-438</td>
<td>Physical Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-442</td>
<td>Molecular Biology of Eukaryotes</td>
<td>9</td>
</tr>
<tr>
<td>03-751</td>
<td>Advanced Developmental Biology</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td>43</td>
</tr>
</tbody>
</table>

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*** See p. 269 for the Mellon College of Science’s Humanities and Social Sciences and Fine Arts Requirements.

Flexibility in course scheduling is offered in the junior and senior years where biology and free electives can be scheduled to fulfill the variety of options offered by the department. (See below for descriptions of options for the B.S. in Biological Sciences).

### Flexibility in Course Scheduling

Options in the junior and senior years for biology and free electives can be scheduled to fulfill the variety of options offered by the department. (See below for descriptions of options for the B.S. in Biological Sciences).

---

### 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. The curriculum in the department provides the opportunity for choosing elective courses in biology in the junior and senior years. Options need not be declared. A student who fulfills the required biology electives for any option can have up to two noted on his or her transcript upon completion of the B.S. degree.

The elective courses required for each of the options are listed below.
Developmental Biology Option

**Required Biology electives:**
- 03-350 Developmental Biology
- 03-441 Molecular Biology of Prokaryotes
- 03-442 Molecular Biology of Eukaryotes
- 03-550 Developmental Genetics

**Recommended Biology electives:**
- 03-360 Biology of the Brain
- 03-438 Physical Biochemistry
- 03-741 Advanced Cell Biology
- 03-751 Advanced Developmental Biology

**Genetics Option**

**Required Biology electives:**
- 03-441 Molecular Biology of Prokaryotes
- 03-442 Molecular Biology of Eukaryotes
- 03-550 Developmental Genetics
  or
- 03-730 Advanced Genetics

**Recommended Biology electives:**
- 03-350 Developmental Biology
- 03-380 Virology
- 03-438 Physical Biochemistry
- 03-550 Developmental Genetics
  or
- 03-730 Advanced Genetics

**Molecular Biology Option**

**Required Biology electives:**
- 03-436 Physical Biochemistry
- 03-441 Molecular Biology of Prokaryotes
- 03-442 Molecular Biology of Eukaryotes

**Recommended Biology electives:**
- 03-350 Developmental Biology
- 03-360 Biology of the Brain
- 03-380 Virology
- 03-550 Developmental Genetics
- 03-730 Advanced Genetics
- 03-751 Advanced Developmental Biology

**Computational Biology Option**

**Required Electives:**
- 03-310 Introduction to Computational Biology
  or
- 03-510 Computational Biology
- 15-200 Data Structures
  or
- 15-211 Fundamental Structures and Algorithms I
  or
- 21-320 Symbolic Programming
- 36-247 Statistics for Laboratory Sciences
  or
- 21-259 Calculus in 3D
  or
- 21-260 Differential Equations
  or
- 21-241 Matrix Algebra

**Recommended Electives:**
- 03-441 Molecular Biology of Prokaryotes
- 03-442 Molecular Biology of Eukaryotes
- 09-560 Computational Chemistry
- 15-212 Fundamental Structures of Computer Science II

**B.S. Computational Biology**

The field of computational biology has undergone tremendous growth in recent years. Not only are computers increasingly used by biological and biomedical researchers, but computational biology has emerged as a distinct discipline that involves the use of computers to solve biological problems. Important areas include i) assisting drug design researchers in unraveling the three-dimensional structure of proteins, ii) analysis of blood flow problems, curved and branched blood vessels and clotting factors, iii) modeling of membrane function that plays a central role in conditions such as Alzheimer’s disease, sickle cell anemia and immunological problems such as AIDS, and iv) computer assisted comparisons of genetic structure. The B.S. in Computational Biology combines a solid foundation in biology, mathematics and computer science.

This degree has the same core requirements as the B.S. degree listed previously. However, certain courses must be completed as Biological Sciences Electives or Free Electives as indicated below.

**Typical Schedule**

The following is a suggested schedule for the B.S. in Computational Biology but may vary depending on your interests and background.

**Freshman Year**

**Fall**
- 03-121 Modern Biology 9
- 09-105 Introduction to Modern Chemistry 10
- 21-115 Differential Calculus* 5
- 21-116 Integral Calculus* 5
- 33-111 Physics for Science Students I 12
- 99-101 or -102 Computer Skills Workshop 3
- 76-101 Interpretation and Argument 9

**Units:** 53

* 21-115 and 21-116 are sequential half-semester mini-courses that are equivalent to a traditional first semester calculus course.

**Spring**
- 09-106 Modern Chemistry II 10
- 33-112 Physics for Science Students II 12
- 15-111* Intermediate/Advanced Programming** 10
- 21-117 Integration and Differential Equations*** 5
- 21-118 Calculus of Approximation*** 5
- xx-xxx Humanities, Social Sciences or Fine Arts Elective 9

**Units:** 51

**Sophomore Year**

**Fall**
- 03-201 Undergraduate Colloquium 1
- 03-231 (232) Biochemistry 9
- 09-217 Organic Chemistry I 9
- 21-127 Concepts of Mathematics 9
- 21-260 Differential Equations 9
- xx-xxx Humanities, Social Sciences or Fine Arts Elective 9

**Units:** 46

**Spring**
- 03-202 Undergraduate Colloquium 1
- 03-240 Cell Biology 9
- 09-218 Organic Chemistry II 9
- 15-211 Fundamental Structures of Computer Science I 12
- 09-214 Physical Chemistry 9
- xx-xxx Humanities, Social Sciences or Fine Arts Elective 9

**Units:** 48

**Junior Year**

**Fall**
- 03-330 Genetics 9
- 09-221 Laboratory I: Introduction to Chemical Analysis 12
- 15-212 Fundamental Structures of Computer Science II 12
- xx-xxx Humanities, Social Sciences or Fine Arts Elective 9

**Units:** 42

**Spring**
- 03-510 Computational Biology 12
- 09-222 Laboratory II: Organic Synthesis and Analysis 12
- xx-xxx Free Elective 9
- xx-xxx Humanities, Social Sciences or Fine Arts Elective 9

**Units:** 42

**Senior Year**

**Fall**
- 03-343 Experimental Genetics and Molecular Biology 12
- 03-411 Topics in Research 1
- 03-3xx Biology Elective 9
- 15-xxx Computing Elective **** 9
- xx-xxx Humanities, Social Sciences or Fine Arts Elective 9

**Units:** 40

**Spring**
- 03-344 Experimental Biochemistry 12
- or
- 03-345 Experimental Cell and Developmental Biology 1
- 03-412 Topics in Research 1
- 15-xxx Computing Elective ** 9
- xx-xxx Free Elective 6
- xx-xxx Humanities, Social Sciences or Fine Arts Elective 9

**Units:** 49

**** Computing Electives may be any Computer Science course (15-xxx) at the 300 level or higher, or a comparable course involving significant computation with approval of the Biological Sciences Department.
Professional Masters Degree in Computational Biology

Students who are interested in more advanced training in this emerging field may want to consider the 3-1-1 Professional Master of Science Program in Computational Biology. For more information on this program, contact the Biological Sciences department.

Unified Major in 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. The specific set of BS degree requirements as described in the Science and Humanities Scholars section (see page 82) allows students to double major between these two disciplines most effectively. Students entering from the Mellon College of Science will earn a Bachelor of Science 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.

Specific Pre-Major Requirements

The unified major specifies particular pre-major requirements in the areas of Mathematical Sciences and Statistics, 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. All other general education categories can be filled in any way that satisfies the requirements of the student’s college or the SHS program.

Mathematical Sciences/Statistics:

21-115, -116 Differential Calculus and Integral Calculus
21-117, -118 Integration & Differential Equations and Calculus of Approximations
36-247 Statistics for Laboratory Sciences*
36-309 Experimental Design Statistics
* 36-202 can be used as an alternative but 36-247 is strongly recommended

Sciences:

09-105 Introduction to Modern Chemistry
09-106 Modern Chemistry II
33-111 Physics for Science Students I
09-217 Organic Chemistry I
09-218 Organic Chemistry II

Computational Reasoning:

99-101/102 Computer Skills Workshop
15-100 Introductory/Intermediate Programming

Discipline Core Requirements:

Biological Sciences

03-121 Modern Biology
03-112 Physics for Science Students II
03-231 (232) Biochemistry
03-240 Cell Biology
03-330 Genetics
03-411, -412 Topics in Research
03-201, -202 Colloquium

Psychology

85-101 Introduction to Psychology

Complete three of the following courses:

85-211 Cognitive Psychology
85-213 Information Processing and Artificial Intelligence
85-219 Biological Foundations of Behavior
85-221 Principles of Child Development
85-241 Social Psychology
85-251 Introduction to Personality

Laboratory/Research Methods Requirements:

08-221 Chemistry Laboratory I
08-222 Chemistry Laboratory II
03-343 Experimental Genetics and Molecular Biology

Research Methods in Psychology

Complete one of the following:

85-310 Research Methods in Cognitive Psychology
85-320 Research Methods in Child Development
85-340 Research Methods in Social Psychology

Additional Laboratory Requirement:

Complete one additional laboratory experience either as an additional 85-3xx Research Methods course in Psychology or a second laboratory in Biological Sciences at the 300 level or above.

Advanced Biological Sciences/Psychology Electives:

1. Psychology Advanced Elective 1
2. Psychology Advanced Elective 2
3. Biology General Elective
4. Biology Advanced Elective 1 (03-360 or 03-315 recommended)
5. Biology Advanced Elective 2
6. Advanced Biological Sciences or Psychology Elective

(Research Recommended)

Additional comments:

Students must also complete the general education core requirements of MCS or SHS and have the required 360 graduation units.

B.A. Additional Major Degree

The Department of Biological Sciences offers a B.A. double major degree with the departments in the College of Humanities and Social Sciences. The degree is intended for high ability students who wish to combine their interest in science with one of the majors in the College of Humanities and Social Sciences. For students in the Department of Biological Sciences, the units for the degree are distributed as follows:

### Core Requirements

<table>
<thead>
<tr>
<th>Courses as specified by specific Holdings Department and Free Electives</th>
<th>Units</th>
</tr>
</thead>
</table>

### Biological Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>03-121</td>
<td>Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-240</td>
<td>Cell Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-231 (232)</td>
<td>Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-330</td>
<td>Genetics</td>
<td>9</td>
</tr>
<tr>
<td>03-xxx</td>
<td>Any Biological Sciences Laboratory</td>
<td>9-12</td>
</tr>
<tr>
<td>03-201, -202</td>
<td>Colloquium</td>
<td>2</td>
</tr>
</tbody>
</table>

### Mathematics, Physics and Computer Science

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-115, -116</td>
<td>Differential Calculus/Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-117, -118</td>
<td>Integration and Differential Equations/Calculus of Approximation</td>
<td>10</td>
</tr>
<tr>
<td>33-111, -112</td>
<td>Physics for Science Students I and II</td>
<td>24</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>99-101 or -102</td>
<td>Computer Skills Workshop</td>
<td>3</td>
</tr>
</tbody>
</table>

### Chemistry

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105, -106</td>
<td>Introduction to Modern Chemistry, Modern Chemistry II</td>
<td>20</td>
</tr>
<tr>
<td>09-217, -218</td>
<td>Organic Chemistry I and II</td>
<td>18</td>
</tr>
<tr>
<td>09-221, -222</td>
<td>Laboratory I and II</td>
<td>24</td>
</tr>
</tbody>
</table>

### Total

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>166/169</td>
</tr>
</tbody>
</table>

### Elective Units

<table>
<thead>
<tr>
<th>Elective Course Title</th>
<th>Units</th>
</tr>
</thead>
</table>

*One elective must be at or above the 03-3xx level exclusive of 03-445

### Minimum number of units required for degree

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>360</td>
<td>Minimum number of units required for degree</td>
<td></td>
</tr>
</tbody>
</table>

### Honors Program in Research Biology

The Honors Program offers an opportunity to become extensively involved in research. The program requires students to conduct an independent project and to prepare a formal thesis that is written and defended in the senior year. This program does not preclude a student from completing any of the options within the department nor is it the only way in which students can participate in undergraduate research but is excellent preparation for graduate studies.
The 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.

Required Courses 36 units
Complete the four courses below:

- 03-121  Modern Biology
- 03-231 (232)  Biochemistry *
- 03-240  Cell Biology
- 03-330  Genetics

Complete two biology electives:* 18 units

*One elective must be at the 03-3xx level or above exclusive of 03-445

You may choose one of the following laboratory courses to satisfy an elective on an as-available basis. You can earn the minor in Biological Sciences without taking either of these courses.

- 03-124  Modern Biology Laboratory
- 03-343  Experimental Genetics and Molecular Biology

Faculty

ERIC AHRENS, Assistant Professor of Biological Sciences — Ph.D., University of California, Los Angeles; Carnegie Mellon, 2000—.

ALISON 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, Senior Lecturer in Biological Sciences; Associate Department Head for Undergraduate Affairs; Director, University Health Professions Program — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1997—.

AMY K. CSINK, Assistant Professor of Biological Sciences, — Ph.D., University of Georgia; Carnegie Mellon, 1998—.

CARRIE B. DOONAN, Senior Lecturer in Biological Sciences — Ph.D., University of Connecticut; Carnegie Mellon, 1993—.

MARIE DANNIE DURAND, Associate Professor of Biological Sciences — Ph.D., Columbia University; Carnegie Mellon, 2000—.

CHARLES A. ETTENSOHN, Associate Professor of Biological Sciences — Ph.D., Yale University; Carnegie Mellon, 1987—.

ERIC W. GROTZINGER, Senior Lecturer in 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 — Ph.D., Yale University; Carnegie Mellon, 1979—.

JEFFREY O. HOLLINGER, Professor of Biological Sciences — Ph.D., D.D.S., University of Maryland; Carnegie Mellon, 2000—.

T. D. JACOBSEN, Adjunct Professor of Biological Sciences; Assistant Director and Principal Research Scientist, Hunt Institute for Botanical Documentation — Ph.D., Washington State University; Carnegie Mellon, 1978—.

JONATHAN W. JARVIK, Associate Professor of Biological Sciences — Ph.D., Carnegie Mellon, 1979—.

ANTONIO-JAVIER LÓPEZ, Associate Professor of Biological Sciences — Ph.D., Duke University; Carnegie Mellon, 1995—.

ANTONIO-JAVIER LÓPEZ, Associate Professor of Biological Sciences — Ph.D., Duke University; Carnegie Mellon, 1989—.

JONATHAN S. MINDEN, Associate Professor of Biological Sciences — Ph.D., Albert Einstein College of Medicine; Carnegie Mellon, 1990—.

ROBERT F. MURPHY, Associate Professor of Biological Sciences — 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—.

JUDIBELLE ROMAN, Special Lecturer — Ph.D., University of Maryland; Carnegie Mellon, 2000—.

GORDON S. RULE, Robert Eberly Associate 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—.

AMIT SRIVASTAVA, Lecturer in Biological Sciences — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2001—.

JOSEPH P. SUHAN, Special Senior Lecturer — MA, Hofstra University; Carnegie Mellon, 1989—.

NATHAN URBAN, Assistant Professor of Biological Sciences — Ph.D., University of Pittsburgh; Carnegie Mellon, 2001—.

FREDERICK UTECH, Adjunct Professor of Biological Sciences — Ph.D., Washington University; Carnegie Mellon, 1977—.

ALAN S. WAGGONER, Professor of Biological Sciences — Ph.D., University of Oregon; Carnegie Mellon, 1999—.

JAMES F. WILLIAMS, Professor of Biological Sciences — Ph.D., University of Toronto; Carnegie Mellon, 1976—.

JOHN L. WOLFFORD JR., Professor of Biological Sciences — Ph.D., Duke University; Carnegie Mellon, 1979—.

C. ROY WORTHINGTON, Professor of Biological Sciences Emeritus — Ph.D., Adelaide University; Carnegie Mellon 1960.

GEORGE S. ZUBENKO, Adjunct Professor of Biological Sciences — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1984—.

Affiliated Faculty

BRUCE A. ARMITAGE, Associate Professor of Chemistry — Ph.D., University of Arizona; Carnegie Mellon, 1997—.

JAMES L. MCCLELLAND, Professor of Psychology — Ph.D., University of Pennsylvania; 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 the chemical industry, 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 offers 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. The B.S. degree also meets the requirements for certification by the American Chemical Society. (Nationwide, only about half of all chemistry baccalaureates are ACS certified.) 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 is one of only a few nationally that is certified by the American Chemical Society. 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.S. 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, students can complete the Honors/M.S. degree programs in 8 to 10 semesters.

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. (See the catalog for some courses with similar content.) A popular program is the degree B.S. in Chemistry with an Additional Major in Biology. 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 sciences, business administration and certain departments in the H & S S (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 Management and Policy.

Study abroad exchange programs are available for chemistry majors and may include spending two semesters at École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland, or one or more semesters at Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM, or Monterrey Tech), in Mexico. Language programs (3 months summer for EPFL, and 6 weeks summer for ITESM) are available to students for each of these programs 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. 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. Beginning Fall 2003, undergraduate laboratory instruction will take place in a new state-of-the-art facility currently under construction. 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: 21-115/6 (First Semester Calculus), 21-117/8 (Second Semester Calculus), 33-111 (Physics for Science Students I), 33-112 (Physics for Science Students II), 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. 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

<table>
<thead>
<tr>
<th>Fall (Four Course Schedule)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105 Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>21-115 Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-116 Integral Calculus</td>
<td>5</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>xx-xxx HSS/CFA Elective 1 (of 4)*</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx HSS/CFA Elective 2 (of 4)*</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx HSS/CFA Elective 3 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

**21-115 and 21-116 are sequential half-semester mini-courses that are equivalent to a traditional first semester calculus course.

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.

### Sophomore Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-201 Undergraduate Seminar I</td>
<td>9</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-221 Laboratory I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-231 Mathematical Methods for Chemists</td>
<td>9</td>
</tr>
<tr>
<td>03-121 Modern Biology (or core elective)</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx HSS Distribution Course 1</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx HSS Distribution Course 2</td>
<td>9</td>
</tr>
</tbody>
</table>

**21-117 and 21-118 are sequential half-semester mini-courses that are equivalent to a traditional second semester calculus course.

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.

### Junior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-301 Undergraduate Seminar III</td>
<td>1</td>
</tr>
<tr>
<td>09-321 Laboratory 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>xx-xxx HSS/CFA Elective 1 (of 4)*</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx HSS/CFA Elective 2 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

**A 3-unit course 09-220 Supramolecular Organic Chemistry is offered as an elective to complement 09-216. (Enrollment Limited)

### Senior Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-401 Undergraduate Seminar V</td>
<td>1</td>
</tr>
<tr>
<td>09-xxx Chemical Elective (see notes on electives)</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx Free Electives</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx HSS/CFA Elective 3 (of 4)*</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx HSS/CFA Elective 4 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

Spring

<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>xx-xxx Electives</td>
<td>36</td>
</tr>
<tr>
<td>xx-xxx HSS/CFA Elective 4 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

### Distribution of Units for the B.S. Degree

**Minimum Total Chemistry Units (161; See distribution below)**

**Required Chemistry Courses***

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105 Introduction to Modern Chemistry**</td>
</tr>
<tr>
<td>09-106 Modern Chemistry II</td>
</tr>
<tr>
<td>09-204 Issues in Chemistry</td>
</tr>
<tr>
<td>09-217 Organic Chemistry I</td>
</tr>
<tr>
<td>09-218 Organic Chemistry II</td>
</tr>
<tr>
<td>09-231 Mathematical Methods for Chemists***</td>
</tr>
<tr>
<td>09-331 Modern Analytical Instrumentation</td>
</tr>
<tr>
<td>09-344 Physical Chemistry (Quantum)</td>
</tr>
<tr>
<td>09-345 Physical Chemistry (Thermo)</td>
</tr>
<tr>
<td>09-348 Inorganic Chemistry</td>
</tr>
<tr>
<td>09-221 Lab I: Introduction to Chemical Analysis</td>
</tr>
<tr>
<td>09-222 Lab II: Organic Synthesis and Analysis</td>
</tr>
<tr>
<td>09-321 Lab III: Molecular Design and Synthesis</td>
</tr>
<tr>
<td>09-322 Lab IV: Molecular Spectroscopy and Dynamics</td>
</tr>
<tr>
<td>09-xxx Chemistry Seminars</td>
</tr>
<tr>
<td>09-xxx Chemistry Electives (includes 9 units of lab elective)</td>
</tr>
</tbody>
</table>

*These are the required courses for students earning an additional major in chemistry.

** 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 below) can be taken to fulfill the requirement for 09-231.

### Other Requirements

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
</tr>
<tr>
<td>Computer Science</td>
</tr>
<tr>
<td>Mathematics</td>
</tr>
<tr>
<td>Physics</td>
</tr>
<tr>
<td>Humanities and Social Sciences or Fine Arts courses</td>
</tr>
<tr>
<td>Free Electives</td>
</tr>
<tr>
<td>Computing Skills Workshop</td>
</tr>
</tbody>
</table>

### 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, Statistical Methods) and 36-302 (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.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-445</td>
<td>Undergraduate Research*</td>
<td>9 units</td>
</tr>
<tr>
<td>03-344</td>
<td>Experimental Techniques in Biochemistry</td>
<td>12 units</td>
</tr>
<tr>
<td>06-xxx</td>
<td>Approved Chemical Engineering Laboratory</td>
<td>8-12 units</td>
</tr>
<tr>
<td>09-560</td>
<td>Computational Chemistry</td>
<td>12 units</td>
</tr>
<tr>
<td>39-802</td>
<td>Colloids, Polymers and Surfaces Laboratory II</td>
<td>9-12 units</td>
</tr>
</tbody>
</table>

*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-xxx 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 from other departments.

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.

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-231/232</td>
<td>Biochemistry I</td>
<td>9</td>
</tr>
<tr>
<td>03-330</td>
<td>Genetics</td>
<td>9</td>
</tr>
<tr>
<td>03-438</td>
<td>Physical Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-344</td>
<td>Experimental Techniques in Biochemistry</td>
<td>12</td>
</tr>
</tbody>
</table>

Polymer Science Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-502</td>
<td>Organic Polymer Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-509</td>
<td>Physical Chemistry of Macromolecules</td>
<td>9</td>
</tr>
<tr>
<td>39-802</td>
<td>Colloids, Polymers and Surfaces Laboratory II</td>
<td>9-12</td>
</tr>
<tr>
<td>09-xxx</td>
<td>Elective in Polymer Science</td>
<td>9</td>
</tr>
</tbody>
</table>

Colloids, Polymers, and Surfaces Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-607</td>
<td>Physical Chemistry of Colloids and Surfaces</td>
<td>9</td>
</tr>
<tr>
<td>06-509</td>
<td>Physical Chemistry of Macromolecules</td>
<td>9</td>
</tr>
<tr>
<td>06-426</td>
<td>Experimental Colloid and Surface Science</td>
<td>9</td>
</tr>
<tr>
<td>06-466</td>
<td>Experimental Polymer Science</td>
<td>9</td>
</tr>
</tbody>
</table>

Materials Chemistry Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>27-100</td>
<td>Materials in Engineering</td>
<td>12</td>
</tr>
<tr>
<td>27-201</td>
<td>Perfect Crystals (9 unit half-semester mini course; 6 units lecture, 3 units lab)</td>
<td>9</td>
</tr>
</tbody>
</table>

Two Elective Courses (from list below) | 18 |

Environmental Chemistry Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-510</td>
<td>Introduction to Green Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-520</td>
<td>Special Topics in Atmospheric Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>06-630</td>
<td>Atmospheric Chemistry, Air Pollution and Global Change</td>
<td>12</td>
</tr>
<tr>
<td>12-090</td>
<td>Technology and the Environment</td>
<td>9</td>
</tr>
<tr>
<td>12-251</td>
<td>Introduction to Environmental Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-651</td>
<td>Air Quality Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-655</td>
<td>Water Quality Engineering (Lab Recommended)</td>
<td>9</td>
</tr>
<tr>
<td>12-720</td>
<td>Water Resources Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>19-420</td>
<td>Chemical Technologies, the Environment, and Society</td>
<td>9</td>
</tr>
<tr>
<td>19-422</td>
<td>Radiation, Health, and Policy</td>
<td>9</td>
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</tbody>
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Management Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-100</td>
<td>Principles of Economics</td>
<td>9</td>
</tr>
<tr>
<td>70-101</td>
<td>Introduction to Business Management</td>
<td>9</td>
</tr>
<tr>
<td>70-121</td>
<td>Accounting I</td>
<td>9</td>
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<tr>
<td>70-364</td>
<td>Business Law</td>
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<tr>
<td>70-365</td>
<td>International Trade Law</td>
<td>9</td>
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</tbody>
</table>

Computational Chemistry Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-200</td>
<td>Data Structures</td>
<td>9</td>
</tr>
<tr>
<td>21-369</td>
<td>Numerical Methods</td>
<td>9</td>
</tr>
<tr>
<td>09-560</td>
<td>Computational Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>One Upper Level Computational Elective Course*</td>
<td>9</td>
</tr>
</tbody>
</table>

*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.

Biochemistry Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>03-231/232</td>
<td>Biochemistry I</td>
<td>9</td>
</tr>
<tr>
<td>03-330</td>
<td>Genetics</td>
<td>9</td>
</tr>
<tr>
<td>03-438</td>
<td>Physical Biochemistry</td>
<td>9</td>
</tr>
<tr>
<td>03-344</td>
<td>Experimental Techniques in Biochemistry</td>
<td>12</td>
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</table>

Polymer Science Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</tr>
</thead>
<tbody>
<tr>
<td>09-502</td>
<td>Organic Polymer Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-509</td>
<td>Physical Chemistry of Macromolecules</td>
<td>9</td>
</tr>
<tr>
<td>39-802</td>
<td>Colloids, Polymers and Surfaces Laboratory II</td>
<td>9-12</td>
</tr>
<tr>
<td>09-xxx</td>
<td>Elective in Polymer Science</td>
<td>9</td>
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Colloids, Polymers, and Surfaces Option

<table>
<thead>
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<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>06-607</td>
<td>Physical Chemistry of Colloids and Surfaces</td>
<td>9</td>
</tr>
<tr>
<td>06-509</td>
<td>Physical Chemistry of Macromolecules</td>
<td>9</td>
</tr>
<tr>
<td>06-426</td>
<td>Experimental Colloid and Surface Science</td>
<td>9</td>
</tr>
<tr>
<td>06-466</td>
<td>Experimental Polymer Science</td>
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Materials Chemistry Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>27-100</td>
<td>Materials in Engineering</td>
<td>12</td>
</tr>
<tr>
<td>27-201</td>
<td>Perfect Crystals (9 unit half-semester mini course; 6 units lecture, 3 units lab)</td>
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</table>

Two Elective Courses (from list below) | 18 |

Environmental Chemistry Option

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>09-510</td>
<td>Introduction to Green Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>09-520</td>
<td>Special Topics in Atmospheric Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>06-630</td>
<td>Atmospheric Chemistry, Air Pollution and Global Change</td>
<td>12</td>
</tr>
<tr>
<td>12-090</td>
<td>Technology and the Environment</td>
<td>9</td>
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<tr>
<td>12-251</td>
<td>Introduction to Environmental Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-651</td>
<td>Air Quality Engineering</td>
<td>9</td>
</tr>
<tr>
<td>12-655</td>
<td>Water Quality Engineering (Lab Recommended)</td>
<td>9</td>
</tr>
<tr>
<td>12-720</td>
<td>Water Resources Chemistry</td>
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</tr>
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Management Option

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-100</td>
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</tr>
<tr>
<td>70-365</td>
<td>International Trade Law</td>
<td>9</td>
</tr>
</tbody>
</table>

Computational Chemistry Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-200</td>
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<td>9</td>
</tr>
<tr>
<td>09-560</td>
<td>Computational Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>One Upper Level Computational Elective Course*</td>
<td>9</td>
</tr>
</tbody>
</table>

*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.

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 to 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. Applications are available from the Director of Undergraduate Studies. 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 recommend 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. 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, preferably before planning a schedule for the second semester of the freshman year. 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 the 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.

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, 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 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.

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 GPA 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>
</thead>
<tbody>
<tr>
<td>03-121</td>
<td>Introduction to Modern Biology</td>
</tr>
<tr>
<td>09-105 *</td>
<td>Introduction to Modern Chemistry</td>
</tr>
<tr>
<td>21-115**</td>
<td>Differential Calculus</td>
</tr>
<tr>
<td>21-116**</td>
<td>Integral Calculus</td>
</tr>
<tr>
<td>33-111</td>
<td>Physics for Science Students I</td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument</td>
</tr>
<tr>
<td>99-101</td>
<td>Computing Skills Workshop</td>
</tr>
<tr>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

** | 21-115 and 21-116 are sequential half-semester mini-courses that are equivalent to a traditional first semester calculus course. 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>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-106</td>
<td>Modern Chemistry II</td>
</tr>
<tr>
<td>21-117**</td>
<td>Integration and Differential Equations</td>
</tr>
<tr>
<td>21-118**</td>
<td>Calculus of Approximation</td>
</tr>
<tr>
<td>33-112</td>
<td>Physics for Science Students II</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;S Distribution Course 1</td>
</tr>
<tr>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

** | 21-117 and 21-118 are sequential half-semester mini-courses that are equivalent to a traditional second semester calculus course. 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 Independent Study**

<table>
<thead>
<tr>
<th>Sophomore Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
</tr>
<tr>
<td>09-217</td>
<td>Organic Chemistry I</td>
</tr>
<tr>
<td>09-231</td>
<td>Mathematical Methods for Chemists</td>
</tr>
<tr>
<td>09-221</td>
<td>Lab I: Introduction to Chemical Analysis</td>
</tr>
<tr>
<td>09-201</td>
<td>Undergraduate Seminar I</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;S Distribution Course 2</td>
</tr>
<tr>
<td>**</td>
<td>**</td>
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<table>
<thead>
<tr>
<th>Spring</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>09-202</td>
<td>Undergraduate Seminar II</td>
</tr>
<tr>
<td>09-204</td>
<td>Issues in Chemistry</td>
</tr>
<tr>
<td>09-222</td>
<td>Lab II: Organic Synthesis and Analysis</td>
</tr>
<tr>
<td>09-218</td>
<td>Organic Chemistry II***</td>
</tr>
<tr>
<td>09-348</td>
<td>Inorganic Chemistry</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;S Distribution Course 3</td>
</tr>
<tr>
<td>***</td>
<td>A 3-unit course 09-220 Supramolecular Organic Chemistry is offered as an elective to complement 09-216. (Enrollment Limited)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Summer</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>12 weeks Honors Research required</td>
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</table>
### Junior Year

**Fall**

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>09-301</td>
<td>Undergraduate Seminar III</td>
<td>1</td>
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<tr>
<td>09-321</td>
<td>Lab III: Molecular Design and Synthesis</td>
<td>12</td>
</tr>
<tr>
<td>09-344</td>
<td>Physical Chemistry (Quantum)</td>
<td>9</td>
</tr>
<tr>
<td>09-331</td>
<td>Modern Analytical Instrumentation</td>
<td>9</td>
</tr>
<tr>
<td>09-445</td>
<td>Undergraduate Research</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;S/CFA Elective 1 of (f of 4)*</td>
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**Spring**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>09-302</td>
<td>Undergraduate Seminar IV</td>
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</tr>
<tr>
<td>09-322</td>
<td>Lab IV: Molecular Spectroscopy and Dynamics</td>
<td>12</td>
</tr>
<tr>
<td>09-445</td>
<td>Undergraduate Research</td>
<td>10</td>
</tr>
<tr>
<td>09-xxx</td>
<td>Graduate Chemistry Course (see notes on Honors B.S./M.S. electives)</td>
<td>12</td>
</tr>
<tr>
<td>09-345</td>
<td>Physical Chemistry (Thermo)</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;S/CFA Elective 2 of (4)*</td>
<td>9</td>
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</table>

**Summer**

- 12 weeks Honors Research required

### Senior Year

**Fall**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>09-402</td>
<td>Undergraduate Seminar VI</td>
<td>3</td>
</tr>
<tr>
<td>09-445</td>
<td>Graduate Research</td>
<td>10</td>
</tr>
<tr>
<td>09-xxx</td>
<td>Graduate Chemistry Course (see notes on Honors B.S./M.S. electives)</td>
<td>12</td>
</tr>
<tr>
<td>09-xxx</td>
<td>Graduate Chemistry Course</td>
<td>12</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;S/CFA Elective 3 of (f of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-401</td>
<td>Undergraduate Seminar V</td>
<td>1</td>
</tr>
<tr>
<td>09-455</td>
<td>Honors Thesis</td>
<td>15</td>
</tr>
<tr>
<td>09-xxx</td>
<td>Graduate Chemistry Course</td>
<td>12</td>
</tr>
<tr>
<td>09-xxx</td>
<td>Graduate Chemistry Course</td>
<td>12</td>
</tr>
<tr>
<td>xxx-xxx</td>
<td>H&amp;S/CFA Elective 4 of (f of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

### 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 Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry**</td>
<td>10</td>
</tr>
<tr>
<td>09-106</td>
<td>Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>09-204</td>
<td>Issues in Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-217</td>
<td>Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-218</td>
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<td>09-331</td>
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<tr>
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<td>09-348</td>
<td>Inorganic Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>09-221</td>
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<td>Lab II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>09-321</td>
<td>Lab III: Molecular Design and Synthesis</td>
<td>12</td>
</tr>
<tr>
<td>09-322</td>
<td>Lab IV: Molecular Spectroscopy and Dynamics</td>
<td>12</td>
</tr>
<tr>
<td>09-xxx</td>
<td>Chemistry Seminars</td>
<td>8</td>
</tr>
</tbody>
</table>

Undergraduate Research (2 summers also required)

Graduate chemistry courses (see notes on B.S./M.S. electives) Honors Thesis

### Other Requirements

- **Biology**
  - 9
- **Computer Science**
  - 10
- **Mathematics**
  - 20
- **Physics**
  - 24
- **Arts**
  - 72
- **Computing Skills Workshop**
  - 3

### 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

The 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 five years not only the degree B.S. in Chemistry with Departmental Honors but also a 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. Bachelor’s students may already be partners in this pro

- **Summer**
  - 53

### Honors B.S./M.S. Program in Chemical Biology

- **Spring**
  - 49

### Distribution of Units for the B.S. with Honors/M.S.

- **Fall**
  - 46

### Required Chemistry Courses

- **Units**
  - 12

### Other Requirements

- **Biology**
  - 9
- **Computer Science**
  - 10
- **Mathematics**
  - 20
- **Physics**
  - 24
- **Arts**
  - 72
- **Computing Skills Workshop**
  - 3

### 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

The 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 five years not only the degree B.S. in Chemistry with Departmental Honors but also a 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. Bachelor’s students may already be partners in this pro

- **Summer**
  - 53

### Distribution of Units for the B.S. with Honors/M.S.

- **Fall**
  - 46

### Required Chemistry Courses

- **Units**
  - 12

### Other Requirements

- **Biology**
  - 9
- **Computer Science**
  - 10
- **Mathematics**
  - 20
- **Physics**
  - 24
- **Arts**
  - 72
- **Computing Skills Workshop**
  - 3

### 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

The 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 five years not only the degree B.S. in Chemistry with Departmental Honors but also a 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. Bachelor’s students may already be partners in this pro
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 in full-time research (with pay) working with their internal 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 to and reviewed by the student’s Advisory Committee. In April of the senior 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 GPA is a strong secondary criterion. While we expect that most students will maintain a GPA 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 GPA 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 (or 232) Biochemistry
03-438 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: Nucleic Acids
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.

09-718 Bioorganic Chemistry
09-721 Bioinorganic Chemistry
09-712 Synthetic Organic Chemistry
09-711 Physical Organic Chemistry
09-841 Spectroscopy
09-560 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</td>
<td>Introduction to Modern Biology</td>
</tr>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry</td>
</tr>
<tr>
<td>21-115**</td>
<td>Differential Calculus</td>
</tr>
<tr>
<td>21-116**</td>
<td>Integral Calculus</td>
</tr>
<tr>
<td>33-111</td>
<td>Physics for Science Students I</td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument</td>
</tr>
<tr>
<td>99-101</td>
<td>Computing Skills Workshop</td>
</tr>
</tbody>
</table>

44

** 21-115 and 21-116 are sequential half-semester mini-courses that are equivalent to a traditional first semester calculus course.

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>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-106</td>
<td>Modern Chemistry II</td>
</tr>
<tr>
<td>21-117**</td>
<td>Integration and Differential Equations</td>
</tr>
<tr>
<td>21-119**</td>
<td>Calculus of Approximation</td>
</tr>
<tr>
<td>33-112</td>
<td>Physics for Science Students II</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Distribution Course 1</td>
</tr>
</tbody>
</table>

51

** 21-117 and 21-119 are sequential half-semester mini-courses that are equivalent to a traditional second semester calculus course.

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</td>
<td>Organic Chemistry I</td>
</tr>
<tr>
<td>09-231</td>
<td>Mathematical Methods for Chemists</td>
</tr>
<tr>
<td>09-221</td>
<td>Lab I: Introduction to Chemical Analysis</td>
</tr>
<tr>
<td>03-231</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>09-201</td>
<td>Undergraduate Seminar I</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Distribution Course 2</td>
</tr>
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</table>

46

Spring

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-202</td>
<td>Undergraduate Seminar II</td>
</tr>
<tr>
<td>09-204</td>
<td>Issues in Chemistry</td>
</tr>
<tr>
<td>09-222</td>
<td>Lab II: Organic Synthesis and Analysis</td>
</tr>
<tr>
<td>09-218</td>
<td>Organic Chemistry II***</td>
</tr>
<tr>
<td>09-348</td>
<td>Inorganic Chemistry</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Distribution Course 3</td>
</tr>
</tbody>
</table>

44

*** A 3 unit course 09-220 Supramolecular Organic Chemistry is offered as an elective to complement 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>
</tr>
</thead>
<tbody>
<tr>
<td>09-301</td>
<td>Undergraduate Seminar III</td>
</tr>
<tr>
<td>09-321</td>
<td>Lab III: Molecular Design and Synthesis</td>
</tr>
<tr>
<td>09-344</td>
<td>Physical Chemistry (Quantum)</td>
</tr>
<tr>
<td>09-331</td>
<td>Modern Analytical Instrumentation</td>
</tr>
<tr>
<td>09-445</td>
<td>Undergraduate Research or Program Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS/CFA Elective 1 (of 4)*</td>
</tr>
</tbody>
</table>

56

Spring

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-302</td>
<td>Undergraduate Seminar IV</td>
</tr>
<tr>
<td>09-322</td>
<td>Lab IV: Molecular Spectroscopy and Dynamics</td>
</tr>
<tr>
<td>09-445</td>
<td>Undergraduate Research or Program Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS/CFA Elective 2 (of 4)*</td>
</tr>
</tbody>
</table>

53

Summer

Summer internship or undergraduate research required.
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 ACS certified 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

Curriculum — B.S. in Chemistry/Computational Chemistry Track

Freshman Year

Fall (Four Course Schedule) Units
09-105 Introduction to Modern Chemistry 10
21-115** Differential Calculus 5
21-116** Integral Calculus 5
33-111 Physics for Science Students I 12
76-101 Interpretation and Argument 9
99-101 Computing Skills Workshop 3
** 21-115 and 21-116 are sequential half-semester mini-courses that are equivalent to a traditional first semester calculus course.

Spring

09-106 Modern Chemistry II 10
15-100+ Introductory/Intermediate Programming 10
21-117** Integration and Differential Equations 5
21-118** Calculus of Approximation 5
33-112 Physics for Science Students II 12
99-101 Computing Skills Workshop 3
** 21-117 and 21-118 are sequential half-semester mini-courses that are equivalent to a traditional second semester calculus course.

+ 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

Fall Units
09-201 Undergraduate Seminar I 1
09-217 Organic Chemistry I 9
09-221 Lab I: Introduction to Chemical Analysis 12
21-127 Concepts of Mathematics 9
15-200 Data Structures 9
99-101 Computing Skills Workshop 3

Minimum number of units required for degrees: 413
### Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate Seminar II</td>
<td>1</td>
</tr>
<tr>
<td>Issues in Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Lab II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>Organic Chemistry II</td>
<td>9</td>
</tr>
<tr>
<td>Calculus in Three Dimensions**</td>
<td>9</td>
</tr>
<tr>
<td>Fundamental Data Structures and Algorithms</td>
<td>12</td>
</tr>
<tr>
<td>H&amp;SS/CFX Elective 3</td>
<td>9</td>
</tr>
</tbody>
</table>

**Fall**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate Seminar III</td>
<td>1</td>
</tr>
<tr>
<td>Lab III: Molecular Design and Synthesis</td>
<td>12</td>
</tr>
<tr>
<td>Physical Chemistry (Quantum)</td>
<td>9</td>
</tr>
<tr>
<td>Modern Analytical Instrumentation</td>
<td>9</td>
</tr>
<tr>
<td>Principles of Programming</td>
<td>12</td>
</tr>
<tr>
<td>H&amp;SS/CFX Elective 1 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

### Summer

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-214 (Physical Chemistry)</td>
<td>9</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>Lab I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>Lab II: Organic Synthesis and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>Lab III: Molecular Design and Synthesis</td>
<td>12</td>
</tr>
<tr>
<td>Lab IV: Molecular Spectroscopy and Dynamics</td>
<td>12</td>
</tr>
<tr>
<td>09-560 (Computational Chemistry)</td>
<td>12</td>
</tr>
<tr>
<td>Chemistry Seminars</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

**Note:** The courses marked with an asterisk (*) are recommended but not required. Students are encouraged to attend. These courses are not formally required, however you are encouraged to attend. These courses are required for all programs in chemistry.

### Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-301 Undergraduate Seminar III</td>
<td>1</td>
</tr>
<tr>
<td>09-321 Lab IV: 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>09-217 Principles of Programming</td>
<td>12</td>
</tr>
<tr>
<td>H&amp;SS/CFX Elective 1 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

### Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>09-401 Undergraduate Seminar V</td>
<td>1</td>
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<tr>
<td>Chemistry Elective</td>
<td>9</td>
</tr>
<tr>
<td>Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>Computing Elective</td>
<td>9</td>
</tr>
<tr>
<td>H&amp;SS/CFX Elective 3 (of 4)*</td>
<td>9</td>
</tr>
</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate Seminar VI</td>
<td>3</td>
</tr>
<tr>
<td>Inorganic Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>Computing Elective</td>
<td>9</td>
</tr>
<tr>
<td>Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>H&amp;SS/CFX Elective 4 (of 4)*</td>
<td>9</td>
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</table>

### Upper Level Mathematics Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-369 Numerical Methods</td>
<td>9</td>
</tr>
<tr>
<td>21-228 Discrete Mathematics</td>
<td>9</td>
</tr>
<tr>
<td>21-301 Combinatorial Analysis (note 21-228 prerequisite)</td>
<td>9</td>
</tr>
<tr>
<td>21-xxx Approved Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

### Distribution of Units for the B.S. in Chemistry/Computational Chemistry Track

<table>
<thead>
<tr>
<th>Course</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>09-222 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>
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<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>Chemistry Seminars</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

**Note:** The courses marked with an asterisk (*) are recommended but not required. Students are encouraged to attend. These courses are not formally required, however you are encouraged to attend. These courses are required for all programs in chemistry.

### Other Requirements

- Biology: 9 units
- Computer Science: 43 units
- Mathematics: 38 units
- Physics: 24 units
- Humanities and Social Sciences or Fine Arts courses: 72 units
- Computing or Math Electives: 18 units
- Computing Skills Workshop: 3 units

### 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.

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. Others may be chosen with departmental approval.

### Upper Level Computing Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-312 Comparative Languages</td>
<td>9</td>
</tr>
<tr>
<td>15-411 Compiler Design</td>
<td>12</td>
</tr>
<tr>
<td>15-412 Operating Systems</td>
<td>12</td>
</tr>
<tr>
<td>15-413 Software Engineering</td>
<td>12</td>
</tr>
<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>15-462 Computer Graphics (or equivalent)</td>
<td>9</td>
</tr>
<tr>
<td>15-xxx Approved Elective</td>
<td>9</td>
</tr>
</tbody>
</table>
**Curriculum — B.A. in Chemistry**

**Freshman Year**

<table>
<thead>
<tr>
<th>Fall (Four Course Schedule)</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>09-105 <strong>Introduction to Modern Chemistry</strong></td>
<td>10</td>
</tr>
<tr>
<td>21-115** Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-116** Integral Calculus</td>
<td>5</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>
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</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-106 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
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<tr>
<td>21-117** Integration and Differential Equations</td>
<td>5</td>
</tr>
<tr>
<td>21-118** Calculus of Approximation</td>
<td>5</td>
</tr>
<tr>
<td>33-112 Physics for Science Students II</td>
<td>12</td>
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<tr>
<td>xx-xxx H&amp;SS Distribution Course 1</td>
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</table>

**Sophomore Year**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>09-201 Undergraduate Seminar I</td>
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<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>xx-xxx Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS Distribution Course 2</td>
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**Junior Year**

<table>
<thead>
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<tr>
<td>09-301 Lab III: Molecular Design and Synthesis</td>
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<tr>
<td>xx-xxx Free Elective</td>
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</tr>
<tr>
<td>xx-xxx H&amp;SS/CFA Elective 1 (of 4)*</td>
<td>9</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>09-302 Undergraduate Seminar IV</td>
<td>1</td>
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<tr>
<td>09-348 Inorganic Chemistry</td>
<td>10</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 2 (of 4)*</td>
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**Senior Year**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>09-401 Undergraduate Seminar V</td>
<td>1</td>
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<tr>
<td>xx-xxx Free Elective</td>
<td>36</td>
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<tr>
<td>xx-xxx H&amp;SS/CFA Elective 3 (of 4)*</td>
<td>9</td>
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</table>

**Distribution of Units for the B.A. Degree**

**Required Courses**

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
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<tbody>
<tr>
<td>09-105 Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>09-xxx Chemistry Electives</td>
<td>18</td>
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**Electives**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>xx-xxx Free Electives</td>
<td>28</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS/CFA Elective 4 (of 4)*</td>
<td>9</td>
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</table>

**Total Units:** 51

**Minimum Total Chemistry Units:** 122

**Other Requirements**

<table>
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<th>Course</th>
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</thead>
<tbody>
<tr>
<td>09-107 Honors Chemistry</td>
<td>18</td>
</tr>
<tr>
<td>xx-xxx H&amp;SS/CFA Elective</td>
<td>18</td>
</tr>
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</table>

**Total Units:** 51

**Total Units for the Degree:** 360

**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 pursing the minor must inform the Chemistry Department of their intentions so that the minor designation can be approved prior to graduation.**

**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*.
   a. 09-348 Inorganic Chemistry
   b. 09-344 Physical Chemistry (Quantum)
   c. 09-214 Physical Chemistry

**Requirement for the Minor in Chemistry**

*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.

**B. Two Elective Courses from the following list.**

1. 09-344 Physical Chemistry (Quantum) or 09-214 Physical Chemistry
2. 09-345 Physical Chemistry (Thermo)
3. 09-348 Inorganic Chemistry
4. 09-222 Laboratory II: Organic Synthesis and Analysis
5. 09-321 Lab III: Molecular Design and Synthesis
6. 09-218 Organic Chemistry II
7. 03-231/232 Biochemistry I
8. 09-xxx Approved Upper Level Chemistry Course
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 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 a chemistry or biochemistry 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 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 toward the minor in chemistry. The undergraduate research course, 09-445, can not 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
CATALINA ACHIM, Assistant Professor of Chemistry — Ph.D., Carnegie Mellon; Carnegie Mellon, 2001—.

BRUCE A. ARMITAGE, Associate Professor of Chemistry — Ph.D., University of Arizona; Carnegie Mellon, 1997—.

MARK E. BIER, Senior Research Scientist and Director, Center for Molecular Analysis — Ph.D., Purdue University; Carnegie Mellon, 1996—.

GUY C. BERRY, University Professor of Chemistry and Polymer Science — Ph.D., University of Michigan; Carnegie Mellon, 1986—.

EMILE BOMINAAR, Senior Research Scientist — Ph.D., University of Amsterdam (The Netherlands); Carnegie Mellon, 1994—.

AKSELA A. BOTHNER-BY, University Professor of Chemistry, Emeritus — Ph.D., Harvard University; Carnegie Mellon, 1958—.

WILLIAM E. BROWN, Professor of Biological Sciences — Ph.D., University of Minnesota; Carnegie Mellon, 1973—.

ALBERT A. CARETTO JR., Professor of Chemistry, Emeritus — Ph.D., University of Rochester; Carnegie Mellon, 1959—.

EDWARD F. CASASSA, Professor of Chemistry, Emeritus — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1956—.

TERRANCE J. COLLINS, Thomas Lord Professor of Chemistry — Ph.D., University of Auckland, New Zealand; Carnegie Mellon, 1987—.

JOSEF DADOK, Professor of Chemical Instrumentation, Emeritus — Ph.D., Czechoslovak Academy of Sciences; Carnegie Mellon, 1967—.

NEIL M. DONAHUE, Assistant Professor Chemistry and Chemical Engineering — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2000—.

REBECCA FREELAND, Associate Department Head — Ph.D., Carnegie Mellon, Carnegie Mellon 1993—.

ANDREW GELLMAN, Lord Professor of Chemical Engineering and Professor of Chemistry — Ph.D., University of California, Berkeley; Carnegie Mellon, 1992—.

ROBERTO GIL, Research Scientist — Ph.D., Universidad de Cordoba (Argentina); Carnegie Mellon, 2002—.

MICHAEL P. HENDRICH, Associate Professor of Chemistry — Ph.D., University of Illinois; Carnegie Mellon, 1994—.

COLIN HORWITZ, Senior Research Scientist — Ph.D., Northwestern University; Carnegie Mellon, 1993—.

MORTON KAPLAN, Professor of Chemistry — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1970—.

PAUL J. KAROL, Professor of Chemistry — Ph.D., Columbia University; Carnegie Mellon, 1969—.

ROBERT L. KAY, Professor of Chemistry, Emeritus — Ph.D., University of Chicago; Carnegie Mellon, 1992—.

ROBERT L. KAY, Professor of Chemistry, Emeritus — Ph.D., State University of New York at Stony Brook; Carnegie Mellon, 1992—.

PAUL J. KAROL, Professor of Chemistry — Ph.D., Columbia University; Carnegie Mellon, 1969—.

ROBERT L. KAY, Professor of Chemistry, Emeritus — Ph.D., University of Toronto; Carnegie Mellon, 1963—.

HYUNG J. KIM, Professor of Chemistry and Interim Head, Department of Chemistry — Ph.D., State University of New York at Stony Brook; Carnegie Mellon, 1992—.

TOMASZ KOWALEWSKI, Assistant Professor of Chemistry — Ph.D., Polish Academy of Sciences: Carnegie Mellon, 2000—.

MIGUEL LLINÁS, Professor of Chemistry — Ph.D., University of California at Berkeley; Carnegie Mellon, 1976—.

KRZYSZTOF MATYJASZEWSKI, J. C. Warner Professor of Natural Sciences and Director, Center for Macromolecular Engineering — Ph.D., Polish Academy of Sciences; Carnegie Mellon, 1995—.

RICHARD D. MCCULLOUGH, Professor of Chemistry and Dean, Mellon College of Science — Ph.D., The Johns Hopkins University; Carnegie Mellon, 1990—.

ECKARD MÜNCK, Professor of Chemistry and Dean, Mellon College of Science — Ph.D., Technical University of Darmstadt (Germany); Carnegie Mellon, 1990—.

GARY D. PATTERSON, Professor of Chemistry — Ph.D., Stanford University; Carnegie Mellon, 1984—.

LINDA A. PETEANU, Associate Professor of Chemistry — Ph.D., University of Chicago; Carnegie Mellon, 1992—.

STUART W. STALEY, Professor of Chemistry — Ph.D., Yale University; Carnegie Mellon, 1986—.

ROBERT F. STEWART, Professor of Chemistry — Ph.D., California Institute of Technology; Carnegie Mellon, 1978—.

KAREN H. STUMP, Principal Lecturer and Director of Undergraduate Studies and Director of Laboratories — M.S., Carnegie Mellon University; Carnegie Mellon, 1983—.

CHARLES H. VAN DYKE, Associate Professor of Chemistry — Ph.D., University of Pennsylvania; Carnegie Mellon, 1969—.

LYNN WALKER, Assistant Professor of Chemical Engineering and Chemistry, Ph.D., University of Delaware; Carnegie Mellon, 1997—.

GARRY F. P. WARNOCK, Senior Lecturer — Ph.D., University of Minnesota; Carnegie Mellon, 1997—.

DAVID YARON, Associate Professor of Chemistry — Ph.D., Harvard University; Carnegie Mellon, 1992—.
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 the B.S. in Mathematical Sciences degree with concentrations in Mathematics, Operations Research, Statistics, Discrete Mathematics and Logic, and Computational and Applied Mathematics.

The Mathematics Concentration is the least structured of our concentrations 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. This is critical if students are to make the most of their years at the University. An advisor and a mentor are assigned to each student after the student has elected Mathematical Sciences as a major. Students are urged to work carefully with their advisor and mentor to formulate their degree program. Study abroad is encouraged, and an interested student should investigate the opportunities available in the Undergraduate Options section of the catalog.

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.

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 option. For students who complete 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.

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 first year of calculus is offered in four mini courses 21-115, 21-116, 21-117, 21-118 to allow placement of entering students.

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.

An H&S Elective refers to a course in the Humanities and Social Science requirements as described in the catalog section for the Mellon College of Science. A course listed as an Elective is a free elective with the only restriction that the maximum total of ROTC and Physical Education units that will be accepted for graduation is nine.

In addition to the courses in the suggested schedules below, a student majoring in mathematical sciences also takes the one unit...
course 21-201 Undergraduate Colloquium each semester of the Sophomore year. This course plays an important role in introducing students to career opportunities, graduate school preparation, and student and faculty research in the Department.

### Mathematics Concentration

This concentration is the most flexible of the five 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 Concentration are:

#### Mathematical Sciences
- 21-115 Differential Calculus
- 21-116 Integral Calculus
- 21-117 Integration and Differential Equations
- 21-118 Calculus of 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 Advanced Calculus I
- 21-356 Advanced Calculus II (or 21-357)
- 21-373 Algebraic Structures

five Mathematical Sciences electives

#### Other courses
- 15-100 Introductory/Intermediate Programming
- 36-225 Introduction to Probability and Statistics I

three Mathematical Sciences, Statistics, or Computer Science electives

MCS humanities, social science, and science core (114 units)

seven free electives

### Suggested Schedule

#### Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>21-115</td>
<td>Differential Calculus</td>
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<tr>
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<td>Integral Calculus</td>
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<td>33-111</td>
<td>Physics for Science Students I</td>
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<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
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<tr>
<td>03-121</td>
<td>Modern Biology</td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument</td>
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<tr>
<td>99-101</td>
<td>Computer Skills Workshop</td>
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<thead>
<tr>
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<tbody>
<tr>
<td>21-117</td>
<td>Integration and Differential Equations</td>
</tr>
<tr>
<td>21-118</td>
<td>Calculus of Approximation</td>
</tr>
<tr>
<td>21-127</td>
<td>Concepts of Mathematics</td>
</tr>
<tr>
<td>33-112</td>
<td>Physics for Science Students II</td>
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<tr>
<td>09-105</td>
<td>Intro to Modern Chemistry</td>
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<td>H&amp;SS Elective</td>
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#### Sophomore Year

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<td>Discrete Mathematics (or 21-301 or 21-484)</td>
</tr>
<tr>
<td>21-341</td>
<td>Linear Algebra I</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
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<td>21-201</td>
<td>Undergraduate Colloquium</td>
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<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
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<tbody>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>21-201</td>
<td>Undergraduate Colloquium</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Mathematical Sci, Statistics, or Computer Sci Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Elective</td>
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<td></td>
<td><strong>Total</strong></td>
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#### Junior Year

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<tr>
<td>21-355</td>
<td>Advanced Calculus I</td>
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<tr>
<td>36-225</td>
<td>Introduction to Probability and Statistics I</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Mathematical Sci, Statistics, or Computer Sci Elective</td>
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<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
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<td>xx-xxx</td>
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<td></td>
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#### Senior Year

<table>
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<tr>
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<th>Units</th>
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<tr>
<td>21-356</td>
<td>Advanced Calculus II</td>
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<tr>
<td>21-373</td>
<td>Algebraic Structures</td>
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<tr>
<td>21-xxx</td>
<td>Mathematical Sciences Elective</td>
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<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
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<td></td>
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</table>

#### 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:

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-301</td>
<td>Combinatorial Analysis</td>
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<tr>
<td>21-342</td>
<td>Linear Algebra II</td>
</tr>
<tr>
<td>21-371</td>
<td>Functions of a Complex Variable</td>
</tr>
<tr>
<td>21-372</td>
<td>Partial Differential Equations</td>
</tr>
<tr>
<td>21-374</td>
<td>Field Theory</td>
</tr>
<tr>
<td>21-460</td>
<td>Topology</td>
</tr>
<tr>
<td>21-470</td>
<td>Selected Topics in Analysis</td>
</tr>
<tr>
<td>21-476</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>21-484</td>
<td>Graph Theory</td>
</tr>
<tr>
<td>21-600</td>
<td>Mathematical Logic I</td>
</tr>
<tr>
<td>21-602</td>
<td>Introduction to Set Theory</td>
</tr>
<tr>
<td>21-620</td>
<td>Real Analysis</td>
</tr>
<tr>
<td>21-621</td>
<td>Introduction to Lebesgue Integration</td>
</tr>
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<td>21-651</td>
<td>General Topology</td>
</tr>
<tr>
<td>21-660</td>
<td>Numerical Analysis I</td>
</tr>
</tbody>
</table>

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 reading course. The Department offers 21-599 Undergraduate Reading and Research for this purpose. A student including Mathematical Studies in the B.S. in Mathematical Sciences program is encouraged to discuss the selection of courses with his or her Mathematical Studies instructors.

### 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
- 21-119 | Differential Calculus | 9 |
- 21-116 | Integral Calculus | 9 |
- 21-117 | Integration and Differential Equations | 9 |
- 21-118 | Calculus of Approximation | 9 |
- 21-127 | Concepts of Mathematics | 9 |
- 21-201 | Undergraduate Colloquium | 1 |
- 21-228 | Discrete Mathematics (or 21-484) | 9 |
- 21-241 | Matrix Algebra | 9 |
- 21-259 | Calculus in Three Dimensions | 9 |
- 21-260 | Differential Equations | 9 |
- 21-292 | Operations Research I | 9 |
- 21-355 | Advanced Calculus I | 9 |
- 21-369 | Numerical Methods | 9 |
- 21-393 | Operations Research II | 9 |
Statistics
36-225 Introduction to Probability and Statistics I
36-226 Introduction to Probability and Statistics II
36-401 Modern Regression
36-402 Topic in Data Analysis
36-410 Introduction to Probability Models
36-410 Introduction to Probability Models

Depth Electives
The detailed curriculum below includes four depth electives. These are to be chosen from among the following.
21-211 Fundamental Data Structures and Algorithms
21-212 Principles of Programming
21-235 Projects in Applied Mathematics
21-236 Topics in Applied Mathematics
21-237 Discrete-Time Finance
21-237 Algebraic Structures
21-420 Continuous-Time Finance
21-484 Graph Theory
36-461 Statistics Topic
36-462 Topic in Statistics
36-464 Applied Multivariate Methods
36-465 Independent Study
70-371 Production and Operations Management
70-460 Mathematical Methods for Consulting
70-471 Logistics and Supply Chain Management
70-473 Modeling for Operations Management Applications

Other courses
15-100 Introductory/Intermediate Programming
70-122 Introduction to Accounting
73-100 Principles of Economics
73-250 Intermediate Microeconomics

MCS humanities, social science, and science core (114 units, including 73-100 and 73-250)

Five free electives

Suggested Schedule
Freshman Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-115</td>
<td>Differential Calculus</td>
</tr>
<tr>
<td>21-116</td>
<td>Integral Calculus</td>
</tr>
<tr>
<td>33-111</td>
<td>Physics for Students I</td>
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<td>Interpretation and Argument</td>
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<tr>
<td>99-101</td>
<td>Computing Skills Workshop</td>
</tr>
</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-117</td>
<td>Integration and Differential Equations</td>
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<td>Calculus of Approximation</td>
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<td>21-127</td>
<td>Concepts of Mathematics</td>
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<tr>
<td>33-112</td>
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<td>09-105</td>
<td>Intro to Modern Chemistry</td>
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Sophomore Year

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<tr>
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<tr>
<td>73-100</td>
<td>Principles of Economics</td>
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Spring

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<td>70-122</td>
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Junior Year

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<tr>
<td>21-369</td>
<td>Numerical Methods</td>
</tr>
<tr>
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<td>Depth Elective</td>
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<tr>
<td>36-225</td>
<td>Introduction to Probability and Statistics I</td>
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<td>73-250</td>
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Spring

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<td>36-226</td>
<td>Introduction to Probability and Statistics II</td>
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<tr>
<td>36-401</td>
<td>Modern Regression</td>
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<tr>
<td>xx-xxx</td>
<td>H&amp;S Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Elective</td>
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Minimum number of units required for the degree: 360

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 strong 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 courses 36-325/326 Probability and Mathematical Statistics I/II have similar content to the 36-225/226 sequence but are presented at a more mathematically rigorous level. This sequence is recommended for students in this concentration with a GPA of 3.0 or above.

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:

Mathematical Sciences

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<tr>
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<td>Integration and Differential Equations</td>
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<td>Calculus of Approximation</td>
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Statistics

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<tr>
<td>36-402</td>
<td>Topic in Data Analysis</td>
</tr>
<tr>
<td>36-410</td>
<td>Introduction to Probability Models</td>
</tr>
</tbody>
</table>

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.

15-211 Fundamental Data Structures and Algorithms
15-212 Principles of Programming
21-365 Topics in Applied Mathematics
21-366 Topics in Applied Mathematics
21-370 Discrete-Time Finance
21-373 Algebraic Structures
21-420 Continuous-Time Finance
21-484 Graph Theory
36-461 Statistics Topic
36-462 Topic in Statistics
36-464 Applied Multivariate Methods
36-495 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**

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<td>33-111 Physics for Science Students I</td>
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<tr>
<td>15-100 Introductory/Intermediate Programming</td>
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<tr>
<td>03-121 Modern Biology</td>
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<td>76-101 Interpretation and Argument</td>
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<table>
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<tr>
<td>21-118 Calculus of Approximation</td>
<td>5</td>
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<tr>
<td>33-112 Physics for Science Students II</td>
<td>12</td>
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<tr>
<td>09-105 Intro to Modern Chemistry</td>
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<tr>
<td>21-127 Concepts of Mathematics</td>
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**Sophomore Year**

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<th>Units</th>
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<tr>
<td>21-228 Discrete Mathematics (or 21-301)</td>
<td>9</td>
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<tr>
<td>21-241 Matrix Algebra</td>
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<tr>
<td>21-259 Calculus in Three Dimensions</td>
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<tr>
<td>21-201 Undergraduate Colloquium</td>
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<td>73-100 Principles of Economics</td>
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<table>
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<tbody>
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<td>15-200 Advanced Programming/Practicum</td>
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<tr>
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<tr>
<td>21-292 Operations Research I</td>
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<tr>
<td>21-201 Undergraduate Colloquium</td>
<td>1</td>
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<td>xx-xx</td>
<td>9</td>
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<td>xx-xx</td>
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<td><strong>Total</strong></td>
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**Junior Year**

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<tbody>
<tr>
<td>21-369 Numerical Methods</td>
<td>9</td>
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<td>36-225 Introduction to Probability and Statistics I</td>
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<table>
<thead>
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<th>Units</th>
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<tbody>
<tr>
<td>21-355 Advanced Calculus I</td>
<td>9</td>
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<tr>
<td>36-226 Introduction to Probability and Statistics II</td>
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<tr>
<td>36-410 Introduction to Probability Models</td>
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**Senior Year**

<table>
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<tr>
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<th>Units</th>
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<tr>
<td>21-393 Operations Research II</td>
<td>9</td>
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<tr>
<td>36-401 Modern Regression</td>
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<td>xx-xx</td>
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**Spring**

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<td>36-402 Topic in Data Analysis</td>
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<td>xx-xx  H&amp;SS Elective</td>
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<tr>
<td>xx-xx  Elective</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
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</tr>
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</table>

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 Structures of Computer Science I
- 15-212 Fundamental Structures of Computer Science II
- 21-115/21-116 Differential Integral Calculus (or 21-131 Analysis I)
- 21-117/21-118 Integration/Diff Equations/Approximation (or 21-132 Analysis II)
- 21-127 Concepts of Mathematics
- 21-201 Undergraduate Colloquium
- 21-300 Basic Logic
- 21-301 Combinatorial Analysis
- 21-341 Linear Algebra I
- 21-355 Advanced Calculus 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
- 21-374 Field Theory
- 21-441 Number Theory
- 80-410 Recursion and Hierarchies
- 21-602 Introduction to Set Theory
- 21-603 Introduction to Model Theory
- 21-610 Algebra I
- 21-700 Mathematical Logic II

**Computer Science electives:** (18 units)

Any two courses at the 300 level or above. The following are specifically suggested:

- 15-312 Programming Languages Design and Processing
- 15-451 Algorithms
- 15-453 Formal Languages and Automata
- 15-671 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
- 80-480 Linguistic Theory+

**Other Courses:**

MCS Humanities, Science and Computer Skills Core: (118 units)

Free Electives: (Sufficient to meet minimum requirement of 360 units.)
### Suggested schedule

#### Freshman Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Units</th>
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<tbody>
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<tr>
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<td>Integral Calculus</td>
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<td>Intermediate/Advanced Programming</td>
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<td>76-101</td>
<td>Interpretation and Argument</td>
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<td>99-101</td>
<td>Computing Skills Workshop</td>
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<tr>
<td>21-117</td>
<td>Integration and Differential Equations</td>
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<td>21-118</td>
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<td>09-105</td>
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#### Sophomore Year

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<tr>
<td>15-211</td>
<td>Fundamental Structures of Computer Science I</td>
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<td>21-301</td>
<td>Combinatorial Analysis</td>
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<td>03-121</td>
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<tr>
<td>Spring</td>
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<tr>
<td>15-212</td>
<td>Fundamental Structures of Computer Science II</td>
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#### Junior Year

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#### Senior Year

<table>
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<td>Discrete Math/Logic</td>
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Minimum number of units required for the degree: 360

### Mathematical Sciences: (101 units)

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### Five of the following distribution courses:

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### Other courses: (19 units)

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</thead>
<tbody>
<tr>
<td>15-111</td>
</tr>
<tr>
<td>36-225</td>
</tr>
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</table>

### MCS Humanities, Science and Computer Skills Core: (118 units)

### Free electives: (Sufficient to meet minimum of 360 units.)

### Suggested schedule

#### Freshman Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
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</tr>
<tr>
<td>21-115</td>
<td>Differential Calculus</td>
</tr>
<tr>
<td>21-116</td>
<td>Integral Calculus</td>
</tr>
<tr>
<td>21-117</td>
<td>Integration and Differential Equations</td>
</tr>
<tr>
<td>21-118</td>
<td>Calculus of Approximation</td>
</tr>
<tr>
<td>21-127</td>
<td>Concepts of Mathematics</td>
</tr>
<tr>
<td>21-201</td>
<td>Undergraduate Colloquium</td>
</tr>
<tr>
<td>21-228</td>
<td>Discrete Mathematics (or 21-301 or 21-484)</td>
</tr>
<tr>
<td>21-241</td>
<td>Matrix Algebra</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
</tr>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>21-320</td>
<td>Symbolic Programming Methods</td>
</tr>
<tr>
<td>21-355</td>
<td>Advanced Calculus I</td>
</tr>
<tr>
<td>21-356</td>
<td>Advanced Calculus II (or 21-357)</td>
</tr>
<tr>
<td>21-369</td>
<td>Numerical Methods</td>
</tr>
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</table>

#### Sophomore Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Units</th>
</tr>
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<tr>
<td>Fall</td>
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<tr>
<td>03-121</td>
<td>Modern Biology</td>
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<tr>
<td>21-241</td>
<td>Matrix Algebra</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
</tr>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>21-201</td>
<td>Undergraduate Colloquium</td>
</tr>
<tr>
<td>xx-xx</td>
<td>Humanities Elective</td>
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<tr>
<td>xx-xx</td>
<td>Elective</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>21-228</td>
<td>Discrete Mathematics (or 21-301 or 21-484)</td>
</tr>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>21-201</td>
<td>Undergraduate Colloquium</td>
</tr>
<tr>
<td>xx-xx</td>
<td>Distribution Course</td>
</tr>
<tr>
<td>xx-xx</td>
<td>Humanities Elective</td>
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<tr>
<td>xx-xx</td>
<td>Elective</td>
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<tr>
<td></td>
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</tr>
</tbody>
</table>
Excluded as acceptable electives are the following: 21-105, 21-111, 21-374 Field Theory) will receive a Minor in Mathematical Sciences.

Two recommended electives (typically 21-470 Topics in Analysis and 21-3xx Mathematical Sciences Elective) count toward the minor.

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 Advanced Calculus I is 21-115/116/117/118 or equivalent courses. Students planning to include 21-373 Algebraic Structures in a Mathematical Sciences Elective should choose 21-341 Linear Algebra I. 21-241 and 21-341 cannot both count toward the minor.

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, 21-115, 21-116, 21-117, 21-118, 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 Combinatorial Analysis
- 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 both the B.S. and M.S. in Mathematical Sciences on its successful completion, normally in four years. The key element in the program is the Mathematical Studies sequence. Students enter this concentrated, accelerated sequence in the Fall semester of the Sophomore year by invitation. Completion of Mathematical Studies does not imply automatic admission to the graduate stage of the program. Admission to the second part, the graduate stage, in the Junior year, is by invitation. The Department will, in this invitation, hold to the same high standards which apply to admission to any graduate program. Students who have not taken or completed Mathematical Studies (this includes transfer students), but whose preparation is substantially comparable, may be admitted to the program at this stage.

Each student in the honors degree program will have a thesis advisor in addition to his or her academic advisor. Most important in the Mathematical Studies stage of the program is advice to the student on selecting electives. Not all students will go on to the graduate stage; many students will want to pursue specialized concentrations in mathematical sciences rather than complete the honors program. Therefore, a student majoring in mathematical sciences and enrolled in Mathematical Studies should choose electives in specialized areas not covered in that sequence, e.g., advanced computer science, combinatorial analysis, graph theory, logic, probability and statistics, numerical methods, and operations research, which will permit the student to complete a chosen concentration without delay.

In practice, the student must start thinking about the thesis as early as possible. For this reason we include some thesis work in the seventh semester to allow for exploratory work under supervision.

**Requirements of the Honors Degree Program:**

**Distribution of units**

<table>
<thead>
<tr>
<th>General Requirements:</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>Analysis I &amp; II</td>
<td>20</td>
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<tr>
<td>Physics</td>
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<tr>
<td>Chemistry</td>
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<tr>
<td>Biology</td>
<td>9</td>
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<tr>
<td>H&amp;SS and Fine Arts</td>
<td>72</td>
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<tr>
<td>Computer Skills Workshop</td>
<td>3</td>
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<td><strong>TOTAL:</strong></td>
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<table>
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<tr>
<th>Mathematical Sciences, Statistics, or Computer Science:</th>
<th>Units</th>
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<tr>
<td>Mathematical Studies</td>
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<tr>
<td>Introduction to Computing</td>
<td>10</td>
</tr>
<tr>
<td>Electives</td>
<td>63</td>
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<td>Graduate Courses</td>
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<td>Thesis</td>
<td>18</td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>191</strong></td>
</tr>
</tbody>
</table>

| Free Electives                                        | 72    |
| **TOTAL:**                                            | **401** |

**Double Major Requirements**

All concentrations 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 following courses are required by all of the concentrations:

- 15-100 Introductory/Intermediate Programming (or 15-111)*
- 21-115 Differential Calculus
- 21-116 Integral Calculus
- 21-117 Integration and Differential Equations
- 21-118 Calculus of Approximation
- 21-127 Concepts of Mathematics
- 21-228 Discrete Mathematics (or 21-301 or 21-484)*
- 21-241 Matrix Algebra I (or 21-341)*
- 21-259 Calculus in Three Dimensions*
- 21-260 Differential Equations*
- 21-355 Advanced Calculus I
- 21-3xx Mathematical Sciences Elective*
- 21-3xx Mathematical Sciences Elective*

* Choice of course to be determined by the requirements of the chosen Concentration.

In addition to these courses, each concentration requires certain specifically named courses from Mathematics, Computer Science, or Statistics plus courses designated as Depth Electives, Technical Electives, Mathematical Science Electives, or Mathematics, Statistics, or Computer Science Electives. See the descriptions of the individual concentration for these requirements.

**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 Advanced Calculus I is 21-115/116/117/118 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 I (or 21-341)
21-355 Advanced Calculus I
21-3xx Mathematical Sciences Elective
21-3xx Mathematical Sciences Elective

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,
In the graduate stage, of the five graduate courses, we require at least one course from each of the following areas:

- Analysis, e.g., Measure and Integration, Complex Analysis, Functional Analysis, Introduction to Numerical Analysis I.

Suggested schedule

<table>
<thead>
<tr>
<th>Freshman Year</th>
<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>21-131</td>
<td>Analysis I</td>
<td>10</td>
</tr>
<tr>
<td>33-111</td>
<td>Physics for Science Students I</td>
<td>12</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Intermediate Programming</td>
<td>10</td>
</tr>
<tr>
<td>15-112</td>
<td>Object-Based Programming I</td>
<td>5</td>
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<tr>
<td>03-121</td>
<td>Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument</td>
<td>9</td>
</tr>
<tr>
<td>99-101</td>
<td>Computer Skills Workshop</td>
<td>3</td>
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<thead>
<tr>
<th>Spring</th>
<th>Units</th>
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<tbody>
<tr>
<td>21-132</td>
<td>Analysis II</td>
</tr>
<tr>
<td>33-112</td>
<td>Physics for Science Students II</td>
</tr>
<tr>
<td>09-105</td>
<td>Intro to Modern Chemistry</td>
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<tr>
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<td>H&amp;SS Elective</td>
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<th>Fall</th>
<th>Units</th>
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<tr>
<td>21-235</td>
<td>Mathematical Studies I</td>
<td>20</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Mathematical Sci, Statistics, or Computer Sci Elective</td>
<td>9</td>
</tr>
<tr>
<td>21-201</td>
<td>Undergraduate Colloquium</td>
<td>1</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Elective</td>
<td>9</td>
</tr>
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<td></td>
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<table>
<thead>
<tr>
<th>Spring</th>
<th>Units</th>
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<tbody>
<tr>
<td>21-236</td>
<td>Mathematical Studies II</td>
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<tr>
<td>xx-xxx</td>
<td>Mathematical Sci, Statistics, or Computer Sci Elective</td>
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<tr>
<td>21-201</td>
<td>Undergraduate Colloquium</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Elective</td>
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<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
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<th>Fall</th>
<th>Units</th>
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<tbody>
<tr>
<td>21-356</td>
<td>Advanced Calculus II</td>
<td>9</td>
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<tr>
<td>xx-xxx</td>
<td>Mathematical Sci, Statistics, or Computer Sci Elective</td>
<td>9</td>
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<tr>
<td>21-221</td>
<td>Mathematical Sciences Elective</td>
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<tr>
<td>xx-xxx</td>
<td>Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
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<td></td>
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<th>Spring</th>
<th>Units</th>
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<tbody>
<tr>
<td>xx-xxx</td>
<td>Graduate course in Mathematics</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Graduate course in Mathematics</td>
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<tr>
<td>21-374</td>
<td>Field Theory</td>
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<tr>
<td>xx-xxx</td>
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<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
</tr>
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<th>Fall</th>
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<tr>
<td>xx-xxx</td>
<td>Graduate course in Mathematics</td>
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<tr>
<td>xx-xxx</td>
<td>Graduate course in Mathematics</td>
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</tr>
<tr>
<td>xx-xxx</td>
<td>Thesis seminar</td>
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</tr>
<tr>
<td>21-201</td>
<td>Mathematical Sciences Elective</td>
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<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
<td>9</td>
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<table>
<thead>
<tr>
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<th>Units</th>
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<tr>
<td>xx-xxx</td>
<td>Graduate course in Mathematics</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>Thesis</td>
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<tr>
<td>xx-xxx</td>
<td>Elective</td>
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<tr>
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<td>Elective</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS Elective</td>
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<tr>
<td></td>
<td>54</td>
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</table>

Minimum number of units required for degrees: 401
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 — 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. SMYTH, 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 — Ph.D., Columbia University; Carnegie Mellon, 1959—.

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, Principal Lecturer of Mathematical Sciences; Associate Head, Department of Mathematical Sciences — D.A., Carnegie Mellon University; Carnegie Mellon, 1984—.

NOEL S. WALKINGTON, Associate 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—.
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 which make life possible. The spectacular enlargement 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 also make decisive contributions. The interplay of pure and applied physics has always been fruitful and today ensures many rewarding career opportunities for physics students.

The 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 coursework and problem solving, the curriculum includes the study of 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 readily be 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 which 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 and 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 serves as 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.

<table>
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<th>Requirements</th>
<th>Entities</th>
<th>Units</th>
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<tr>
<td>Physics Courses</td>
<td>33-104 Experimental Physics</td>
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<tr>
<td>or</td>
<td>33-111 Physics I for Science Students</td>
<td>12</td>
</tr>
<tr>
<td>or</td>
<td>33-131 Matter and Interactions I</td>
<td>12</td>
</tr>
<tr>
<td>or</td>
<td>33-112 Physics II for Science Students</td>
<td>12</td>
</tr>
<tr>
<td>or</td>
<td>33-132 Matter and Interactions II</td>
<td>12</td>
</tr>
<tr>
<td>or</td>
<td>33-201, 202, 301, 302, 401, 402 Colloquium I to VI (1 unit each)</td>
<td>6</td>
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<tr>
<td>or</td>
<td>33-211 Physics III: Modern Essentials</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>33-228 Electronics</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>33-231 Physical Analysis</td>
<td>9</td>
</tr>
<tr>
<td>or</td>
<td>33-234 Quantum Physics</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>33-331 Physical Mechanics I</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>33-332 Physical Mechanics II</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>33-340 Modern Physics Laboratory</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>33-341 Thermal Physics I</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>33-338 Intermediate Electricity and Magnetism I</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>33-439 Intermediate Electricity and Magnetism II</td>
<td>10</td>
</tr>
<tr>
<td>Physics Electives</td>
<td>(at least 18 units)</td>
<td>18</td>
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<tr>
<td>Minimum Total Physics Units</td>
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<td>Mathematics Courses</td>
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<td>5</td>
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<tr>
<td>or</td>
<td>21-116 Integral Calculus</td>
<td>5</td>
</tr>
<tr>
<td>or</td>
<td>21-117 Integration and Differential Equations</td>
<td>5</td>
</tr>
<tr>
<td>or</td>
<td>21-118 Calculus of Approximation</td>
<td>5</td>
</tr>
<tr>
<td>or</td>
<td>21-259 Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>or</td>
<td>21-260 Differential Equations</td>
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<tr>
<td>Mathematics Elective</td>
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<td>may be 33-345 Mathematical Methods of Physics</td>
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<tr>
<td>Total Mathematics Units</td>
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<tr>
<td>Mellon College of Science Core</td>
<td>03-121 Modern Biology</td>
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</tr>
<tr>
<td>or</td>
<td>09-105 Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>or</td>
<td>15-100 Introductory/Intermediate Programming</td>
<td>10</td>
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<tr>
<td>or</td>
<td>99-101 Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>Total MCS Core</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>Humanities, Social Sciences, or Fine Arts Courses</td>
<td></td>
<td>72</td>
</tr>
<tr>
<td>Technical Electives</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>Free electives</td>
<td></td>
<td>26</td>
</tr>
</tbody>
</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&SS/FA units count towards free elective units.
5. 21-115 and 21-116 are sequential half-semester mini-courses that are equivalent to a traditional first semester calculus course.
6. 21-117 and 21-118 are sequential half-semester mini-courses that are equivalent to a traditional second semester calculus course.
7. The MCS core courses may be taken in any order, but must be finished by the end of the junior year.
8. Humanities, Social Sciences and Fine Arts (H&SS/FA) requirements follow the Mellon College of Science guidelines.
9. Technical electives are any courses in MCS, SCS, Statistics, and CIT.
10. 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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-350</td>
<td>Undergraduate Research(1)</td>
<td>Var.</td>
</tr>
<tr>
<td>33-451</td>
<td>Senior Research(2)</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(2)</td>
<td>Var.</td>
</tr>
</tbody>
</table>

Fall Only

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<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>33-345</td>
<td>Mathematical Methods of Physics</td>
<td>9</td>
</tr>
<tr>
<td>33-441/03-343</td>
<td>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>33-448</td>
<td>Introduction to Solid State Physics</td>
<td>9</td>
</tr>
<tr>
<td>33-453</td>
<td>Intermediate Optics</td>
<td>12</td>
</tr>
<tr>
<td>33-467</td>
<td>Astrophysics of Stars and the Galaxy</td>
<td>9</td>
</tr>
</tbody>
</table>

Spring Only

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>33-114</td>
<td>Physics of Musical Sound(1)</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>
</tr>
<tr>
<td>33-448</td>
<td>Introduction to Solid State Physics</td>
<td>9</td>
</tr>
<tr>
<td>33-466</td>
<td>Extragalactic Astrophysics and Cosmology</td>
<td>9</td>
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</table>

Fall Only (Alternate Years)

<table>
<thead>
<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</td>
<td>9</td>
</tr>
<tr>
<td>33-456</td>
<td>Advanced Computational Physics (2003, 2005)</td>
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Graduate Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</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>33-759</td>
<td>Introduction to Theoretical Physics</td>
<td>12</td>
</tr>
<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>
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<tr>
<td>33-765</td>
<td>Statistical Mechanics</td>
<td>12</td>
</tr>
<tr>
<td>33-777</td>
<td>Introductory Astrophysics</td>
<td>12</td>
</tr>
<tr>
<td>33-779</td>
<td>Introduction to Nuclear and Particle Physics</td>
<td>12</td>
</tr>
<tr>
<td>33-783</td>
<td>Theory of Solids I</td>
<td>12</td>
</tr>
</tbody>
</table>

Notes

(1) For 33-114 to be a qualifying elective, needs prior approval from the Department.

(2) 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.

B.S. in Physics – Sample Schedule

First Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-111</td>
<td>Physics for Science Students I</td>
<td>12</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33-131</td>
<td>Matter and Interactions I</td>
<td>12</td>
</tr>
<tr>
<td>15-100</td>
<td>Introductory/Programming</td>
<td>10</td>
</tr>
<tr>
<td>21-115</td>
<td>Differential Calculus</td>
<td>5</td>
</tr>
<tr>
<td>21-166</td>
<td>Integral Calculus</td>
<td>5</td>
</tr>
<tr>
<td>98-101</td>
<td>Computing Skills Workshop</td>
<td>3</td>
</tr>
<tr>
<td>76-101</td>
<td>Interpretation and Argument (MCS Core 1 of 8)</td>
<td>9</td>
</tr>
</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>33-112</td>
<td>Physics for Science Students II</td>
<td>12</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33-132</td>
<td>Matter and Interactions II</td>
<td>12</td>
</tr>
<tr>
<td>33-104</td>
<td>Experimental Physics</td>
<td>9</td>
</tr>
<tr>
<td>21-177</td>
<td>Integration and Differential Equations</td>
<td>5</td>
</tr>
<tr>
<td>21-118</td>
<td>Calculus of Approximation</td>
<td>5</td>
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<tr>
<td>xx-xxx</td>
<td>Mathematics Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS/FA Course (MCS Core 2 of 8)</td>
<td>9</td>
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</tbody>
</table>

Sophomore Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>33-211</td>
<td>Physics III: Modern Essentials</td>
<td>10</td>
</tr>
<tr>
<td>33-231</td>
<td>Physical Analysis</td>
<td>9</td>
</tr>
<tr>
<td>21-260</td>
<td>Differential Equations</td>
<td>9</td>
</tr>
<tr>
<td>33-201</td>
<td>Undergraduate Colloquium I</td>
<td>1</td>
</tr>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>xx-xxx</td>
<td>H&amp;SS/FA Course (MCS Core 3 of 8)</td>
<td>9</td>
</tr>
</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 mathematics elective are required
- No units of technical electives 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 which 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
- 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 topic in the research course must be in Applied Physics, 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:**
- 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 / Astrophysics Track**
The B.S. in Physics/Astrophysics 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 readily be adapted to the requirements of individual students. To that end, the student will first meet with the Track Advisor to discuss interests and career goals and to choose electives which fulfill the requirements of the track.

The Biological Physics Track incorporates 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 both with 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
- Only 9 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 / 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 school in physics with an emphasis on chemical physics or chemistry. The program is sufficiently flexible that it can readily be adapted to the requirements of individual students. To that end, the student will first meet with the Track Advisor to discuss interests and career goals and to choose electives which 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 both with their 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.
The minimum number of units required for this degree is 360.

- Only 20 units of Free Electives are required
- No units of Technical Electives are required
- No units of Mathematics Electives are required
- No units of Physics Electives are required
  - 15-212 Principles of Programming
  - 15-211 Fundamental Data Structures and Algorithms
  - 21-369 Numerical Methods
  - 21-127 Concepts of Mathematics
  - 33-456 Advanced Computational Physics
  - 15-100 is required.

Additions to the requirements listed for the B.S. in Physics:

- 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&SS/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 in which the student will become familiar with a sample of the many modern areas of physics, and the concepts and techniques employed therein. The sequence consists of two introductory level courses followed by five electives chosen from the below list. 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 (21-115, 116, 117, 118, 259, 260).

**Required Courses**

I. Introductory Physics I

Choose one course:

- 33-106 Physics for Engineering Students I
- 33-111 Physics for Science Students I
- 33-131 Matter and Interactions I

II. Introductory Physics II

Choose one course:

- 33-107 Physics for Engineering Students II
- 33-112 Physics for Science Students II
- 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
- 33-234 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
- 33-340 Modern Physics Laboratory
- 33-341 Thermal Physics I
- 33-342 Thermal Physics II
- 33-345 Mathematical Methods of Physics
- 33-350 Undergraduate Research
- 33-439 Intermediate Electricity and Magnetism II
- 33-444 Introduction to Nuclear & 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
- 33-453 Intermediate Optics
- 33-456 Advanced Computational Physics
- 33-458 Special Problems in Computational Physics
- 33-466 Astrophysics of Stars and the Galaxy
- 33-467 Extragalactic Astrophysics and Cosmology
- 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. BRERE, 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—.

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, 1985—.

ROBERT H. SWENDSEN, Professor of Physics, — Ph.D., University of Pennsylvania; Carnegie Mellon, 1969—.

STEPHEN GAROFF, Professor of Physics — Ph.D., Harvard University; Carnegie Mellon, 1969—.

REINHARD A. SCHUMACHER, Professor of Physics — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1967—.

ROBERT F. SEKERKA, University Professor of Physics and Mathematics — Ph.D., Stanford University; Carnegie Mellon, 1964—.

JAMES S. RUSS, Professor of Physics — Ph.D., Princeton University; Carnegie Mellon, 1995—.

STEPHANIE TRISTRAM-NAGLE, Senior Research Biologist — Ph.D., University of California, Berkeley; Carnegie Mellon, 1982—.

HUGH D. YOUNG, Professor of Physics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1956—.

ROBERT B. GRIFFITHS, University Professor & Otto Stern Professor of Physics — Ph.D., Stanford University; Carnegie Mellon, 1964—.

ROYER CROFT, Assistant Professor of Physics — Ph.D., Oxford University; Carnegie Mellon, 2001—.

NED S. VANDER VEN, Professor Emeritus of Physics — Ph.D., Princeton University; Carnegie Mellon, 1948—.

RICHARD E. GRIFFITHS, Professor of Physics — Ph.D., University of Leicester, U.K.; Carnegie Mellon, 1996—.

HUGH D. YOUNG, Professor of Physics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1985—.

MICHAEL J. LEVINE, Professor of Physics — Ph.D., California Institute of Technology; Carnegie Mellon, 1968—.

ROBERT W. KRA EMER, Professor of Physics — Ph.D., Johns Hopkins University; Carnegie Mellon, 1965—.

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 Chicago; Carnegie Mellon, 1995—.

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—.

ROBERT C. NICHOL, Assistant Professor of Physics — Ph.D., University of Edinburgh, Scotland; Carnegie Mellon, 1996—.

MORTON KAPLAN, Professor, Chemistry — Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1970—.

MANfred PAULINI, Associate Professor of Physics — Ph.D., University of Erlangen, Germany; Carnegie Mellon, 2000—.

RAYMOND A. SORENSEN, Professor Emeritus of Physics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1993—.

KUNAL GHOSH, Principal Lecturer, Assistant Head for Undergraduate Affairs, Department of Physics — Ph.D., Princeton University; Carnegie Mellon, 1999—.

JEFFREY B. PETERSON, Associate Professor of Physics — Ph.D., University of California San Diego; Carnegie Mellon, 1997—.

WHITE, Director, Data Storage Systems Center, Electrical and Computer Engineering — Ph.D., Lehigh University; Carnegie Mellon, 1993—.

JOHN F. NAGLE, Professor of Physics and Biological Sciences — Ph.D., Yale University; Carnegie Mellon, 1967—.

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—.

MANfred PAULINI, Associate Professor of Physics — Ph.D., University of Erlangen, Germany; Carnegie Mellon, 2000—.

ROBERT T. SCHUMACHER, Professor Emeritus of Physics — Ph.D., University of Illinois; Carnegie Mellon, 1957—.

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—.

SIMEON A. FRIEDBERG, Professor Emeritus of Physics — D.Sc., Carnegie Institute of Technology; Carnegie Mellon, 1953—.

JOHN G. METKOVICH, Professor Emeritus of Physics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1959—.

Jian-Gang ZHOU, Professor of Electrical and Computer Engineering — Ph.D., University of Chicago; Carnegie Mellon, 1997—.

JOHN A. RAYNE, Professor Emeritus of Physics — Ph.D., University of Chicago; Carnegie Mellon, 1963—.

RAYMOND A. SORENSEN, Professor Emeritus of Physics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1961—.

JOHN A. RAYNE, Professor Emeritus of Physics — Ph.D., University of Chicago; Carnegie Mellon, 1963—.

SIMEON A. FRIEDBERG, Professor Emeritus of Physics — D.Sc., Carnegie Institute of Technology; Carnegie Mellon, 1953—.

NED S. VANDER VEN, 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—.

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. METKOVICH, 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—.

JOHN A. RAYNE, Professor Emeritus of Physics — Ph.D., University of Chicago; Carnegie Mellon, 1963—.

ROBERT T. SCHUMACHER, Professor Emeritus of Physics — Ph.D., University of Illinois; Carnegie Mellon, 1957—.

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. METKOVICH, Professor Emeritus of Physics — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1959—.

JOHN A. RAYNE, Professor Emeritus of Physics — Ph.D., University of Chicago; Carnegie Mellon, 1963—.

Joint Appointments and Courtesy Appointments
School of Computer Science

James Morris, Dean
Peter Lee, Associate Dean for Undergraduate Education
Mark Stehlik, Assistant Dean for Undergraduate Education
Undergraduate Office: Wean 5101
http://www.csd.cs.cmu.edu/bscs

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 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. Suitably 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. Additionally, a double major in Human-Computer Interaction is available through the College of Humanities & Social Sciences.

Curriculum — B.S. in Computer Science

**Computer Science**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-111</td>
<td>Intermediate/Advanced Programming (students with no prior programming experience take 15-100 &amp; 15-200)</td>
</tr>
<tr>
<td>15-113</td>
<td>Systems Skills in C (mini)</td>
</tr>
<tr>
<td>15-128</td>
<td>Freshman Immigration Course</td>
</tr>
<tr>
<td>15-211</td>
<td>Fundamental Data Structures and Algorithms</td>
</tr>
<tr>
<td>15-212</td>
<td>Principles of Programming</td>
</tr>
<tr>
<td>15-213</td>
<td>Introduction to Computer Systems</td>
</tr>
<tr>
<td>15-251</td>
<td>Great Theoretical Ideas in Computer Science I</td>
</tr>
<tr>
<td>15-451</td>
<td>Algorithm Design and Analysis</td>
</tr>
</tbody>
</table>

**Applications course:**

- 15-381 Artificial Intelligence: Representation & Problem Solving
- 15-384 Robotic Manipulation
- 15-385 Computer Vision
- 15-415 Database Applications
- 16-362 Mobile Robot Programming Laboratory
- xx-xxx Others as appropriate

**Fundamentals of Algorithms course:**

- 15-351 Great Theoretical Ideas in Computer Science II
- 15-354 Computational Discrete Mathematics
- 15-355 Computational Algebra
- 21-301 Combinatorial Analysis
- 21-373 Algebraic Structures
- 21-484 Graph Theory
- xx-xxx Others as appropriate

**Fundamentals of Programming course:**

- 15-312 Foundations of Programming Languages
- 15-453 Formal Languages and Automata
- 17-851 Models of Software Systems
- 21-300 Basic Logic
- 80-310 Logic and Computation
- 80-311 Computability and Incompleteness
- xx-xxx Others as appropriate

**Systems Programming course:**

- 15-412 Operating System Design and Implementation
- xx-xxx Others as appropriate

**Two Computer Science electives**

**Mathematics/Statistics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-115</td>
<td>Differential Calculus (mini)</td>
</tr>
<tr>
<td>21-116</td>
<td>Integral Calculus (mini)</td>
</tr>
<tr>
<td>21-117</td>
<td>Integration and Differential Equations (mini)</td>
</tr>
<tr>
<td>21-118</td>
<td>Calculus of Approximation (mini)</td>
</tr>
<tr>
<td>21-127</td>
<td>Concepts of Mathematics</td>
</tr>
<tr>
<td>21-241</td>
<td>Matrix Algebra (or 21-341, Linear Algebra)</td>
</tr>
<tr>
<td>21-251</td>
<td>Matrix Algebra (or 21-341, Linear Algebra)</td>
</tr>
</tbody>
</table>

**Probability courses:**

- 36-217 Probability Theory and Random Processes
- 36-325 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 33-111, Physics for Science Students I)
- 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
- 33-115 Energy and Environmental Issues
- 33-117 Discovery of the Physical Universe
- 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. These general education courses for SCS students are to meet the following distribution requirements:

**A. Writing Requirement (9 units)**

Complete the following:

- 76-101 Interpretation and Argument
B. Breadth Requirement (27 units)

Complete three courses, one each from Category 1, Category 2, and Category 3:

**Category 1: Cognition, Choice and Behavior**
- 80-150 Nature of Reason
- 80-180 Nature of Language
- 80-181 Language and Thought
- 80-242 Conflict, Dispute Resolution
- 85-100 Introduction to Intelligence
- 85-102 Introduction to Psychology
- 85-211 Cognitive Psychology
- 85-221 Principles of Child Development
- 85-241 Social Psychology
- 85-251 Personality
- 88-120 Reason, Passion, and Cognition

**Category 2: Economic, Political and Social Institutions**
- 36-203 Sampling, Surveys, and Society
- 73-100 Principles of Economics
- 73/88-110 Experiments with Economic Principles
- 79-266 Time of Feasts/Famine: Population and Family in History
- 80-135 Introduction to Political Philosophy
- 80-136 Social Structure, Public Policy & Ethical Dilemmas
- 88-104 Decision Processes in American Political Institutions
- 88-105 Introduction to World Politics

**Category 3: Cultural Analysis**
- 76-201 Literature and the Social
- 76-227 Comedy
- 79-104 Introduction to World History
- 79-110 The Development of European Culture
- 79-112 Race, Nationality and the Development of American Cultures
- 79-113 Culture and Identity in American Society
- 79-201 Introduction to Anthropology
- 79-206 Development of American Culture
- 79-368 Poverty, Charity, and Welfare
- 80-100 What Philosophy Is
- 80-182 Language and Culture
- 82-304 Francophone World
- 82-396 The Faust Legend
- 82-415/416 Studies in French Literature
- 82-427 The New Germany
- 82-428 German Classical Literature
- 82-429 German Literature of the 19th Century
- 82-430 German Literature of the Early 20th Century
- 82-436 Studies in German Literature
- 82-451 Introduction to Latin American Literature and Culture
- 82-452 The Latin American Fin De Siglo
- 82-454 Floating Continents/Whispering Voices
- 82-456/456 Studies in Spanish and Latin American Literature
- 82-491 Literature, Politics and Film in Russia and East Europe Today
- 82-492 The Historical Imagination in 19th Century Russian Literature

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 http://www.cs.cmu.edu/csd/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 be 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>4 minis + 3</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>
</tbody>
</table>

**Minimum number of units required for the degree: 360**

**Suggested Course Sequence:**

**Freshman Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-111 Intermediate/Advanced Programming</td>
<td>10</td>
</tr>
<tr>
<td>15-128 Freshman Immigration Course</td>
<td>1</td>
</tr>
<tr>
<td>21-115 Differential Calculus (mini)</td>
<td>5</td>
</tr>
<tr>
<td>21-116 Integral Calculus (mini)</td>
<td>5</td>
</tr>
<tr>
<td>21-127 Concepts of Mathematics</td>
<td>9</td>
</tr>
<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-xx-xx Science/Engineering Course</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15-211 Fundamental Data Structures and Algorithms</td>
<td>12</td>
</tr>
<tr>
<td>15-251 Great Theoretical Ideas in Computer Science</td>
<td>12</td>
</tr>
<tr>
<td>21-117 Integration and Differential Equations (mini)</td>
<td>5</td>
</tr>
<tr>
<td>21-118 Calculus of Approximation (mini)</td>
<td>5</td>
</tr>
<tr>
<td>xx-xx-xx Science/Engineering Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Humanities and Arts Elective</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sophomore Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Units</td>
</tr>
<tr>
<td>15-113 Systems Skills in C</td>
<td>5</td>
</tr>
<tr>
<td>15-212 Principles of Programming</td>
<td></td>
</tr>
<tr>
<td>36-217 Probability Theory and Random Processes</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Science/Engineering Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Humanities and Arts Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Minor Requirement / Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>15-213 Introduction to Computer Systems</td>
<td>12</td>
</tr>
<tr>
<td>15-xx-xx Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>21-241 Matrix Algebra</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Science/Engineering Course</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Humanities and Arts Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Minor Requirement / Free Elective</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>46</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Junior Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Units</td>
</tr>
<tr>
<td>15-451 Algorithm Design and Analysis</td>
<td>9</td>
</tr>
<tr>
<td>15-xx-xx Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Humanities and Arts Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Minor Requirement / Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Minor Requirement / Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>15-xx-xx Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Humanities and Arts Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Minor Requirement / Free Elective</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Senior Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Units</td>
</tr>
<tr>
<td>15-xx-xx Computer Science Elective</td>
<td>12</td>
</tr>
<tr>
<td>xx-xx-xx Humanities and Arts Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Minor Requirement / Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Minor Requirement / Free Elective</td>
<td>9</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>15-xx-xx Computer Science Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Humanities and Arts Elective</td>
<td>9</td>
</tr>
<tr>
<td>xx-xx-xx Minor Requirement / Free Elective</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>39</td>
</tr>
</tbody>
</table>

**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 Machine Learning
80-300 Minds, Machines, and Knowledge
85-211 Cognitive Psychology
85-213 Human Information Processing and Artificial Intelligence
85-419 Introduction to Parallel Distributed Processing
Cognitive Modeling
15-199 Special Topics – Modeling of Agents in Video Games
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
15-411 Compiler Design
15-412 Operating System Design and Implementation
15-441 Computer Networks
18-347 Introduction to Computer Architecture
19-345 Advanced Digital Design Project
36-410 Introduction to Probability Modeling

Entrepreneurship
15-391 Technology Consulting in the Community
70-414 Technology-Based Entrepreneurship

Graphics/Virtual Reality
05-331 Building Virtual Worlds
15-462 Computer Graphics
15-49x Special Topics – Computer Graphics
15-86x Graduate Graphics course

Human-Computer Interaction
05-610 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 84 of the Undergraduate Catalog.

Language Technologies
80-180 Nature of Language
11-682 Introduction to IR, NLP, MT, and Speech
11-731 Machine Translation
11-741 Information Retrieval
11-751 Speech Recognition

Additionally, students who are interested in Language Technologies are encouraged to look at the description of the Minor in Linguistics on page 201 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 93 of the Undergraduate Catalog.

Scientific Computation
21-259 Calculus in Three Dimensions
21-260 Differential Equations
21-320 Symbolic Programming Methods
21-355 Advanced Calculus I
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 272 in the Undergraduate Catalog as well as the following discipline-specific Computational Science courses:

03-510 Computational Biology
09-560 Computational Chemistry
33-241 Introduction to Computational Physics

Software Systems
15-312 Foundations of Programming Languages
15-411 Compiler Design
15-412 Operating System Design and Implementation
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
21-373 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 I (students with no prior programming experience take 15-100 & 15-200)
15-113 System Skills in C (mini)
21-127 Concepts of Mathematics
21-228 Discrete 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
15-451 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
15-462 Computer Graphics
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
15-355 Computational Algebra
21-201 Combinatorial Analysis
21-237 Algebraic Structures
21-484 Graph Theory

one Fundamentals of Programming course:
15-312 Fundamentals of Programming Languages
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:
15-412 Operating System Design and Implementation
15-441 Computer Networks

two Computer Science electives
one of the following Probability courses:
36-217 Probability Theory and Random Processes
36-325 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:
  - 15-411 Compiler Design
  - 15-412 Operating System Design and Implementation
  - 15-415 Database Applications
  - 15-441 Computer Networks
  - 16-362 Mobile Robot Programming Laboratory

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 46 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.

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

VINCENT ALEVEN, Systems Scientist – Ph.D., University of Pittsburgh; Carnegie Mellon, 1997–.

ANASTASSIA AILAMAKI, Assistant Professor – Ph.D., University of Wisconsin; Carnegie Mellon, 2001–.

OMEAD AMIDI, Senior Systems Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1996–.

JOHN ANDERSON, Walter VanDyke Bingham Professor – Ph.D., Stanford University; Carnegie Mellon, 1978–.

DIMITRIOS APOSTOLOPOULOS, Systems Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1998–.

CHRISTOPHER ATKESON, Associate Professor – Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 2000–.

SIMON BAKER, Research Scientist – Ph.D., Columbia University; Carnegie Mellon, 2000–.

HANS BERLINER, Principal Research Computer Scientist, 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, Associate 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–.

RANDAL BRYANT, President’s Professor, Head, Computer Science Department – Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1984–.

YANG CAI, Research Scientist – Ph.D., West Virginia University; Carnegie Mellon, 2001–.

JAMIE CALLAN, Associate Professor – Ph.D., University of Massachusetts; Carnegie Mellon, 1999–.

JAMIE 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, Senior Lecturer – M.S., Carnegie Mellon University; Carnegie Mellon, 1998–.

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–.

ROBERT COLLINS, Research Scientist – 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, Research Scientist – Ph.D., University of Oregon; Carnegie Mellon, 1999–.

KARL CRARY, Assistant Professor – Ph.D., Cornell University; Carnegie Mellon, 1998–.

STEVE CROSS, Senior Research Scientist – Ph.D., University of Illinois; Carnegie Mellon, 1994–.

ROGER DANNENBERG, Senior Research Computer Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1982–.

MARK DERTHICK, Research Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000–.

ANTHONY DIGIOIA, Senior Research Scientist – M.D., Harvard Medical School; Carnegie Mellon, 1999–.

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WILLIAM EDDY, Professor – Ph.D., Yale University; Carnegie Mellon, 1976–.

MICHAEL ERMANN, Professor – Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1989–.

MAXINE ESKENAZI, Systems Scientist – Ph.D., University of Paris; Carnegie Mellon, 1995–.

MICHAEL EVANGELIST, Professor of the Practice – Ph.D., Northwestern University; Carnegie Mellon, 2001–.

SCOTT FAHLMAN, Principal Research Computer Scientist – Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1978–.

CHRISTOS FALOUTSOS, Professor – Ph.D., University of Toronto; Carnegie Mellon, 1998–.

GARY FEDDER, Associate Professor – Ph.D., University of California at Berkeley; Carnegie Mellon, 1994–.

STEPHEN FIENBERG, Maurice Falk University Professor – Ph.D., Harvard University; Carnegie Mellon, 1980–.

JODI FORLIZZI, Assistant Professor – M.Des., Carnegie Mellon University; Carnegie Mellon, 2000–.

ROBERT FREDERICK, 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., Carnegie Mellon University; Carnegie Mellon, 1997–.

DAVID GARLAN, Associate 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–.

SETH COPEN GOLDSTEIN, Assistant Professor – Ph.D., University of California, Berkeley; Carnegie Mellon, 1997–.

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GEOFFREY GORDON, Research Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 2001–.

ANANDA GUNAWARDENA, Senior Lecturer – Ph.D., Ohio University; Carnegie Mellon, 1998–.

MOR HARCHOL-BALTER, Assistant Professor – Ph.D., University of California, Berkeley; Carnegie Mellon, 1999–.

ROBERT HARPER, Professor – Ph.D., Cornell University; Carnegie Mellon, 1998–.

ALEXANDER HAUPTMANN, Senior Systems Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1994–.

MARTIAL HEBERT, Professor – Ph.D., Paris–XI; Carnegie Mellon, 1985–.

PAUL HECKBERT, Associate Professor – Ph.D., University of California, Berkeley; Carnegie Mellon, 1992–.

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TIMOTHY HOFFMAN, Lecturer – M.S., University of Pittsburgh; Carnegie Mellon, 2000–.

RALPH HOLLIS, Principal Research Scientist – Ph.D., University of Colorado; Carnegie Mellon, 1993–.

SCOTT HUDSON, Associate Professor – Ph.D., University of Colorado; Carnegie Mellon, 1997–.

ELAINE HYDER, Systems Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1998–.

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BRANISLAV JARAMAZ, Research Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1999–.

PAMELA JENNINGS, Assistant Professor – Ph.D., University of Wales; Carnegie Mellon, 2001–.

BONNIE JOHN, Associate Professor – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1989–.

ANGEL JORDAN, Keithley University Professor, Emeritus – Ph.D., Stanford University; Carnegie Mellon, 1985–.

TAKEO KANADE, U.A. and Helen Whitaker University Professor – Ph.D., Kyoto University; Carnegie Mellon, 1980–.

ALONZO KELLY, Research Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1998–.

GREGORY KESDEN, Lecturer – M.S., Clemson; Carnegie Mellon, 1999–.

PRADEEP KHOSLA, Philip and Marsha Dowd Professor; Head, Department of Electrical and Computer Engineering – Ph.D. Carnegie Mellon University; Carnegie Mellon, 1986–.
JAMES KUFFNER, Research Scientist – Ph.D., Stanford University; Carnegie Mellon, 2002–.

SARA KIESLER, Professor – Ph.D., Ohio State University; Carnegie Mellon, 1999–.

ROBERTA KLATZKY, Professor, Head, Department of Psychology – Ph.D., Stanford University; Carnegie Mellon, 1993–.


ROBERT KRAUT, Herbert A. Simon Professor – Ph.D., Yale University; Carnegie Mellon, 1993–.

JOHN LAFFERTY, Associate Professor – Ph.D., Princeton University; Carnegie Mellon, 1994–.

ANTHONY J. LATTANZE, Senior Lecturer – M.S., Carnegie Mellon University; Carnegie Mellon, 1999–.

ALON LAVIE, Research Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1995–.

CHRISTIAN LEBIERE, Research Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000–.

PETER LEE, Professor; Associate Dean, Undergraduate Education – Ph.D., University of Michigan; Carnegie Mellon, 1987–.

TAI SING LEE, Associate Professor – Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1996–.

LORI LEVIN, Senior Research Scientist – Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1986–.

MICHAEL LEWICKI, Assistant Professor – Ph.D., California Institute of Technology; Carnegie Mellon, 1999–.

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BRUCE MAGGS, Associate Professor – Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1994–.


MATTHEW MASON, Professor – Ph.D., Massachusetts Institute of Technology; Carnegie Mellon, 1982–.

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GARY MILLER, Professor – Ph.D., University of California, Berkeley; Carnegie Mellon, 1988–.

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TOM MITCHELL, Fredkin Professor, Director, Center for Automated Learning and Discovery– Ph.D., Stanford University; Carnegie Mellon, 1986–.

ALAN MONTGOMERY, Associate Professor – Ph.D., University of Chicago; Carnegie Mellon, 1999–.

ANDREW MOORE, A. Nico Habermann Associate Professor – Ph.D., University of Cambridge; Carnegie Mellon, 1993–.

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JACK MOSTOW, Principal Research Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1993–.

TODD MOWRY, Associate Professor – Ph.D. Stanford University; Carnegie Mellon, 1997–.

ROBERT MURPHY, Associate Professor – Ph.D., California Institute of Technology; Carnegie Mellon, 1983–.

BRAD MYERS, Principal Research Scientist – Ph.D., University of Toronto, 1987; Carnegie Mellon, 1987–.

DAVID NAGLE, Senior Research Computer Scientist – Ph.D., University of Michigan; Carnegie Mellon, 1995–.

PRIYA NARASIMHAN, Assistant Professor – Ph.D., University of California, Santa Barbara; Carnegie Mellon, 2001–.

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TOBUN DORBIN NG, Systems Scientist – Ph.D., University of Arizona; Carnegie Mellon, 1999–.

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ANDREAS NOWATZKY, Associate Professor – Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000–.

ERIC NYBERG, Associate Professor – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1989–.

DAVID O’HALLARON, Associate Professor – Ph.D., University of Virginia; Carnegie Mellon, 1989–.

IRVING OPPENHEIM, Professor – Ph.D., Cambridge University; Carnegie Mellon, 1972.

RICHARD PATTIS, Senior Lecturer – M.S. Stanford University; Carnegie Mellon, 1997–.

RANDY PAUSCH, Professor, Co–Director, Entertainment Technology Center – Ph.D., Carnegie Mellon University, 1988; Carnegie Mellon, 1997–.

FRANK PFENNING, Professor – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1986–.

RAJ REDDY, Herbert A. Simon University Professor – Ph.D., Stanford University; Carnegie Mellon, 1969–.

MICHAEL REITER, Professor – Ph.D. Cornell University; Carnegie Mellon, 2001–.

JOHN REYNOLDS, Professor – Ph.D., Harvard University; Carnegie Mellon, 1988–.

CABERON RIVIERE, Systems Scientist – Ph.D., Johns Hopkins; Carnegie Mellon, 1999–.

ALFRED RIZZI, Research Scientist – Ph.D., Yale University; Carnegie Mellon, 1998–.

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RONI ROSENFELD, Associate Professor – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1995–.

STEVE ROTH, Senior Research Scientist – Ph.D., University of Pittsburgh; Carnegie Mellon, 1985–.

STEVEN RUDICH, Professor – Ph.D., University of California, Berkeley; Carnegie Mellon, 1989–.

ALEXANDER RUDNICKY, Senior Systems Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1980–.

NORMAN SADH, Associate Professor – Ph.D., Carnegie Mellon University; Carnegie Mellon, 2001–.

TUOMAS SANDHOLM, Associate Professor – Ph.D., University of Massachusetts, Amherst; Carnegie Mellon, 2001–.

MAHDEV SATYANARAYANAN, Carnegie Group Professor – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1983–.

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, Principal Research Scientist – Ph.D., Stanford University; Carnegie Mellon, 1989–.

JEFF SCHNEIDER, Research Scientist – Ph.D., University of Rochester; Carnegie Mellon, 1969–.

HENRY SCHNEIDERMAN, Research Scientist – Ph.D., Carnegie Mellon University; Carnegie Mellon, 2000–.

TANYA SCHULTZ, Research Scientist – Ph.D., University of Karlsruhe; Carnegie Mellon, 2000–.

DANA SCOTT, Hillman University Professor – Ph.D., Princeton University; Carnegie Mellon, 1981–.

STEVEN SEITZ, 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., Yale University; Carnegie Mellon, 1998–.

MARY SHAW, Alan Perlis Professor – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1971–.
## Course Descriptions

<table>
<thead>
<tr>
<th>Department</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sciences (03-xxx)</td>
<td>310</td>
</tr>
<tr>
<td>Chemical Engineering (06-xxx)</td>
<td>312</td>
</tr>
<tr>
<td>Chemistry (09-xxx)</td>
<td>314</td>
</tr>
<tr>
<td>Civil and Environmental Engineering (12-xxx)</td>
<td>317</td>
</tr>
<tr>
<td>Computer Science (15-xxx)</td>
<td>319</td>
</tr>
<tr>
<td>Robotics (16-xxx)</td>
<td>321</td>
</tr>
<tr>
<td>Electrical and Computer Engineering (18-xxx)</td>
<td>321</td>
</tr>
<tr>
<td>Engineering and Public Policy (19-xxx)</td>
<td>325</td>
</tr>
<tr>
<td>Mathematical Sciences (21-xxx)</td>
<td>326</td>
</tr>
<tr>
<td>Mechanical Engineering (24-xxx)</td>
<td>330</td>
</tr>
<tr>
<td>Materials Science and Engineering (27-xxx)</td>
<td>332</td>
</tr>
<tr>
<td>Military Science - Army ROTC (30-xxx)</td>
<td>334</td>
</tr>
<tr>
<td>Aerospace Studies - Air Force ROTC (31-xxx)</td>
<td>335</td>
</tr>
<tr>
<td>Naval Science - Navy ROTC (32-xxx)</td>
<td>336</td>
</tr>
<tr>
<td>Physics (33-xxx)</td>
<td>336</td>
</tr>
<tr>
<td>Statistics (36-xxx)</td>
<td>340</td>
</tr>
<tr>
<td>MCS Interdisciplinary (38-xxx)</td>
<td>341</td>
</tr>
<tr>
<td>Carnegie Institute of Technology Interdisciplinary (39-xxx)</td>
<td>341</td>
</tr>
<tr>
<td>Biomedical Engineering (42-xxx)</td>
<td>341</td>
</tr>
<tr>
<td>Architecture (48-xxx)</td>
<td>342</td>
</tr>
<tr>
<td>Design (51-xxx)</td>
<td>346</td>
</tr>
<tr>
<td>Drama (54-xxx)</td>
<td>350</td>
</tr>
<tr>
<td>Music (57-xxx)</td>
<td>359</td>
</tr>
<tr>
<td>Art (60-xxx)</td>
<td>365</td>
</tr>
<tr>
<td>College of Fine Arts Interdisciplinary (62-xxx)</td>
<td>368</td>
</tr>
<tr>
<td>H&amp;SS Interdisciplinary (66-xxx)</td>
<td>369</td>
</tr>
<tr>
<td>Physical Education (69-xxx)</td>
<td>371</td>
</tr>
<tr>
<td>Business Administration (70-xxx)</td>
<td>372</td>
</tr>
<tr>
<td>Economics (73-xxx)</td>
<td>376</td>
</tr>
<tr>
<td>English (76-xxx)</td>
<td>378</td>
</tr>
<tr>
<td>History (79-xxx)</td>
<td>385</td>
</tr>
<tr>
<td>Philosophy (80-xxx)</td>
<td>394</td>
</tr>
<tr>
<td>Modern Languages (82-xxx)</td>
<td>402</td>
</tr>
<tr>
<td>Psychology (85-xxx)</td>
<td>411</td>
</tr>
<tr>
<td>Social and Decision Sciences (88-xxx)</td>
<td>419</td>
</tr>
</tbody>
</table>
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 and Blood Substitutes, and Prions-Mad Cows and Englishmen.

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 will provide an integrated overview of organismic botany, including historical perspectives. It surveys the organization of the plant kingdom above the cellular level, focusing particularly on the vascular plants, both fossil and extant. Emphasis is on major morphological, developmental and evolutionary patterns, and their interrelationships to the environment. On a sub-disciplinary basis, the course will include introductions to the basic principles of anatomy, morphology, ontogeny, speciation and macroevolution, phytogeography, ecology, and systematics. Prerequisites: 03-121

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. Co-requisites: 03-121. Special permission required.

03-125 Evolution and History of Life
Intermittent: 9 units
Historical emergence of evolutionary concepts. Recognition of evolutionary pattern (biological diversity in geological time); foundation theory of evolutionary process. Overview of modern understanding of the history of life. Relationships of the major existing domains, kingdoms of life, the past history of life and relationship to geological events. Early Earth; prebiotic evolution; origin of nucleic acids; the RNA world; endosymbiotic theory of the evolution of eukaryotes. Molecular nature of mutation. Overview of modern theory of evolutionary process. Microevolution, speciation (including concepts of species), and macroevolution, relationship of phylogenics and systematics. Molecular approaches to the study of evolution. Use of molecular methods in construction of phylogenies. Correlation of molecular studies with fossil record and morphological characters of extant and extinct forms. Evolutionary trends among major groups and major transitions. A) Eubacteria and archaea: unicellular eukaryotes. B) Fungi. C) Plants. D) Animals. Prerequisites: 03-121

03-130 Biology of Organisms
Spring: 9 units
This course will survey the major organ systems in higher animals and humans, 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: 03-121

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: 0 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 program(s) to satisfy this last requirement. A student may take this course only once. Special permission required.

Course Descriptions

03-211 Directed Reading
All Semesters: 9 units
Students will read papers from the primary research literature in an emerging research area. Recent topics have been human behavioral genetics and human diseases of the cytoskeleton. Emphasis is on classroom discussion, weekly written assignments, and a term paper. Special permission required.

03-231 Biochemistry I
Fall: 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. 09-217 is a prerequisite or co-requisite.

03-232 Biochemistry II
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. 09-217 is a prerequisite or co-requisite.

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: 03-121 and (03-231 or 03-232)

03-301 Undergraduate Colloquium for Sophomores
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. Prerequisites: 03-121, 21-118, and 99-101

03-311 Introduction to Computational Molecular Biology
Spring: 8 units
This course presents both the theoretical underpinnings of computational methods used in modern molecular biology and practical training in use of these methods. It is intended for students without computer programming experience. Topics included are 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. Prerequisite: 03-131, 99-101 or equivalents. Students may use only one of the following for credit, 03-310, 03-311, or 03-510.

03-315 Magnetic Resonance Imaging in Neuroscience
Spring: 9 units
This 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. Prerequisite: 03-121 and 21-117 or permission of instructor.
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: (03-231 or 03-232) and 03-240

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. Prerequisites: (03-231 or 03-232) and 09-222 Co-requisites: 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, enzymes, kinetides, carbohydrates, lipids, and isolation and quantitation of biological molecules are covered. During the last five weeks students plan and carry out an original research project. Prerequisites: (03-231 or 03-232) and 03-343

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. Prerequisites: (03-231 or 03-232) and 03-240 and 03-330 and 03-343

03-350 Developmental Biology
Spring: 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. This course focuses on fundamental processes that are common to the development of multicellular animals and explores the experimental and conceptual paradigms that have been used to study these processes. It provides an overview of our current knowledge of the cellular and molecular mechanisms that underlie development. Prerequisites: (03-231 or 03-232) and 03-240 and 03-330

03-360 The Biology of the Brain
Fall: 9 units
This course will survey a range of topics found in the science of neurobiology. Neurobiology is the study of the nervous system, its development, its function and its diseases. Topics will include Evolution and Development of the Nervous System, Electrophysiology of Neurons, Human Neuroanatomy, Anatomy and Functioning of the Sensory Systems and Molecular Genetics of the Nervous System. The focus of the course is on how a scientist discovers the inner workings of the brain. A vast array of living organisms have brains. Science has shown that the study of "simple" brains can tell us a great deal about how all brains function, including human brains. As such, in this class, we will study aspects of the neurobiology of many different organisms. Prerequisites: (03-231 or 03-232) and 03-240 and 03-330

03-380 Virology
Fall: 9 units
The concepts and methods of virology are studied with emphasis on animal viruses. A 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: (03-231 or 03-232) and 03-240 Co-requisites: 03-330

03-401 Undergraduate Colloquium for Seniors
Fall: 1,3 units
03-402 Undergraduate Colloquium for Seniors
Spring: 1,3 units
03-410 Independent Study Biological Study
Fall and Spring: 3-9 units

03-411 Topics in Research
Fall and Spring: 1 units
During the year students attend and submit brief summaries of weekly seminars given by outside speakers or members of the Biological Sciences Department. Prerequisites: current research topics in modern biology; some seminars outside of the department may be substituted.

03-412 Topics in Research
Spring: 1 units
During the year students attend and submit brief summaries of weekly seminars given by outside speakers or members of the Biological Department or outside of the department may be substituted.

03-438 Physical Biochemistry
Fall: 9 units
The physical properties of biological macromolecules and the methods used to analyze their structure and function are discussed. Topics covered include: protein architecture and folding; nucleic acid structures and energetics; structure determination by X-ray crystallography and NMR; biological spectroscopy with emphasis on the biological applications of absorption, fluorescence, NMR, IR and CD spectroscopies; the kinetics and thermodynamics of protein-ligand interactions; enzyme catalysis; and the use of hydrodynamics and electrophoresis in the characterization of biological macromolecules. One or two research topics selected from the current literature are examined in depth as in-class case studies. Prerequisites: (03-231 or 03-232) and 33-112 and 09-214.

03-439 Introduction to Biophysics
Fall: 9 units
This course develops the use of physical methods in the study of biological systems. The forces that play roles in biological systems and the role of thermal energy are introduced. These concepts are used to elucidate protein and membrane structure and function. Topics discussed include X-ray diffraction, protein structure, helix-coil transitions, double layer potentials, membrane structure and transport, Nernst-Planck equations and electrochemical potential, action potentials and voltage sensitive channels. The treatment of biophysical phenomena and methods is based on physical principles, which will be treated with appropriate mathematics when necessary. Prerequisites: 03-121 and 09-105 and 33-111 and 33-112

03-441 The Molecular Biology of Prokaryotes
Spring: 9 units
This course covers the molecular biology 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 and Salmonella typhimurium, the structure and function of flagella, the molecular mechanisms of bacterial chemotaxis and motility, and the principles of self-assembly and catalyzed assembly of virus particles. Prerequisites: (03-231 or 03-232) and 03-330

03-442 Molecular Biology Of Eukaryotes
Fall: 9 units
The structure and expression of eukaryotic genes are discussed, focusing on model systems from a variety of organisms including yeast, Drosophila and humans. Topics discussed include (1) control of gene expression at the level of transcription, pre-mRNA splicing and translation, (2) chromosome structure, including origins of replication, centromeres, telomeres, transposons, and regulated chromosomal rearrangements, and (3) recombination, mutations and repair. Prerequisites: 03-441

03-445 Undergraduate Research
Fall and Spring: 1-18 units
Students may investigate research problems under the supervision of members of the faculty. Permission of a research faculty advisor required.

03-510 Computational Biology
Spring: 12 units
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. Prerequisites: 03-121 and 15-211 or permission of the instructor.

03-511 Computational Genomics and Molecular Biology
Fall: 9 units
This course is intended to be a second course in computational molecular biology, following 03-510. The first half of the course will begin with a review of pairwise sequence alignment and dynamic programming and then focus on problems in multiple sequence alignment and phylogeny reconstruction. The material in the second half of the course will be drawn from recent results in computational genomics and will also cover computational molecular biology algorithms in depth. Prerequisites: 03-510 or permission of the instructor.
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 of cellular systems. Topics to be covered include: absorption and fluorescence spectroscopy; interaction of light with biological molecules, cells, and systems; design of fluorescent probes and optical biosensors; genetically expressible optical probes; photochemistry; optics and image formation; transmitted light and fluorescence microscopy 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, membrane permeability, 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: (03-231 or 03-232) and 03-240 and 09-218 and 09-214.

03-545 Honors Research
Fall and Spring: 4 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: 03-330.

03-550 Developmental Genetics
Fall: 9 units
This course will examine in detail the genetic basis of specific developmental processes and the use of genetic methods to investigate general problems in developmental biology. Lectures and readings will focus primarily on studies using Drosophila melanogaster, Caenorhabditis elegans, zebrafish, and the laboratory mouse. Consideration will be given to both the identification and the functional dissection of genes involved in a variety of developmental processes ranging from the establishment of embryonic polarity to the control of cell proliferation. Questions concerning the evolutionary continuity of developmental regulatory mechanisms and the links between different developmental processes will also be explored. Prerequisites: 03-330

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 in 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 the Hitachi 7100 and 24600 electron microscopes. Lectures and laboratories during the last few weeks of the semester will introduce the students to special techniques (e.g., immunoelectron microscopy, cryo-embedding, cryo-substitution, freeze drying, high pressure SEEM, etc.) and will allow them to work with samples from their own research.

03-700 MS Thesis Research
All Semesters: 3-36 units
An independent investigation on a project selected from a major area of research study with the advice and approval of the faculty advisor. Required of students enrolled in the Master of Science program.

03-711 Computational Genomics and Molecular Biology
Fall: 9 units
The proposed course is intended to be a second course in computational molecular biology, following 03-510. The first half of the proposed course will begin with a review of pairwise sequence alignment and dynamic programming and then focus on problems in multiple sequence alignment and phylogeny reconstruction. The material in the second half of the course will be drawn from recent results in computational genomics. Multiple sequence alignment and phylogeny reconstruction will be covered in the proposed course. The course will cover computational molecular biology algorithms in depth and will focus on problems in genomics. Prerequisites: 03-510 or permission of the instructor.

03-730 Advanced Genetics
Spring: 9 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 in Drosophila. Prerequisites: 03-441 and (03-442 or 03-742)

03-738 Physical Biochemistry
Fall: 9 units
The physical properties of biological macromolecules and the methods used to analyze their structure and function are discussed. Topics covered include: protein architecture and folding; nucleic acid structures and energetics; structure determination by X-ray crystallography and NMR; biological spectroscopy with emphasis on the biological applications of absorption, fluorescence, NMR, IR and CD spectroscopies; the kinetics and thermodynamics of protein-ligand interactions; enzyme catalysis; and the use of hydroydynamics and electrophoresis in the characterization of biological macromolecules. One or two research topics selected from the current literature are examined in depth in class.

03-741 Advanced Cell Biology
Spring: 9 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 transmembrane protein translocation, signal transduction control of cell motility, and a molecular mechanism for membrane fusion. Prerequisites: (03-231 or 03-232) and 03-240.

03-742 Molecular Biology Of Eukaryotes
Fall: 9 units
The structure and expression of eukaryotic genes are discussed, focusing on model systems from a variety of organisms including yeast, Drosophila and humans. Topics discussed include (1) control of gene expression at the level of transcription, pre-mRNA splicing and translation, (2) chromosome structure, including origins of replication, centromeres, telomeres, transposons, and regulated chromosomal rearrangements, and (3) recombination, mutations and repair. Prerequisites: 03-441

03-751 Advanced Developmental Biology
Fall: 9 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: 03-350

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, process flow sheeting, reactive and non-reactive mass balances, problem solving strategies and tools, and team dynamics. The course is targeted for CCE First Year students. Co-requisites: 09-105, 21-115, 21-116

06-200 Sophomore Research Project
Fall and Spring: variable 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. 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 transitions.

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
Course Descriptions

are also discussed. A case-study project based on new technological advances and environmental engineering is also required. Prerequisites: 21-259
Co-requisites: 06-262, 06-100

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 data analysis. Prerequisites: 06-221 and 21-118

06-300 Junior Research Project
Fall and Spring: variable units
Research projects under the direction of the Chemical Engineering faculty. The course 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. 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; fluid calculations, Gibbs energy minimization; thermodynamics of chemical reactions including equilibrium conversions. Prerequisites: 06-221

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 unsteady-state heat conduction and molecular diffusion, convection, and thermal radiation, with applications to heat and mass transfer processes. Development of dimensionless quantities for engineering analysis is emphasized. Prerequisites: 06-262 or 21-260

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: 06-321 and 06-323

06-362 Chemical Engineering Process Control
Spring: 6 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. Prerequisite: 06-262

06-363 Transport Process Lab
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: 06-261 and 06-323

06-400 Senior Research Project
Fall and Spring: variable 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. A final written report or an oral presentation of the results is required.

06-421 Chemical Process Systems Design
Fall: 12 units
Survey of process equipment, cost estimation and evaluation for chemical plants. Preliminary design of large industrial project. Prerequisite: 06-321 Co-requisite: 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. Introductory principles in heterogeneous catalysis. Prerequisites: 06-201

06-423 Unit Operations Lab
Fall: 9 units
A summary 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 distillation 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 hydrogenolysis; and separating oxygen and nitrogen in air using a hollow-fiber membrane. Oral and written reports are required.

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 adhesion. Basic concepts will be related to practical problems of wetting, lubrication, foaming, adhesion, coatings and corrosion. Prerequisites: 06-607, 09-221

06-461 Process Design Project
Spring: Mini Session - 6 units
Computer-aided design of a large industrial project involving synthesis of process, energy and material balances and economic evaluation. Extensive report on the project must be submitted. Prerequisites: 06-421

06-462 Economics and Optimization
Spring: Mini Session - 6 units
Formulation and solution of mathematical optimization problems with and without constraints. Objective functions are based on economics or functional specifications. Both discrete and continuous variables are considered. Prerequisites: 06-461

06-466 Experimental Polymer Science
Spring: 6 units
Macromolecular behavior in bulk and in solution will be explored in experiments on tensile strength, elasticity, swelling of networks, solution viscosity, melt flow, and polymerization reactions. Particular reference will be made to aspects affecting production and fabrication of polymeric materials. Prereq: 09-221 and (06-609 or 09-509)

06-606 Computational Methods for Large Scale Process Design & Analysis
Spring: 9 units
This course deals with the underlying computer-aided design techniques for steady-state and dynamic simulation, numerical solution and decomposition strategies for large systems of sparse nonlinear algebraic equations, and mixed algebraic/differential systems and computer architectures for flowsheating systems. Prerequisites: 06-262 and 06-202

06-607 Physical Chemistry of Colloids and Surfaces
Spring: 9 units
Thermodynamics of surfaces; adsorption at gas, liquid, and solid interfaces; capillarity; wetting, spreading, lubrication and adhesion; properties of monolayers and thin films; preparation and characterization of colloids; colloidal stability, flocculation kinetics, micelles, electrokinetic phenomena and emulsions. Prerequisites: 06-221 and 09-247

06-608 Safety Issues in Science and Engineering Practice
Fall: 3 units
This course will expose students to personal safety issues encountered in normal science and engineering practice. Topics to be discussed include mechanical, electrical, chemical, radiation, and biological hazards to provide an awareness of these hazards and to inform students of appropriate action to be taken in the event of accidents.

06-609 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 commercial 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 polymeric systems.
Prerequisites: 06-262 and 06-321 and their relationship to urban, regional, and global pollution problems.

Spring:
06-620 Special Topics in Atmospheric Chemistry
This course will explore global atmospheric chemistry through a series of case studies: Stratospheric Ozone; Urban and Regional Air Quality; Perturbations; Mathematical Modeling of Air Pollution. The student completing 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 in a complex chemical environment such as the atmosphere, validate or refute those hypotheses, and then by extension predict how the system will respond in a complex chemical environment such as the atmosphere, validate or refute those hypotheses, and then by extension predict how the system will respond.

Fall:
06-610 Rheology and Structure of Complex Fluids
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: 06-609 or 06-509

Spring:
06-619 Semiconductor Processing Technology
This is an introductory course to the physical and chemical concepts involved in integrated circuit (IC) processing. The material focuses on basic principles in chemical reaction engineering and their application to IC process engineering. Topics include elementary theory of semiconductor devices: adsorption and reaction on semiconductor surfaces; process principles in crystal growth, diffusion, oxidation, and vapor deposition. Prerequisites: 06-422 and 09-347

Fall:
06-621 Biotechnology and Environmental Processes
This course has two sections. The first section covers microbial physiology and metabolism, fermentation and respiration, metabolic regulation, bioconversions, recombinant DNA methodology and gene cloning. The second section covers separation and purification, kinetics and design of biological reactors, mass transfer limitations within cell suspensions, and control of fermentation processes.

Spring:
06-622 Bioprocess Design
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 include proteins, nucleic acids, and fermentation-derived fine chemicals. Associated regulatory issues and biotech 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 opened-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 the US biotechnology industry. A fair knowledge of cell culture and fermentation operations is desirable.

Fall:
06-630 Atmospheric Chemistry, Air Pollution and Global Change
Principles necessary to understand the atmospheric behavior of air pollutants on urban, regional, and global scales. Key topics include atmospheric gas-, aqueous-, and aerosol-phase chemistry; removal processes and residence times; aerosol physics; pollutant effects on visibility and the energy balance of the planet; mathematical modeling of air pollution. The student completing this course will understand the fundamentals of atmospheric chemistry and physics and their relationship to urban, regional, and global pollution processes.

Spring:
06-640 Principles and Applications of Molecular Simulation
This course will introduce modern concepts and methods for simulating physical and thermodynamics properties of materials from atomic-scales, with special emphasis on the gas and liquid states. Strengths and limitations of molecular simulation methods will be discussed, topics will include basic statistical mechanics, interatomic potentials, Molecular Dynamics methods, Monte Carlo methods, computation of phase coexistence curves, and Brownian Dynamics. Prerequisites: 06-262 and 06-321
Course Descriptions

09-201 Undergraduate Seminar I
Fall: 1 unit
Issues and topics of importance to beginning chemistry majors are discussed in this seminar. It provides a general introduction to the facilities, faculty and programs of the Chemistry Department and introduces students to career and research opportunities in the field of chemistry. Students attend and evaluate seminars of fourth-year students. 1 hr.

09-202 Undergraduate Seminar II
Spring: 1 unit
Issues and topics focused on laboratory safety are discussed in this class. The topics are selected to supplement information covered in 09-221, Laboratory 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. 1 hr. lec.

09-214 Physical Chemistry
Spring: 9 units
This end-of-quarter course intended primarily for students in Biological Sciences, students in the B.A. degree program in Chemistry, and students from other departments interested in pursuing graduate studies in the health professions. The course focuses on thermodynamics and its applications 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, solutions, and chemical kinetics. 3 hrs. lec. Prerequisites: 09-106 and 09-118 and 33-111 and (09-105 or 09-107)

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: 09-105 or 09-107

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: 09-217

09-220 Supramolecular Organic 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 applications of supramolecular chemistry from the scientific literature, learning to compare articles, to evaluate 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: 09-217 Co-requisites: 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 and have included spectroscopic methods, volumetric analysis including acid-base titrations, gravimetric analysis, and high-pressure liquid chromatography as well as some preparative techniques used in organic and inorganic synthesis. 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: (09-106 or 09-206)

09-222 Laboratory II: Organic Synthesis and Analysis
Spring: 12 units
This second course in the laboratory sequence introduces some important laboratory methods for synthesis and purification of organic compounds, as well as practical applications of spectroscopy and chromatography for characterization of organic compounds. Use of the chemical literature is included. 2 hrs. lec., 6 hrs. lab. Prerequisites: 09-217 and 09-221 Co-requisites: 09-218

09-231 Mathematical Methods for Chemists
Fall: 9 units
This course covers mathematical techniques that are important in chemical sciences. The techniques will be covered in the context of chemical phenomena, and combine topics from dimensional analysis, differential equations, linear algebra and statistics. This course does not count towards the minor in chemistry. 3 hrs. lec. Prerequisites: 09-106 and 21-118

09-301 Undergraduate Seminar III
Fall: 1 units
Students attend one seminar per week on a chemistry related topic. A menu of choices is provided one week in advance. 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 other departments interested in pursuing graduate studies in the health professions. Some pointers on how to organize and present an effective seminar on a topic in chemistry are given. The course establishes what should be included in a good seminar. 1 hr.

09-321 Laboratory III: Molecular Design and Synthesis
Fall: 12 units
This third course in the laboratory sequence is an advanced synthesis course covering a variety of synthetic methods including vacuum and inert atmosphere methods to prepare organic, inorganic, organometallic, and polymeric compounds. Methods may involve resolution procedures to prepare optically active compounds, separation of mixtures and isolation of products by use of column and thin-layer chromatography, sublimation and extraction techniques. Experiments on characterization and identification by chemical and spectroscopic methods form an important part of the course. Use of the chemical literature is included. 2 hrs. lec., 6 hrs. lab. Prerequisites: 09-218 and 09-222

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 spectroscopy. 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: 09-221 and 09-344 Co-requisite: 09-345

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 spectroscopy, electrochemistry, optical and force microscopies and potentially NMR. In addition, the course will emphasize how to select an analytical method appropriate to the problem at hand, how to optimize the signal to noise obtained by a measurement, and the quantitative analysis of experimental data. 3 hrs. lec. Prerequisites: 09-221 and 09-222 Co-requisites: 09-344

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: (09-105 or 09-107) and (21-259 or 09-231)

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 detail. 3 hrs. lec., 1 hr. rec. Prerequisites: 09-106 and (21-259 or 09-231)
Course Descriptions

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: (06-151 or 06-221) and (06-155 or 06-262) and (09-105 or 09-107)

09-348 Inorganic Chemistry
Spring: 10 units
The focus of this class is the understanding of the properties of elements and inorganic compounds. The electronic structure of the elements will be discussed as the basis for their organization in the Periodic Table and for their properties. The systematic chemistry of main group elements and of transition metals will be presented. The number of inorganic compounds is extremely large and their properties are extremely diverse. Therefore in this course, the presentation of physical and chemical properties of inorganic compounds will be based on observation of the trends in the respective properties and the relation between these trends and the place of elements in the Periodic Table. The biological role of inorganic compounds present in the living matter will be illustrated in the part of the class dedicated to the study of bioinorganic chemistry. 3 hrs. lec., 1 hr. rec. Prerequisites: 09-106

09-401 Undergraduate Seminar V
Fall: 1 unit
Offered, as a 7 week mini-course, students review the skills necessary for giving an effective oral technical presentation. The poster as a tool for communicating technical information is discussed. The course concludes with a poster session by participants.

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. 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, 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: 09-345

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 before an Honors Committee is 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 procedures 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 applications of polymers. (Graduate Course: 12 units, 09-741) Prerequisites: 09-218

09-504 Chemical Kinetics
Intermittent: 9 units
Rate laws. Analysis of linear chemical networks by LePlace transform and matrix formalism. Transient and steady methods. Stability of chemical systems. Theories of reaction rates. Molecular energetics. Application to reactions in solution, electrolytes, electron and proton transfer reactions, heterogeneous systems. (Graduate Course: 09-704, 12 units)

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 polymeric systems. (This course is also listed as 06-609.) 3 hrs. lec. Prerequisites: 09-345

09-510 Introduction to Green Chemistry
Spring: 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 proposals for their minimization, and approaches for their eradication. Particular attention will be paid to sources and potential replacements of persistent bioaccumulative pollutants. A historical perspective on the technology 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: 09-218 and 09-348

09-511 Solid State and Material Chemistry
Intermittent: 9 units
The course will interface general principles in solid-state physics and chemistry as applied to novel organic and inorganic materials. The general focus of the course will be on electronic and optic properties. Specific topics to be covered include: solid state structures, the free electron model, energy bands (Bloch theory, tight binding model, etc.) and electrical conductivity. Techniques for defining both the electronic and physical structures and properties of solids will be discussed throughout the course. Magnetic and optical properties of some organic and inorganic materials will be covered. (Graduate Course: 12 units, 09-811) Prerequisites: 09-218 and 09-345

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)

09-518 Biorganic Chemistry
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 proteins, 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: 09-217 and 09-218

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, tuning them 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
Course Descriptions

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. (This course is also listed as 06-620.) Prerequisites: 21-260

Co-requisites: (09-347 or 09-344)

09-521 Bioinorganic Chemistry Intermittent: 9 units

This 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 metallproteins will be reviewed. The array of physical methods required for study will be introduced, with application toward the determination of electronic and molecule structure and enzymatic mechanisms. (Graduate Course: 12 units, 09-721) Prerequisites: 09-344 and 09-348

09-522 Oxidation and Inorganic Chemistry Intermittent: 9 units

The roles of metal complexes in oxidation processes (inorganic, organic, biological) will be presented. Special attention is given to processes involving the activation of molecular oxygen and hydrogen peroxide from a mechanistic viewpoint. The electronic structures of metal complexes of dioxygen and its reduced species suxide, peroxide, and oxide are reviewed, as are the relationships between electronic structure and oxidation reactivity. (Graduate Course: 12 units, 09-722) Prerequisites: 09-348

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: 09-344 and 09-345

09-545 Polymer Rheology
Intermittent: 9 units

A survey of the mechanical properties of polymeric materials in their many forms: melt, rubber, glass, crystalline, solution, mixtures, and composites with other materials. The dependence on structure of viscosity, viscoelasticity, and plasticity failure. The role of rheological properties in characterization, testing, fabrication, and use of polymeric materials. (Graduate Course: 12 units, 09-745) Prerequisites: (09-344 or 09-347) and (09-509 or 09-609).

09-560 Computational Chemistry
Fall: 12 units

Computer modeling is playing an increasingly important role in chemical research. This course provides an overview of computational chemistry techniques including molecular mechanics, molecular dynamics and both semi-empirical and ab initio electronic structure theory. 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 chemical tools running on graphics workstations. 4 hrs. lec. Prerequisites: (15-111 or 15-200) and 09-344 and 09-345

Graduate Courses

The graduate courses listed below are available to undergraduate students who have the appropriate prerequisites and permission of the instructor.

09-701 Quantum Chemistry I
Fall: 12 units

Introduction to quantum mechanics. The main topics to be covered will include wave packets, interference, the uncertainty principle, Ehrenfest’s theorem, the Schrödinger equation and its solution for finite and infinite square wells and barriers, the harmonic oscillator, the rigid rotor, the hydrogen atom and time-independent perturbations.

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.

09-720 Physical Inorganic Chemistry
Intermittent: 12 units

This course develops principles of magnetocochemistry and inorganic spectroscopy. Electronic absorption, magnetic circular dichroism, resonance raman, NMR, EPR, Mossbauer, magnetization and x-ray methods will be introduced with application toward the determination of electronic structures of transition metal complexes.

09-746 Linear Viscoelasticity
Intermittent: 12 units

The mathematical model for linear viscoelasticity is developed and compared with the behavior observed for polymeric materials. Emphasis is on the interrelation of experimental results in terms of fundamental material properties and discussion of the latter in terms of molecular concepts for a variety of amorphous and crystalline polymers.

Civil & Environmental Engineering

Undergraduate Courses

12-090 Technology and the Environment
Spring: 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 writing proficiency. 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. Co-requisites: 21-115, 21-116, 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. Co-requisites: 12-100, 21-117, 21-118, 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. 3hrs. rec. Prerequisites: 06-101 or 12-100

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. Co-requisites: 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: 21-115 and 21-116 and 33-106

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
Course Descriptions

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

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: 12-331

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: 12-335

12-651 Air Quality Engineering
Fall: 9 units
An introduction to the fundamentals and engineering aspects of water quality. Basic principles of water chemistry; physical, chemical and biological phenomena affecting water quality; and application of these concepts to a description of water quality changes that may occur in treatment processes and in natural-water environments including water and wastewater treatment systems and groundwater. 3 hrs. rec. Prerequisites: 12-251 and 12-355 and 36-211

12-655 Water Quality Engineering
Spring: 9 units
Introduction to the fundamentals and engineering aspects of water quality. Basic principles of water chemistry; physical, chemical and biological phenomena affecting water quality; and application of these concepts to a description of water quality changes that may occur in treatment processes and in natural-water environments including water and wastewater treatment systems and groundwater. 3 hrs. rec. Prerequisites: 12-251 and 12-355

12-656 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. Co-requisites: 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: 12-251 Co-requisites: 12-355

12-658 Hyraulic Structures
Spring: 9 units
Theory and practice of design or riverine and coastal structures, including dams, levees, bridge piers, culverts, jetties and groins, seawalls, bulkheads, breakwaters, marinas, and harbors. Key related concepts from surface and ground water hydrology, and wave mechanics. 3 hrs. rec. Co-requisites: 12-355

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. Prerequisites: 12-235 Co-requisites: 21-269

12-332 Solid Mechanics Lab
Fall: 3 units
Analysis of stress-strain relationships, torsion of solid shafts, deformation due to 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. 1 hr. lab. Prerequisites: 12-235 Co-requisites: 12-331

12-335 Soil Mechanics
Spring: 9 units
Sampling, testing and identification of soils. Physical, chemical and hydraulic characteristics. Stress-strain-strength 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: 12-331 Co-requisites: 12-355

12-336 Soil Mechanics and Materials Laboratory
Spring: 3 units
Examination of material properties and behavior of soils, concrete, steel, polymers, and timber. 1 hr. lab. Prerequisites: 09-105 and 27-357 and 33-107

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. Co-requisites: 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. Co-requisites: 12-355

12-411 Engineering Economics
Fall: 9 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. Prerequisites: 21-115 and 21-116

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. Co-requisites: 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: 36-211
Course Descriptions

Computer Science

Undergraduate Courses

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 Career Center. More information on the Computer Science Co-Op program is available at the CS Undergraduate Office.

15-090 Computer Science Practicum
All Semesters: 3 units
This course is for international students who are interested in working for 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), files, 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.

15-111 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 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. 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: 15-111 or 15-200

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. 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: 15-100

15-211 Fundamental Data Structures and Algorithms
Fall and Spring: 12 units
Fundamental programming concepts are presented together with supporting theoretical bases 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: (21-127) and (15-111 or 15-200)

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 advanced module composition. It also introduces the use of formal methods for specifying and verifying programs. Prerequisites: 15-211

15-213 Introduction to Computer Systems
Fall and Spring: 12 units
This course provides a programmer’s view of how computer systems executes programs, stores 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 course 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: 15-113 and 15-211

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: 21-127 and 15-100

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: 15-212

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: 15-251

15-354 Computational Discrete Mathematics
Fall: 12 units
This course is about the computational aspects of some of the standard concepts of discrete mathematics (sets, functions, logic, graphs, courses in computer science), 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: 15-251

15-355 Computational Algebra
Spring: 12 units
The emphasis of the course is on how to use computational methods to solve algebraic problems. Topics will include: Algebra of vectors and matrices. Solutions of linear equations and inequalities. Use of various software packages. Polynomial algebra. Combinatorial applications. Solving algebraic equations. Boolean algebra. Finite algebra theory. Generating functions and manipulations of infinite series. Familiarity with Mathematica is required. Prerequisites: 15-251

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., satisfying 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 complexity and limitations of 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 probabilistic algorithms, randomized algorithms, geometric algorithms, low level techniques for efficient programming, cryptography, and cryptographic protocols. Prerequisites: 15-212 and (15-351 or 15-354 or 15-355 or 21-301 or 21-373 or 21-484)

**15-451 Algorithm Design and Analysis**

**Fall and Spring: 9 units**

This course is about the design and analysis of algorithms. We study specific algorithms for a variety of applications, including 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 probabilistic algorithms, randomized algorithms, geometric algorithms, low level techniques for efficient programming, cryptography, and cryptographic protocols. Prerequisites: 15-212 and (15-351 or 15-354 or 15-355 or 21-301 or 21-373 or 21-484)

**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: 15-212 and (15-351 or 15-354 or 15-355 or 21-301 or 21-373 or 21-484)

**15-462 Computer Graphics**

**Fall and Spring: 12 units**

This course provides a comprehensive introduction to computer graphics modeling, animation, and rendering. Topics covered include basic image processing, geometric transformations, geometric modeling of curves and surfaces, animation, 3-D viewing, visibility algorithms, shading, and ray tracing. Prerequisites: (15-213 and 21-241 and 21-259) or (15-213 and 18-202)

**15-485 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 principles of those biases, 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: 15-385 or 85-370

**15-519 Independent Study in Programming Systems**

**Fall and Spring: 3-18 units**

This is a project-oriented course which will deal with all aspects of project development: the application, the artifact, the computer-aided design environment, and the physical prototyping facilities. The class, in conjunction with the instructors, will develop specifications for a mobile computer to assist in inspection and maintenance. The application will be partitioned between human computer interaction, electronics, industrial design, mechanical, and software components. The class will be divided into groups to specify, design, and implement the various subsystems. The goal is to produce a working hardware/software prototype of the system and to evaluate the user acceptability of the system. We will also monitor our progress in the design process by capturing our design escapes (errors) with Orthogonal Defect Classification (ODC). Upon completion of this course each student will be able to: generate systems specifications from a perceived need; partition functionality between hardware and software; produce interface specifications for a system composed of numerous subsystems; use computer-aided design tools; fabricate, integrate, and debug a hardware/software system; and evaluate the system in the context of an end user application. Prerequisites: 15-211

**15-549 Independent Study in Computer Systems**

**Fall and Spring: 3-18 units**

This is a project-oriented course which will deal with all aspects of project development: the application, the artifact, the computer-aided design environment, and the physical prototyping facilities. The class, in conjunction with the instructors, will develop specifications for a mobile computer to assist in inspection and maintenance. The application will be partitioned between human computer interaction, electronics, industrial design, mechanical, and software components. The class will be divided into groups to specify, design, and implement the various subsystems. The goal is to produce a working hardware/software prototype of the system and to evaluate the user acceptability of the system. We will also monitor our progress in the design process by capturing our design escapes (errors) with Orthogonal Defect Classification (ODC). Upon completion of this course each student will be able to: generate systems specifications from a perceived need; partition functionality between hardware and software; produce interface specifications for a system composed of numerous subsystems; use computer-aided design tools; fabricate, integrate, and debug a hardware/software system; and evaluate the system in the context of an end user application. Prerequisites: 15-211

**15-559 Independent Study in Theoretical Computer Science**

**Fall and Spring: 3-18 units**

This course introduces the basic concepts of multiprogramming, timesharing and asynchronous processes. These concepts lead to interesting problems in synchronization, scheduling, memory management, information sharing and protection. Emphasis is on the design of the operating systems of operating systems. Prerequisites: 15-213

**15-569 Independent Study in Graphics**

**Fall and Spring: 3-18 units**

This course is an introduction to computer graphics. The emphasis will be on the basic performance and engineering tradeoffs in the design and implementation of computer systems. 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: 15-213
Course Descriptions

15-589  Independent Study in Artificial Intelligence
Fall and Spring:  3-18 units

15-599  Undergraduate Thesis Research
Fall and Spring:  18 units
Available only to students registered in the CS Senior Research Thesis Program. More information is available at the CS Undergraduate Office.

15-681  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, explanation-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: 15-212

Robotics Undergraduate Courses

16-199  Building the Future
Spring:  4 units
The goal of this project course is to teach undergraduates (especially freshmen and sophomores) how to build such things as robots and intelligent environments, and how to get involved in research. In the process we will develop our abilities to predict how technology will affect the future.

16-299  Introduction to Feedback Control Systems
Spring:  12 units
This course is designed as a first course in feedback control and systems for computer science majors. Course topics will include systems, dynamic response, feedback control, time and frequency domain analysis, Laplace transforms, state-space design, digital control, and robotic control. Laboratory work will include implementation of controllers for force feedback robotic devices. Priorities will be given to those with robotics minor. Prerequisites: 15-211 and 21-117

16-362  Mobile Robot Programming Laboratory
Fall:  9,12 units
This course is a complete, hands-on introduction to Mobile Robot Programming. Using six Nomad Scout robots and portable computers, we will survey topics ranging from low-level control and obstacle avoidance, including PID control, to high-level navigation, planning, robot-robot communication and cooperation.

16-363  Advanced Mobile Robot Programming
Spring:  6-12 units
Advanced Mobile Robot Programming is an advanced research and development course for graduates of 16362 and 16862. In this class, teams of students will use computer-aided design software and actual hardware implementation laboratories to learn about real mobile robot systems. Prerequisites: 16-362

Electrical & Computer Engineering Undergraduate Courses

18-100  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. Corequisites: 15-127, 21-115, 21-116

18-200  Math Foundations of Electrical Engineering All Semesters:  12 units
This course covers topics from engineering mathematics, which serve as foundations for descriptions of electrical engineering devices and systems. It has four major parts: (1) Complex analysis, including complex numbers and complex analytic functions, (2) Ordinary differential equations of first- and second-order; (3) Linear algebra, including matrices, vectors and determinants; (4) Vector calculus, including the vector differential operators gradient, divergence and curl, and vector integral calculus, including multiple integration and integral theorems. Prerequisites: 21-122

18-220  Fundamentals of Electrical Engineering
Fall and Spring:  12 units
Electrical engineers control electrical energy by creating systems that process information, convert electrical energy to mechanical motion to do work, generate and distribute power, sense the environment, and transmit & receive signals to communicate. This course will cover the analysis and synthesis of such systems through the study of linear electric circuits. Topics to be covered 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, and frequency domain analysis. The laboratories are designed to give students the opportunity to design, build and operate circuits that individually explore the specific concepts (e.g., digital-to-analog conversion, amplifiers, and signal detection & processing) while collectively leading to a navigation system assembly, demonstration and competition at the end of the term. Prerequisites: 18-100 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.

18-232  Sophomore Projects
Spring:  3-12 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.

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 design software and actual hardware implementation laboratories to learn about real digital systems. Prerequisites: 18100 Corequisites: 21-127

18-303  Engineering Electromagnetics
Fall:  12 units
This course and the subsequent course, 18-304, introduce fundamental electromagnetic principles and describe ways in which these principles are applied in engineering devices and systems. In 18-303, Maxwell’s equations are used to describe the ways in which charges and currents serve as sources for electric and magnetic fields, including electromagnetic waves. These ideas provide a basis for analysis of uniform plane waves, reflection and transmission of waves at interfaces, waveguides, transmission lines and antennas. Descriptive methods correspond to a wide variety of applications in which electromagnetic waves propagate between sending and receiving devices, including transmission line interconnections and wireless communication systems. Prerequisites: 18-202 or 18-220

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 used 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. Prerequisites: 18-220

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: 18-220
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 course covers 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. Prerequisites: 18202

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 laboratory students will gain exposure designing and implementing analog circuits such as an AM transmitter and an audio amplifier. 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.

Prerequisites: 18-220

Analysis and Design of Digital Circuits

Spring: 12 units
The purpose of this course is to introduce the student to the fundamentals of the analysis and design of basic digital circuits. Topics to be covered include: MOSFET and BJT large-signal device models, propagation delay calculations, MOS and BJT combinational and sequential gate circuits, physical layout techniques, semiconductor memories, programmable logic arrays, pulse-frequency techniques, and TTL and ECL technologies. The nature of circuit simulation (SPICE), timing simulation (COSMOS) and physical layout (MAGIC) computer tools is stressed. The lab includes the design, analysis, layout and verification of a digital circuit such as a simple microprocessor. Prerequisites: 18-220 and 18-240

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.

Junior Projects

Spring: 3-18 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.

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 arithmetics 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 carry-lookahead) along with various divide architectures. Floating point units are then built upon the concepts introduced for adder, multiplier, and dividers.

Finally, we will investigate the design and implementation of digital filter circuits. For each circuit introduced, we will develop techniques for evaluating their functionality, their power, their speed, their area, and various other performance measures and properties. 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 also subtle concepts that include hazards, metastability, false paths, inertial delay, sticky bits, clock skew/jitter, dynamic and static sensitization, and many others.

Prerequisites: 18-240

Introduction to Telecommunication Networks

All Semesters: 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. Prerequisites: 18-240 and 36-217

Introduction to Computer Architecture

Fall and Spring: 12 units
The goal of this course is to develop an understanding of the structure and operation of contemporary computer systems from the instruction set architecture level through the register transfer implementation level. We explore: theory of computation, levels of abstraction, instruction set design, assembly language programming, processor data paths, data path control, pipeline design, design of memory hierarchies, memory management, input/output. Several of the principles presented in lecture are reinforced through laboratory projects including assembly language programming, evaluation of instruction set architectures by benchmarks, behavioral simulation of an instruction set architecture, and design/simulation of a register transfer implementation of an instruction set architecture. A contemporary behavioral microprocessor simulator will be used for the laboratory projects. Prerequisites: 18-240

Corequisites: 15-211

Introduction to Performance Analysis

Fall: 12 units
The objective of this course is to present the necessary background, methods and techniques for math- ematical performance analysis of computer and communication systems. The course is intended to provide a reasonable grounding on how to use modeling techniques to evaluate the dynamic behavior of simple real sys- tems. This includes choosing the appropriate modeling formalism, constructing the model, verifying and solv- ing the model. The systems in which we are interested are subject to requests with random characteristics. The processes that take place in response to these requests are also random. Accordingly, the modeling tools that are needed to study such systems come from the domain of probability theory. Broadly speaking, the course is divided into two modules: analytical modeling and simulation & measurement. Each of these topics is a prerequisite for the next, and will be covered in detail. By structure and contents, this class is targeted primarily towards computer and electrical engineers who implement computer and communication systems. It may also provide a valuable basis for students in computer science and related subjects. Prerequisites: (18-202 or 18-205) AND (18-347 or 15-213)

Introduction to Embedded Systems

Fall: 12 units
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 systems or embedded computers. This class also discusses the needs of today’s systems, which 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 control, manufacturing, defense systems, telecommunication systems, automotive systems, 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 guaran- teed real-time behavior. These embedded systems often use simple executive (or kernels) or real-time operating systems with typically small footprints, support for real-time scheduling and no hard drives. Many embedded systems also interact with their physical environment using a variety of sensors and/or actuators. This introductory course on embedded computing focuses on these issues germane to embedded systems. Prerequisites: 18-347 or (15-213 and 18-240)

Fundamentals of Control

Fall: 12 units
An introduction to the fundamental principles and methodologies of classical feedback control and its application. 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 synthesizing automatic control systems; analysis of performance, stability criteria, realizability, and speed of response; compensation methods in the frequency domain, root-locus and frequency response design, and computer synthesis techniques for performance and delay and computer control systems; transfer function and state space modeling of linear dynamic systems; nonlinearities in control systems; and control engineer- ing software (MATLAB). Prerequisites: 18-396

Junior Seminar

Spring: 0 units
This junior seminar provides the undergraduate students with career-oriented information to guide them in setting career objectives and making the transition to professional engineering practice and graduate and professional school studies. The weekly seminar meetings feature faculty member and invited speaker presentations, with the students participating in the discussions.

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 relationship 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 z-transforms in the context of digital filtering. Prerequisites: 18-202 and 18-220

18-410 Sensors and Instrumentation

Spring: 12 units

In this course we will explore many types of response effects to physical stimuli, detection techniques, signal conversion, instrumentation, and signal processing techniques to optimize, via attributes such as cost, detectivity, size, speed, etc, their sensing and transformation functions between the analog and digital worlds. Prerequisites: While no specific prerequisites are designated, it is assumed that the student arrives with a basic understanding of physics, materials, chemistry, mathematics, and electronic circuits taught at the sophomore and junior college engineering and science course level.

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 and circuits that are used in modern electronic devices and circuits. 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 desktop computer power is required. Particular emphasis is placed on digital circuits, in detail, scaled integrated MOSFETs for logic and memory; CCD imagers; active matrix flat panel displays; and MESFETs for digital and RF applications. Although they are covered in the laboratories, a number of web-based laboratory experiments are planned. 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: 18-311 and 33-107

18-414 Introduction to MEMS

Fall: 12 units

This course introduces fabrication and design fundamentals for MicroElectroMechanical Systems (MEMS): on-chip sensor and actuator systems that have micrometer-scale dimensions. Basic principles covered include microstructure fabrication, mechanics of silicon and thin-film materials, capacitive motion detection, fluidic damping, piezoelectricity, piezoresistivity, and thermal effects. Applications covered include micromirrors, accelerometers, resonant mechanical filters, microspeakers and microphones. Design principles include use of layout tools, finite-element analysis, behavioral modeling, and simulation. Hands-on laboratory assignments introduce fabrication and testing of microstructures. Grades are based on lab work and homework assignments, exams, and a final project paper and oral presentation. Prerequisites: 18-321 or 18-322

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.

18-432 Senior Projects

Spring: 1-42 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.

18-440 Internet Security

Spring: 12 units

This course will provide a principled introduction to techniques for defending against breaches of security in IP networks and Internet (and other web-related) applications. Topics covered in the course will include network security, including cryptography and cryptographic protocols, firewalls, and network denial-of-service attacks and defenses; advanced user authentication technologies; security for network servers; and security for mobile code technologies, such as Java and Javascript. More advanced topics will additionally be covered as time permits, such as: host and network intrusion detection; techniques to provide privacy in Internet applications; and protecting digital content (music, video, software) from unintended use. Pre-reqs: 1. 15-211 2. 18-345 or 15-441 or permission of the instructor

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 primary goal of verification will be introduced and its importance motivated by the current crisis in industry. Various simulation-based techniques will be presented including white, grey, 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 the advanced design experience and therefore prerequisites include one of the following courses: 18-340, 18-347, 18-349 or 18-360. 3 hrs.lec. Prerequisites: 18-340 or 18-347 or 18-349 or 18-360

18-450 Introduction to Digital Communication Systems

Fall: 12 units

This course is a general introduction to the main concepts in digital communications. It has a strong review relevant aspects of linear systems, probability theory, and random variables. Topics covered will include: signal formats, baseband digital modulation, signal-space representation, detection of signals in noise, intersymbol interference, equalization, passband digital modulation, error probability evaluation, synchronization, block codes, trellis codes, Viterbi algorithms, and modulation and coding trade-offs. Applications are drawn from broadcasting, telephone networks, digital data storage, satellite communications and wireless communications. 4 hrs. lec. Prerequisites: 18-396 and 36-217

18-474 Real-Time Computer Control System

Fall: 12 units

This design course project gives students experience with current methods for designing and implementing real-time computer programs for feedback control of mechanical devices and systems which are focused on the use of software tools for modeling, analysis, design, simulation, and auto-code generation. Lectures and laboratory experiments cover empirical and analytical modeling of system dynamics, switching control, basic algorithms including PID and intelligent variable feedback, tracking and control, state observers, recursive state estimation (Kalman filters), and adaptive control techniques. Throughout the semester, each laboratory group develops a real-time computer control system of its choice, culminating in a final demonstration of the completed project. 3 hrs. lecture, 3 hrs. lab. Prerequisites: 18-349 and 18-370

18-482 Telecommunications, Technology Policy and 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

18-483 Civilian and Military Applications of Space

Spring: 12 units

Space is an arena of growing activity and importance. The use in space puts specific requirements on the technology of remote sensing and communication. Furthermore, the access to space requires rocket engines. Operation in space supposes the ability of controlling automatically the attitude of spacecraft. Navigation and guidance requires a very large and powerful infrastructure. Most space endeavors are very ambitious and long-term projects. The cost of space projects are often easier to estimate than the benefit. The goal of this course is to penetrate somewhat in the world of space policy dilemmas by studying the interface between the technology and what space programs could or try to accomplish.

18-484 Information Warfare

Spring: 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, intrusion detection, host detection, and authentication techniques. 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. PRE-REQUISITES: This course is intended for senior level undergraduates and first-year graduate students.

18-501 Electromechanics

Spring: 12 units

This course provides a broadly based introduction to interactions between mechanical media and electromagnetic fields. Attention is focused on the electromechanical dynamics of lumped-parameter systems, wherein electrical and mechanical subsystems may be modeled in terms of discrete elements. Interactions of quasielastic electric and magnetic fields with moving media are described and exemplified. Unifying examples are drawn from a wide range of technological applications, including energy conversion in synchronous, induction, and commutator rotating machines, electromechanical relays, a capacitor microphone and speaker, and a feedback-controlled magnetic levitation system.
18-515 From Design to the Market for Deep Submicron IC’s

Spring: 12 units

The general objective of the 18-515 class is to introduce and analyze all major design-dependent trade-offs which decide the IC product’s commercial success. This objective will be achieved via playing in the class an “imaginary startup game” - a main class activity. In this game students will be asked to construct “business plans” for a startup fabless IC design house. Each team in the class will have to envision, as an IC design objective, a new product with a functionality which is already provided by another existing IC product (i.e. by microprocessor). The envisioned product should provide a subset of functionality of the existing product but it should respect (e.g. it could be less expensive to fabricate, faster etc.). Prerequisites: 18-322

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 hr rec. Prerequisites: (18-303 and 18-306) or (18-316 and 18-396)

18-523 Analog Integrated Circuit Design

Fall: 12 units

Analog circuit design issues play an important role in creating modern ICs. First and foremost, analog circuits act as the interface between digital systems and the real world. They 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 involves 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 of operational amplifiers, design and implementation details of switched-capacitor circuits and continuous-time circuits for filtering will be covered. BJT CMOS, and BiCMOS design approaches will be discussed. Basic design of data converters, design of both clocked and unclocked comparators will be discussed. Prerequisites: 18-321 and 18-322

18-525 Integrated Circuit Design Project

Spring: 12 units

The purpose of this course is to study the design process of VLSI circuits. The first part of the course will be devoted to the standard cell design methodologies. Major emphasis will be put on layout design, circuit and parasitic extraction and verification of circuit performance via simulation tools. In the second part of the course, students will design functional blocks of digital ICs and verify their performance using such simulators as COSMOS and SPICE. The collection of these functional blocks will constitute a multiproject chip, which will be submitted for fabrication to MOSIS. Prerequisites: 18-322

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 have to work on an actual network, and the evaluation will evaluate whether the success criteria will be met. Students will work in teams and will have a choice of a small number of projects. Prerequisites: 18-345 or (15-641 and 15-213)

18-645 Advanced Digital Design Project

Spring: 12 units

This project-oriented course develops skills to design large digital systems at a professional level. Large digital systems typically contain a mix of hardware and software. Models and languages of systems containing both hardware and software components, or code, will be introduced. A substantial design project will be designed and built by each project group of four students. Contemporary techniques for analysis, design and implementation of large digital systems will be introduced and evaluated via simulation tools. HW/SW partitioning, HW/SW communications modeling, and hardware simulation and synthesis. Verilog will be used for hardware simulation and synthesis onto FPGAs. A classic processor such as the 68HC11 will be utilized for the software component of the project. Industry standard practices of design reviews, final project presentations, and weekly reports will be followed. The design process will be studied. Previous and current term projects will be compared and contrasted to classic case studies. Prerequisites: 18-347 or 18-349 or 18-360

18-546 Storage Systems

Spring: 12 units

This course covers the design, implementation, and use of storage systems, from the characteristics and operation of individual storage devices through the OS, database, and networking approaches involved in tying them together and making them useful to key application’s demands and technology trends. Topics to be covered include: disk drive operation and firmware, file system structures, disk I/O performance enhancement, disk arrays, storage networking, network-attached storage, storage management, alternative storage technologies, and storage-intensive applications. 3 hrs. lec. Prerequisites: 15-412

18-549 Distributed Embedded Systems

Fall: 12 units

This course is a follow-up to 18-349, Introduction to Embedded Systems. Whereas that introduction-level course focuses on single processor applications, 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 emphasis will be placed on methodologies for software organization and operation is assumed, the focus of the course is mainly on software 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 periods 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: (18-240) and (15-412 or 18-349)

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 students with DSP hardware 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. Prerequisites: 18-396

18-552 Wireless Transmission Tech

Spring: 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 two existing wireless standards (e.g. GSM and W-CDMA). Possible research directions will be pointed out for students interested in a more detailed understanding. Prerequisites: 18-396 and 36-217

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 servomechanisms and Kalman filtering. A significant emphasis is placed upon student selected design projects. Prerequisites: 18-370

18-747 Advanced Techniques in Microprocessors

Fall: 12 units

Advanced Techniques in Microprocessors: This course presents recent commercial and research developments in microprocessors. The course begins with an in-depth microarchitectural-level review of basic out-of-order superscalar processor datapath. The course next discusses extensions and variations of the basic superscalar design to address not only performance but also increasingly important issues of power and energy efficiency. Both hardware and software techniques for improving the efficiency of microprocessing will be discussed. Furthermore, the course goes beyond current commercial state-of-the-art to discuss emerging ideas that are likely to impact microprocessor developments in the next 10 years. 3 hrs. lec. Prerequisites: 18-547.
Course Descriptions

18-859 Special Topics in Communications: Communication and Networking
Fall: 12 units
This course is intended for graduate students who wish to learn about current topics of interest to the communications networking research communities. Part of the course will be tutorial in nature, where the instructor will introduce the topic of interest, primarily through introductory research papers. Part of the course will involve independent reading and group discussion, where students will read research papers on the topic and discuss the papers in class, with an end towards proposing new ideas on the topic. Students registering for the course are expected to have had exposure to undergraduate-level communications courses based on a few homeworks and an independent class reading and research project, on any topic of interest to the student, within the spirit of the course. Group projects will also be acceptable. The topics covered may vary from one course offering to the next. There will be one course offering every two years. This year, the following topics will be discussed, a) Topics on ad-hoc wireless networks, such as Medium Access Control (MAC) protocols, routing schemes, and Quality of Service (QoS), b) Ultra-wideband communications and networking. Prerequisites: 18-396 and 36-217

19-424 Energy and the Environment
Intermittent: 9 units
This course will explore the relationships between environmental impacts and the utilization of energy through a series of case studies on topics of current interest. Such topics might include the use of renewable and non-renewable fuels for electric power generation; energy use for automobiles and other transportation systems; energy use for buildings and industrial processes; and environmental issues associated with urban air quality, radiation exposure, and global warming. The emphasis will be on analysis of environmental-technological interactions and tradeoffs, and their dependency upon engineering design choices, economic variables, and public policy parameters.

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 the more general framework 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, military services 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. Co-requisites: 21-115, 21-116, 33-106

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, military services 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. Co-requisites: 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 Observation 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 and are taught to think critically and creatively about maintaining the quality of life and the environment. Part of the course will be tutorial in nature, where the instructor will introduce the topic of interest, primarily through introductory research papers. Part of the course will involve independent reading and group discussion, where students will read research papers on the topic and discuss the papers in class, with an end towards proposing new ideas on the topic. Students registering for the course are expected to have had exposure to undergraduate-level communications courses based on a few homeworks and an independent class reading and research project, on any topic of interest to the student, within the spirit of the course. Group projects will also be acceptable. The topics covered may vary from one course offering to the next. There will be one course offering every two years. This year, the following topics will be discussed, a) Topics on ad-hoc wireless networks, such as Medium Access Control (MAC) protocols, routing schemes, and Quality of Service (QoS), b) Ultra-wideband communications and networking. Prerequisites: 18-396 and 36-217

19-319 Law and the Engineer
Intermittent: 9 units
Basic legal concepts of interest to the general business/industrial setting are examined for their relevance to the engineering profession. From this foundation, we explore new technologies and their present performance versus future promises, practical approaches that harness the benefits of technology efficiently. We hope to gain an overview of the role of law and policy in shaping the economic growth, the environment of the telecommunications industry. Topics covered are: role of new technologies such as fiber, wireless, voice over packet, and broadband access; principles behind telecommunications regulation from common carrier law and natural monopoly to open access and interconnection; differences in the treatment of telecommunications versus information services. Also, mergers, antitrust, and the changing industrial structure of telecommunications; spectrum allocation and management; and international comparison of telecommunications regulations. Special emphasis on how the new technologies have altered and are altered by regulation. Prerequisites: 73-100

19-402 Telecommunications, Technology Policy & Management
Intermittent: 12 units
This course provides a comprehensive introduction to basic principles of telecommunications technology and the legal, economic, and regulatory environment of the telecommunications industry. Topics covered are: role of new technologies such as fiber, wireless, voice over packet, and broadband access; principles behind telecommunications regulation from common carrier law and natural monopoly to open access and interconnection; differences in the treatment of telecommunications versus information services. Also, mergers, antitrust, and the changing industrial structure of telecommunications; spectrum allocation and management; and international comparison of telecommunications regulations. Special emphasis on how the new technologies have altered and are altered by regulation. Prerequisites: 73-100

19-422 Radiation, Health, and Public Policy
Intermittent: 9 units
This course is concerned with the impact of radiation on public health, and the regulatory and social framework that controls radiation exposure to the public. After an overview of radiation physics and biology, the origin and magnitude of the exposure to the public is considered. Further, the course will introduce the extent of the public to radiation exposure and the determination of the effects of low-level radiation exposure. The course is designed to be an overview of the principles of health risk assessments and of the two major areas of radiation exposure: energy technologies and medical radiation. In each case the role of the government and of the citizen in the decision-making process that affect population exposure and strategies to optimize these roles will be examined.

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 thermochemical equilibrium, flame temperature, chemical kinetics, hydrocarbon chemistry, and flame structure. Formation of gaseous pollutants 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. Prerequisite: senior standing or permission of instructor

19-442 New Technologies and Economic Growth
Intermittent: 12 units
Why are some nations rich and some poor? Has technology got anything to do with it? Is the availability of technology alone sufficient or are there other issues? Broady stated, this is the theme of this course. We shall explore these questions, not just with a few case histories, but with some quantitative analysis and practical approaches that harness the benefits of technology efficiently. We hope to gain an overview of the role of law and policy in shaping the economic growth, the environment of the telecommunications industry. Topics covered are: role of new technologies such as fiber, wireless, voice over packet, and broadband access; principles behind telecommunications regulation from common carrier law and natural monopoly to open access and interconnection; differences in the treatment of telecommunications versus information services. Also, mergers, antitrust, and the changing industrial structure of telecommunications; spectrum allocation and management; and international comparison of telecommunications regulations. Special emphasis on how the new technologies have altered and are altered by regulation. Prerequisites: 73-100

19-444 Technology Transfer
Intermittent: 9 units
Technology, by the products and processes it enables to produce, is now increasingly prized as a major engine for growth. Its success is determined by many variables including the ability to be widely and successfully disseminated. The process of moving technology across corporations and countries is known as Technological Transfer. In this course, we plan to discuss various issues that determine such transfers. These include a detailed analysis of the relationship of technology to economic growth, diffusion mechanisms and the processes for the transfer of "know-how" and "know-why." We shall also consider programs of dual-use or military technology transfers across national borders, and intellectual property protection. There will be a few case studies and also guest lecturers sharing their experience in transferring technologies and protecting patents.
succeeded and failed. The second half of the course will involve 2-3 detailed using historical examples, will explore the reasons why past regulations have economy will react to new regulations can be hard to predict. Unintended side never being realized. This course will review the basics of regulatory policy and effects sometimes occur resulting in costs exceeding estimates and/or benefits.

19-448 Science, Technology and Ethics
Intermittent: 9 units
Technology has always been a pervasive force in society. But the past 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 requires an examination of the responsibility that must guide the action of those who develop, deploy and spread technologies. This course examines the meaning and significance of technology in society through general paradigms and through specific examples. It first traces the stages of technology as described by Bright and Mansfield. It reviews the philosophers with special reference to those whose work has significance for the development of an Ethics for the Technological Age. The course then applies these principles of ethics to the different stages of a technology from scientific discovery and invention through societal impact. Finally, it explores in detail the field of engineering ethics.

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.

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.

19-501 Special Topics in Engineering And Public Policy
Intermittent: 9 units
Special topics dealing with the relationship between technology and public policy in interest areas such as: environmental systems and resources, application of technology to urban problems, energy and fuel utilization, interaction of law and technology, problems in communication technology.

19-600 Undergraduate Research - Sophomore
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 protecting computer networks. 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.

19-609 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.

19-610 Undergraduate Research - Junior
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.

19-620 Undergraduate Research - Senior
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.

19-630 Atmospheric Chemistry Air Pollution and Global Change
Intermittent: 12 units
This course covers the principles necessary to understand the atmospheric behavior of atmospheric particulate matter and the related air quality problems in urban, regional, and global scales. Key topics include aerosol physics, chemistry, thermodynamics and dynamics, removal processes and residence times; aerosol effects on visibility and the energy balance of the planet. The student finishing the course will understand the fundamentals of atmospheric heterogeneous chemistry and their relationship to smog, acid rain, and global climate change.

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.

19-650 Climate and Energy: Science, Economics and Public Policy
Intermittent: 9 units
The climate problem ties energy policy to the geosciences in one of the central environmental dilemmas of the new century. How much will the planet warm? Can we avert climate change without wrecking our economy? The political and economic stakes are high. We will first explore the science of climate change, through study of simple physical models of the atmosphere and climate. Topics will include models of atmospheric radiation and of the vertical and latitudinal temperature structure of the atmosphere. In the latter half of the course we will focus on energy policy through study of the engineering and energetic constraints on industrial systems. Topics will include primary energy sources, energy conversion technologies, and energy economics and policy. Throughout the course we will alternate between lectures that survey the key topics and detailed examples that require student involvement. Analysis of the energy flows and transformations will serve as a unifying theme for the course.

Mathematical Sciences

Undergraduate Courses

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 Topics in Pre-Calculus
Fall: Mini Session - 5 units
A review of precalculus and its use in solving problems similar to those to be encountered in calculus. Placement based upon Placement Test.

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 proofs, games, 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.
Course Descriptions

21-121 Calculus I
Fall: 10 units
Functions, limits, derivatives, curve sketching, Mean Value Theorem, trigonometric functions, related rates, linear and quadratic approximations, maximum-minimum problems, Lagrange multipliers, geometric series, Newton’s method, applications. 3 hrs. lec., 2 hrs. rec. Prerequisites: 21-111

21-122 Calculus 2
Fall and Spring: 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. 3 hrs. lec., 2 hrs. rec. Co-requisites: 21-116

21-124 Differential Equations Lab
Fall and Spring: 3 units
An introduction to the symbolic programming package Maple using mathematical topics chosen from calculus and linear algebra. This course is designed to accompany 21-260 Differential Equations.

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, Taylor’s series; linear and quadratic approximations, maximum-minimum problems. 3 hrs. lec., 2 hrs. rec. Prerequisites: 21-131

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: 15-129 or 21-127
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
All Semesters: 9 units
Taylor’s Theorem; geometric sequences and series and their applications in finance; 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: 21-116 or 21-121

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; other structured optimization problems. 3 hrs. lec., 1 hr. rec. Prerequisites: 06-262 or 18-200 or 18-202 or 21-241 or 21-256 or 21-341

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: 21-116 or 21-121

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: 21-118 or 21-122 or 21-132

21-292 Operations Research I
Spring: 9 units
Operations research offers a scientific approach to decision making, most commonly involving the allocation of scarce resources. This course develops some of the fundamental methods used. Linear programming: the simplex method and its linear algebra foundations, duality, post-optimality and sensitivity analysis; the transportation problem; the critical path method; non-linear programming methods. 3 hrs. lec., 1 hr. rec. Prerequisites: 21-118 and 21-241

21-295 Putnam Seminar
Fall: 3 units
A problem solving seminar designed to prepare students to participate in the annual William Lowell Putnam Mathematical Competition. Students solve and present their solutions to problems posed. 1.5 hrs. lecture/lab.

21-300 Basic Logic
Fall: 9 units
Propositional and predicate logic: Syntax, proof theory and semantics up to completeness theorem, Lowenheim Skolem theorems, and applications of the compactness theorem. 3 hrs. lec. Prerequisites: 21-132 or 21-225 or 21-373 or 21-484

21-301 Combinatorial Analysis
Fall: 9 units
A major part of the course concentrates on algebraic methods, which are relevant in the study of error correcting codes, and other areas. Topics covered in depth include permutations and combinations, generating functions, recurrence relations, the principle of inclusion and exclusion, and the Fibonacci sequence and the harmonic series. Additional topics may include existence proofs, partitions, finite calculus, generating combinatorial objects, Polya theory, codes, probabilistic methods. 3 hrs. lec. Prerequisites: 21-116 and 21-127

21-320 Symbolic Programming Methods
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

21-342 Linear Algebra II
Intermittent: 9 units

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 origins of the ideas of analysis, through to the origins of modern set theory. 3 hrs. lec.

21-355 Advanced Calculus I
Fall and Spring: 9 units
This course expands on topics introduced in the calculus sequence and considers them at a higher mathematical level. Infinite series and sequences, completeness of the real numbers, continuous and differentiable functions. Riemann integral. 3 hrs. lec. Prerequisites: 21-118 or 21-122

21-356 Advanced Calculus II
Spring: 9 units
The calculus of functions of several variables: limits and continuity, differentiability, inverse and implicit function theorems; integrability, Fubini’s Theorem, change of variables in multiple integrals; vector analysis, including Stokes’ Theorem. 3 hrs. lec. Prerequisites: 21-241 and 21-259 and 21-355

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 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: 21-241 and 21-259 and 21-355

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.

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: 21-259

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: 21-257 and 36-225

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: 21-259 and 21-260

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. Both analytic and numerical methods, Green’s functions, 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: 21-259 and 21-260
Course Descriptions

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: 21-241 or 21-341

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: 21-373

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: 21-241 and 21-260

21-383 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: 21-257 or 21-292

21-420 Continuous-Time Finance
Spring: 9 units

21-440 Selected Topics in Algebra
Intermittent: 12 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: 21-127

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: 21-356 or 21-460

21-460 Topology
Intermittent: 9 units
This course introduces the topological concepts that underlie analysis. Included are metric spaces, topological spaces, separation, compactness, convergence and connectedness. Also included are constructions and concepts in topological spaces that parallel those found elsewhere in mathematics such as quotients, products, sums, factorization of mappings, and isomorphisms. Other topics included as time permits according to the interests of the instructor. 3 hrs. lec. Prerequisites: 21-355

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: (21-236) or (21-241 and 21-355)

21-478 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: 21-241 and 21-260

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: 21-127

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: 21-132 or 21-228 or 21-373 or 21-484

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, Ulm 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-Sheinfield 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. Gödel’s Incompleteness Theorems, undecidability, undefinability. Prerequisites: 21-300 or 21-600

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. Co-requisites: 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 orthographic 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: 21-118 and 24-101 and 33-106

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 similitude as an 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. Co-requisites: 21-115, 21-116, 33-106

24-241 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 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: 21-118 and 33-106

24-242 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: 24-261, 21-259 and 33-106

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 and Spring: 10 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: 21-259 and 21-260

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: 21-118, 24-221, 24-231, 24-311, 24-322 and 33-106

24-322 Heat Transfer
Fall: 10 units

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 liqueifiers. Thermodynamics of irreversible systems, including equilibrium criteria, the phase rule, heats of reaction, combustion and dissociation. 3 hrs. rec., 3 hrs. lab. Prerequisites: 24-221 and 24-231

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: 21-259, 21-260, 24-221 and 24-231

24-332 Potential Flow Aerodynamics
Spring: 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: 21-259, 21-260 and 24-231

24-333 Gas Dynamics
Spring: 9 units
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: 21-259, 21-260, 24-221 and 24-231

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: 24-262 or permission of the instructor.
Course Descriptions

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 motion 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: 21-259, 24-261, and 33-106

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: 21-260, 24-351 and 33-107

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 kinematics, rigid bodies including the Newton-Euler equations in 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. Prerequisites: 24-311. Co-requisite: 24-352

24-354 General Robotics
Fall: 11 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 laboratory. 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: 21-118 or 21-122

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. The course bridges 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. Co-requisite: 24-352

24-356 Engineering Vibrations
Fall: 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. Co-requisites: 24-352

24-361 Intermediate Stress Analysis
Spring: 10 units
This course first reviews important solutions from strength of materials, Mohr’s circle, and multifield 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. rec. Prerequisites: 21-259 and 24-262

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. Prerequisite: 24-351; Co-requisite: 24-352

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 thermodynamic engineering; 3 is fluid mechanics; 4 is design and manufacturing; 5 is dynamics and controls; and 6 is solid mechanics. Prerequisites: set by instructor.

24-391 Mechanical Engineering Project
Fall and Spring: 3-12, 16 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.

24-392 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. Problems include the formulation 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: 24-262, 24-321 and 24-352

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: 24-321

24-422 Thermal System Analysis
Spring: 9 units
Performance studies of various thermal processes and devices with emphasis on environmental impact 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: 24-221 and 24-321

24-423 Direct Energy Conversion
Spring: 9 units
Principles of energy conversion between various forms of energy including heat, electricity, and light. Applications. Theory of thermoelectric, thermionic, magnetohydrodynamic, and photovoltaic direct conversion devices, Principles of chemical and mechanical energy storage. Prerequisites: 24-221, 24-231 and 33-107

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 conventional systems 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: 24-221 or equivalent, junior or senior standing

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 thermoequilibrium, flame temperature, chemical kinetics, hydrocarbon chemistry, and flame structure. Formation of gaseous and particulate pollutants in combustion systems, combustion mechanisms, 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. Prerequisites: senior standing or consent of instructor.
Materials Science & Engineering

Undergraduate Courses

27-100 Materials in Engineering
Fall and Spring: 12 units
The objective of this course is to provide an introduction to several important classes of materials and to the use and selection of materials for engineering applications. Polymers, ceramics, semiconductors, metals, glasses and composites are discussed in detail. The physical, optical, electrical and/or mechanical properties critical to the design of the engineered component are also discussed. Considerations involved in materials selection for the particular application are discussed with emphasis on the balance between performance and cost. Processing methods used for improvement of material properties are presented and practiced through a series of laboratory experiments that illustrate the connection between microstructure, properties and processing. Recycling and environmental factors in materials selection are also highlighted. Co-requisites: 21-115, 21-116, 33-106

Course Descriptions

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, directions 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.

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.

27-211 Perfect Crystals
Fall: 9 units
This course is identical to 27-201, but without the 3-unit lab component.

27-215 Thermodynamics of Materials
Fall: 3 units
The first half of the course will focus on the laws of thermodynamics and the inter-relations 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.

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 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.

27-217 Phase Relations and Diagrams
Spring: 12 units

27-299 MSE Undergraduate Seminar I
Fall: 1 unit
This seminar course will address a range of topics, relating to professional development and technical enrichment. Subjects covered will vary from year to year, but will include seminars on current department and college research topics, speakers from various different industries, information on professional societies, resume writing and job-interviewing skills as well as employment opportunities and post-graduate education options.

27-301 Microstructure and Properties I
Fall: Mini Session - 9 units
The objective of this course 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.

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.
Course Descriptions

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 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 Processing of Ceramic Materials
Fall: 9 units
This course addresses the methods used in, and the principles that underlie, ceramics processing. Topics include chemical thermodynamics, reaction kinetics, surfaces, colloids, dispersions, process engineering, powder handling, powder compaction, shape forming, densification and sintering. These aspects of processing science will be discussed in relation to the use of ceramics as engineering materials. The relationship between processing methods for ceramics and the environment will be discussed. The relationship between processing methods and the targeted applications will be discussed using specific examples.

27-357 Introduction to Materials Selection
Fall: 9 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.

27-399 MSE Undergraduate Seminar II
Fall: 1 unit
This seminar course will address a range of topics, relating to professional development and technical enrichment. Subjects covered will vary from year to year, but will include seminars on current department and college research topics, speakers from various different industries, information on professional societies, resume writing and job-interviewing skills as well as employment opportunities and post-graduate education options.

27-401 MSE Capstone Course I
Fall: Mini Session - 6 units
This capstone 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.

27-402 MSE Capstone Course II
Fall: Mini Session - 6 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.

27-403 Capstone Course III
Spring: Mini Session - 6 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. As in the lecture-based capstone courses (27-401,402) the student will be expected to integrate knowledge of materials structure, properties processing and performance in their work.

27-404 MSE Capstone Course IV
Spring: Mini Session - 6 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. As in the lecture-based capstone courses (27-401,402) the student will be expected to integrate knowledge of materials structure, properties processing and performance in their work.

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
Spring: 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 include such topics as electrical conduction in metals and semiconductors, 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.

27-442 Deformation Processing
Intermittent: 9 units
A continuum analysis of plastic flow of isotropic and anisotropic (textured) materials will be applied to deformation processing. Crystallographic models of yielding and plastic flow will be developed and used to characterize various industrial deformation processing techniques.

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 unit
This seminar course will address a range of topics, relating to professional development and technical enrichment. Subjects covered will vary from year to year, but will include seminars on current department and college research topics, speakers from various different industries, information on professional societies, resume writing and job-interviewing skills as well as employment opportunities and post-graduate education options.

27-510 Introduction to 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 Introduction to 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 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 Introduction to Modern Chemistry (09105), Biomaterials-I (42-501), and Introduction to Biomedical and Health Engineering (42101) will be useful, though not required.

27-512 Diffraction Methods in Materials Science
Intermittent: Mini Session - 9 units
This is a specialized course in x-ray diffraction intended for advanced undergraduate students or graduate students. The theory and experimental techniques of diffraction in crystalline solids are introduced. Attention is given to the physical concepts behind crystal structure and diffraction, including the direct and reciprocal lattices, Bragg and Laue diffraction theories and structure-factor calculations. The experimental methods of x-ray and electron diffraction are presented, with emphasis on x-ray diffraction. Topics include the production and scattering of x-rays, factors affecting the scattered intensity, and techniques for obtaining and interpreting diffraction patterns.

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, mechanisms 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 to grow and characterize bulk and multilayered 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 growth 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 ferreoelectricity; and optical properties as they pertain to glasses. The course also includes a discussion of 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. Numerous 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 exam 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.

27-560 Physical Chemistry of Metallurgical Reactions
Spring: 9 units
This course addresses the important rate controlling processes in high temperature reactions, including gas phase mass transfer, free vaporization, 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: 8 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 diffusionless and non-diffusionless 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.

Course Descriptions

27-591 Mechanical Behavior of Materials
Spring: 9 units
Fundamentals of stress and strain. Linear elastic behavior. Tensile testing and yield criteria. Relationships 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 fracturing of highly brittle materials. Time permitting fatigue and creep of materials will be discussed.

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, solid state 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: 27-215

Military Science (Army ROTC)

Undergraduate Courses

30-101 Introduction to Military Leadership
Fall: 5 units
This course will introduce 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 marksmanship, 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.
Course Descriptions

30-202 Applications in Leadership and Combat Power
Spring: 5 units
This course continues the study of the topics covered in 30201 and focuses upon practical applications 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 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-managed team exercises, 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. National Advanced Leadership Course (NALC). Each student must participate in physical training, 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. National Advanced Leadership Course (NALC). 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 experiences are used to reinforce advanced 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 to command and staff positions within the cadet battalion, corresponding to those found in United States Army units. Students perform the duties of the unit 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 the other cadets as part of a functioning command organization. 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 (Air Force 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, officerhood and 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 followship experiences.

31-104 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, officerhood and 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 followship 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 presentation and preparation 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 presentation and preparation 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 presentation and preparation 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 presentation and preparation 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 followship 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 followship experiences.
### Course Descriptions

#### 32-202 Naval Ships Systems I
**Fall: 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.

#### 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

#### 33-100 Basic Experimental Physics
**Fall and Spring: 6 units**
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.
Course Descriptions

33-101 Physics First Year Seminar
Fall: Mini Session - 3 units
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 open only to MCS freshmen.

33-102 Concepts of Modern Physics
Spring: 9 units
This course is designed to provide non-technical students 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 to a limited extent to develop 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.

33-104 Experimental Physics
Fall and Spring: 9 units
This course provides freshmen and sophomores with an introduction 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.

33-106 Physics for Engineering Students I
All Semesters: 12 units
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, equilibria of state, thermodynamic processes, heat engines, refrigerators, first and second laws of thermodynamics, kinetic theory of gases.
Co-requisites: 21-115, 21-116

33-107 Physics for Engineering Students II
All Semesters: 12 units
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, and electromagnetic radiation. The remaining two fifths cover magnetism, including magnetic forces, magnetic fields, and applications of these concepts to gaseous applications with a focus on nuclear and atomic physics.
Co-requisites: 21-117, 21-118

33-111 Physics for Science Students I
Fall and Spring: 12 units
This calculus-based course combines the basic principles of mechanics with 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. Simple computer models will be used to develop insight into the solar system using Newton's laws. Topics covered will include vectors, momentum, force, gravitation, oscillations, energy, quantum physics, center of mass motion, angular momentum, statistical physics, and the laws of thermodynamics. No computer experience is needed.
Co-requisites: 21-115, 21-116

33-112 Physics for Science Students II
Fall and Spring: 12 units
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. Prerequisites: 33-111
Co-requisites: 21-117, 21-118

33-114 Physics of Musical Sound
Spring: 9 units
Prerequisites: 33-114

33-115 Energy and Environmental Issues
Fall: 10 units
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&S and Fine Arts and does not require prerequisites; however, students are expected to have some facility with basic algebra.

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 astrophysics. Subjects covered include the solar system, stars, galaxies, and the universe as a whole. The student should develop an appreciation of the ever-changing universe and our place within it. Computer laboratory exercises will be used to gain practical experience in astronomical techniques. In addition, small telescopes will be used to study the sky.

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 volunteer for 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, kinematics of gases, statistical mechanics (temperature, entropy, and specific heat of the Einstein solid, Boltzmann factor). Co-requisites: 21-116, 21-115

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, Ampere'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, radiation, interference, Computer modeling and visualization, desktop experiments. Prerequisites: 21-116 and 33-131

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 can include anyone who wants an introduction to the physics of the 21st 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: 33-112

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 “Special Relativity” part of the Mechanics problems. This portion of the course has been designed with the intention of introducing students to the ideas of special relativity and of providing some background in the use of Lorentz transformations, 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 (33-338/33-439). Prerequisites: 33-112

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, 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 social science 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. Co-requisites: 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 one hydrogen atom from which approximations of nonlinear systems, numerical analysis of nonlinear systems, including differential equations, complex exponential functions, and Fourier series, are introduced as needed. Prerequisites: 21-122 and 33-112 Co-requirements: 21-260

33-226 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: 33-112

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. The symbolic computing language MAPLE is introduced and used throughout the course. Specific topics include exponential growth and decay, the harmonic oscillator with damping and driving forces, linear approximations of nonlinear systems, numerical analysis of nonlinear systems, coupled oscillators, and wave motion. Necessary mathematical techniques, including differential equations, complex exponential functions, and Fourier series, are introduced as needed. Prerequisites: 21-122 and 33-112 Co-requirements: 21-260

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 II (Modern Essentials). Wave mechanics is then developed in an elementary way, but in sufficient detail to provide a separation 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: 33-211

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: 15-127 and 21-118 and 33-104 and 33-112

33-301 Undergraduate Colloquium II 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 Fundamental concepts of classical mechanics. Conservation laws, momentum, energy, angular momentum, Lagrange's and Hamilton's equations, motion under a central force, scattering section, and properties of particles. Prerequisites: 21-118 and 21-259 and 21-260 and 33-112 and 33-231

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: 33-331

33-338 Intermediate Electricity and Magnetism I Spring: 10 units This course includes the basic concepts of electrostatics, the electric field, and potential, and their calculation in typical configurations; work and energy in electrostatics; the method of images and solution of Laplace's Equation; multipole expansion; electrostatics in the presence of matter; magnetostatics; the magnetic field and vector potential; magnetostatic fields in matter; electrodynamics and electromagnetic waves; introduction to Special Relativity, Lorentz transformations, four-vectors, invariants, and applications to particle mechanics. Prerequisites: 21-259 and 21-260 and 33-112 and 33-232

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 physics. Those currently available are the following: Zeeman effect, light scattering, 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.

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 measurable 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: 33-111 and 33-234

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 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: 33-341

33-345 Mathematical Methods of Physics Fall: 9 units This course is intended to provide mathematical tools useful in upper-level physics courses and advanced theoretical study in the physical sciences. Topics include: complex variables and functions, including power series and integration in the complex plane; Fourier series and transforms; partial differential equations and boundary value problems; Legendre and Bessel functions. Some familiarity with the symbolic language MAPLE (or MATHEMATICA) is assumed. Prerequisites: 21-259 and 21-260 and 33-232

33-350 Undergraduate Research Fall and Spring: 1-20 units The student undertakes a project of interest under the supervision of one of the members of the faculty.

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 unit
A continuation of 33-301, 302 for seniors. All physics majors meet together one hour per week to discuss topics of interest.

33-439 Intermediate Electricity and Magnetism II
Fall: 10 units
Techniques are developed for calculating magnetic fields for typical configurations: Faraday’s Law of induction, magnetostatics in the presence of matter, properties of dipoles, and ferromagnetic materials, magnetic energy. Maxwell’s equations, electromagnetic waves, plane waves, waves in non-conducting and in conducting media, reflection and refraction of waves, guided waves. Electromagnetic radiation: generation and characteristics of electric and magnetic dipole radiation. Application of Special Relativity to electrodynamics: electric and magnetic fields in different reference frames. Prerequisites: 33-338

33-441 Introduction to BioPhysics
Fall: 10 units
This course introduces the use of physical methods in the study of 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 will be treated, 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 diffraction, electron microscopy, spectroscopy, dielectric response and calorimetry.

33-444 Introduction to Nuclear and Particle Physics
Spring: 9 units
Description of 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: 33-234 and 33-338

33-445 Adv 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: 33-234 Co-requisites: 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: 33-445

33-448 Introduction to Solid State Physics
Spring: 9 units
This course begins with 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. X-ray diffraction is then studied as a tool to quantify crystal lattices, including Bragg’s law and structure factors. X-ray diffraction of amorphous substances and liquids is also introduced. Then various types of atomic bonding, e.g., Van der Waals, metallic, ionic, covalent and hydrogen are surveyed. Binding 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. Models are developed to calculate the heated capacities of insulating crystals, to introduce the concept of density of states, and to discuss phonon scattering. The band structure is introduced with emphasis on the band structure of metals and the energy band structure of semiconductors. Prerequisites: 33-234, 33-338 and 33-341

33-451 Senior Research
Fall and Spring: 9 units
Open to all senior physics majors. May include research done in a research 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 project 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.

33-453 Intermediate Optics
Fall: 12 units

33-456 Advanced Computational Physics
Spring: 9 units
This course will emphasize application of practical numerical techniques to the types of problems that are encountered by practicing physicists. The student will be expected to understand the principles behind numerical methods such as SVD decomposition, chi-squared minimization, and 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: 33-241

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: 33-456

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, is shown to provide 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: 33-234

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 the halo of dark matter which encompasses it. Prerequisites: 33-234

33-499 Supervised Reading
Fall and Spring: 1-36 units
The student explores a certain area of advanced physics under the supervision of a faculty member.

33-550 General Relativity
Fall: 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: 33-211 and 33-439

33-658 Quantum Computation and Quantum Information Theory
Spring: 10 units
This course provides an overview of quantum computation and quantum information theory. The topics include: an introduction to quantum mechanics; quantum channels, both ideal and noisy; quantum cryptography; an introduction to computational complexity; Shor’s factorization algorithm; Grover’s search algorithm; proposals for the physical realization of quantum devices, such as ions in traps, solid-state devices, and nuclear magnetic resonance. Linear algebra at the level of 21-241 or 21-341, or as taken up in 33-345, is a prerequisite; in addition, students who are not familiar with vector spaces over complex numbers, including unitary and Hermitian operators, will need to learn these topics on their own. Quantum mechanics is not a prerequisite, but some prior knowledge of the level of 33-334 or 33-445 will prove helpful. Algorithms and complexity theory are not prerequisites, but some prior knowledge at the level of 15-211, 15-251 or 15-451 will prove helpful. This course is also offered for 12 units as 33-758, which involves some additional work.
Statistics

Undergraduate Courses

36-201 Statistical Reasoning, Statistical Practice
All Semesters: 9 units
This course will introduce students to the basic concepts, logic, and issues involved in statistical reasoning. The major topics to be covered include methods for exploratory data analysis. Not open to students who have received credit for 36-207, 36-220, 36-225, 36-325, or 36-247.

36-202 Topics in Statistical Methods
Intermittent: 9 units
This course builds on the principles and methods of statistical reasoning developed in 36-201. It will cover elementary probability theory, statistical methods, and data analysis. Specific topics covered include: conditional probability, regression analysis, analysis of variance, and the analysis of contingency tables. The objectives of this course are to introduce and to develop skills in the applications of the basic principles and methods that underlie the practice of statistics and empirical research. 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, 36-325, or 36-247. Prerequisites: 36-201

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 36-202, 36-220, 36-225, 36-325, or 36-247. Cross-listed as 70-207. Prerequisites: 21-111 or 21-116 or 21-121 and 36-207

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 information theory will be given. The use of a computer package will be an integral part of this course. Not open to students who have received credit for 36-221, 36-225, or 36-325. Prerequisites: 21-118 or 21-122 or 21-256

36-220 Engineering Statistics and Quality Control
Spring: 9 units
This is a course in introductory statistics for engineers with emphasis on modern product improvement techniques. Besides basic probability, distribution theory and statistical inference, special topics include exploratory data analysis, 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 36-220, 36-225, 36-268/70-208, 36-226, 36-326, or 36-247. Prerequisites: 21-111 or 21-116 or 21-121

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 36-325. Prerequisites: 21-112 or 21-118 or 21-122 or 21-256

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 36-326. Prerequisites: 36-217 and 36-225

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 36-202, 36-208, 36-220, 36-225 or 36-325. Prerequisites: 21-111 or 21-116 or 21-121

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: 36-202

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: 36-201 or 36-208 or 70-208

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 presentation. The analysis phase will cover data collection and computation, especially analysis of variance and will, stress the interpretation of results. In addition to weekly lecture, students will attend a computer lab once a week. Prerequisites: 36-202 or 36-220 or 36-247

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 36-326 may not receive credit for this course. Students who have taken 73-360 need permission of the instructor. Prerequisites: 36-203 or 36-208 or 36-309 and (21-112)

36-315 Statistical Graphics and Visualization
Spring: 9 units
This course provides a one-semester introduction to graphical displays of quantitative information with an emphasis on modern product improvement techniques. Besides basic probability, distribution theory and statistical inference, special topics include exploratory data analysis, experimental design, regression, control charts and acceptance sampling. In all semesters: 9 units

36-325 Probability and Mathematical Statistics I
Fall: 9 units
This course is a rigorous introduction to the mathematical theory of probability, and it provides the necessary background for the study of mathematical statistics and probability modeling. A good working knowledge of calculus is required. Topics include combinatorial analysis, conditional probability, generating functions, sampling distributions, law of large numbers, and the central limit theorem. Students studying Computer Science, or considering graduate work in Statistics or Operations Research, should carefully consider taking this course in Fall and 36-225 after consultation with their advisor. Not open to students who have received credit for 36-217 or 36-225. Prerequisites: 21-118 or 21-122 or 21-256

36-350 Data Mining
Fall: 9 units
This course focuses on a variety of methods for the analysis of large data sets. The course provides an introduction to data mining, covering techniques such as regression analysis, association rule mining, and clustering. Students will learn how to use software tools to implement these techniques and to interpret the results of their analyses. Prerequisites: 36-309 or 36-310 or 36-315

Course Descriptions
Course Descriptions

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 73-380 need permission of the instructor. Prerequisites: 36-226 or 36-326 or 36-310

36-402 Advanced Data Analysis
Spring: 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 the design of experiments, the analysis of categorical data, and if time permits, other topics such as nonlinear regression models, survival analysis, and multivariate methods. Real-world examples will be drawn from engineering and the various physical and social sciences. Students will do projects and write reports. Prerequisites: 36-401

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 received credit for from reliability theory, queuing theory, inventory theory, and various applications in the social and physical sciences. Prerequisites: 36-217 or 36-225 or 36-325

36-461 Statistics Topics
Fall: 9 units
The format and content of the course are flexible and vary, depending on demand. Historical applications of statistical methods to real problems of data analysis may be studied, or special topics in probability and statistics such as decision theory, biostatistics, time series analysis, Bayesian statistics or non-parametric statistics may be covered. Prerequisites: 36-226 or 36-310 or 36-326

36-462 Topics in Statistics
Intermittent: 9 units
This course is an introduction to applied multivariate methods. Topics include a discussion of the multivariate normal distribution, the multivariate linear model, repeated measures designs and analysis, principle component and factor analysis. Emphasis is on the application and interpretation of these methods in practice. Students will use at least one statistical package. Prerequisites: (36-309) and (36-226 or 36-326)

MCS Interdisciplinary

Undergraduate Courses

38-101 MCS Freshman Seminar: EUREKA
Fall: Mini Session - 3 units
Excited about science? Join your peers and faculty to explore science and ourselves as scientists, through this seven-week mini course, ending at mid-semester. We will engage in weekly discussions and projects drawn from some of the most exciting advances in science and mathematics. Questions addressed in the past have included: 1) Can we starve cancer cells? 2) Can we determine the origins of the universe by going to the South Pole? 3) Are molecular wires the key to microscopic computers? 4) Can mathematics predict the future of our species?

CIT Interdisciplinary

Undergraduate Courses

39-200 Business for Engineers
All Semesters: 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.

39-405 Engineering Design: The Creation of Products and Process
All Semesters: 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.

39-500 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
All Semesters: 12 units
This course has gained an international reputation as a leading course in new product development. This year, Ford Motor Company will sponsor the course. The projects will focus around a product application in the car, using the Flint Truck division for interdisciplinary teams to work on. The project will be open ended and will involve identifying a product opportunity and developing the opportunity into a product solution.

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. Examples 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 the applications of technology in medicine and biology. In each weekly, hour-long meeting, speakers describe real world problems and the ways they have been trying to solve them. This course acts as an introduction to the physiology and analytical techniques students need to have an understanding of problem environments. Prerequisites: None.

42-301 Physiology
Fall and Spring: 9 units
This course is an introduction to human physiology and includes units on all major organ systems. Particular focus 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 physiological function. Prerequisite: 03-121 Modern Biology OR 03-231/03-232 Biochemistry, or permission of the instructor.

42-377 Rehabilitation Engineering
Fall: 12 units
This course covers system integration and draws on knowledge from all the classical engineering disciplines. Although the course encompasses the application of technology to restoring human functions, its focus is different from the medical/bioengineering method of using prosthetics. Instead, Rehabilitation Engineering uses case studies to teach students how to develop systems that restore mobility, communication, and recreation. Prerequisite: None, but Physiology is useful. Junior or Senior status, or permission of instructor.

42-401 Biomedical Engineering Design
Spring: 12 units
The BMIE design course focuses on integrated product development of biomedical and health products. Teams will consist of BMIE engineers, business, and design 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 will produce a form model, functional prototype, marketing plan, and manufacturing plan of their product. Prerequisite: Senior status.

42-510/27-510 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 will be discussed including 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. Prerequisites: None, but 09-105 Introduction to Modern Chemistry and 42-101 Introduction to Biomedical and Health Engineering will be useful, though not required
Course Descriptions

42-511/27-511 Biomaterials II
Fall: 9 units
This is Part II of a two-part course sequence in Biomaterials. The 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, human health effects, and toxicology 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 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 Health Engineering (42-101) will be useful, though not required.

42-560 Undergraduate Project
Fall and Spring: 9-12 units
Students work with a faculty member affiliated with Biomedical Engineering at the University or in a hospital. Emphasizing resourcefulness and initiative, the student with his advisor will evolve a project with both research and development aspects. Prerequisite: consent of advisor. See Hilda Diamond to assist with an advisor.

42-604 Biological Transport
To Be Announced: 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 solubility; membrane diffusion; reaction-diffusion mechanisms; osmosis; Donnan equilibrium; receptor-mediated binding; lateral diffusion in membranes and reduction of dimensionality; ultra filtration and nephron function; compartmental modeling; pharmacokinetics. Prerequisite: Ordinary differential equations.

42-621/06-621 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 respiration, metabolic regulation, biocorrections, 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. Prerequisites: 03-121 Biochemistry or permission of instructor.

42-622/06-622 Bioprocess Design
Spring: 12 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 include proteins, nucleic acids, and fermentation-derived fine chemicals. Associated regulatory issues and biotech 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 the US biotechnology industry. A fair knot of cell culture and fermentation operations is assumed. Prerequisite: 42-621 Biotechnology and Environmental Processes or equivalent background knowledge. Useful, but not required, background: 03-231 Biochemistry I.

42-644/19-644 | Medical Devices | Spring: 9 units Cross-listed courses: 42-744
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 major portion of the course is a final design project that involves the design of a new medical device or the redesign of an existing device. Junior or senior status.

42-651/12-651 | Air Quality Engineering | Fall: 9 units
This course covers the problems and methodologies of environmental management. We study air pollution, characterization of pollutant sources, behavior of aerosol and gaseous pollutants in the atmosphere, micrometeorology as it relates to pollutants transport, human health effects focusing on the respiratory systems, methods of air pollutant measurement, statistical treatment of data, and regulation of air pollutants including procedures by which regulatory agencies develop and enforce standards. Prerequisite: 12-330, or equivalent.

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 model and part problems is also considered. A minimum of 6 students must be registered for this course to be offered. Prerequisites: 21-280 Differential Equations or permission of instructor.

42-723/12-723 Biological Processes in Environmental Systems
Spring: 12 units
This course presents the theory of microbial 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 in engineered and natural systems. The major applications discussed in this course focus on pollution prevention and waste water treatment including activated sludge, biofilm process, tertiary nutrient removal and manethanogenesis. Prerequisites: 12-720 Water Resources Chemistry or Aquatic Chemistry equivalent, 03-121 Modern Biology or equivalent.

Architecture

Undergraduate Courses

48-095 Architecture for Non-Majors I
All Semesters: 9 units
Architecture for Non-Majors is designed to introduce students from other disciplines to the history, technology, and design skills of architecture. The goal of the course is to assist students in making insightful observations, reasoned analyses, and informed interpretations of buildings. The course provides a brief introduction to architectural history, an overview of drawing fundamentals, and an exploration of architectural ideas through various design exercises using model making and drawing. The course is divided into two parts: history and theory and design and drawing.

48-100 Experiments in Building & Design
Fall: 12 units
This studio explores fundamental issues of design and the design process. Using projects and an associated lecture the course examines perceptual tendencies and their social dimensions in visual and spatial constructions.

48-105 Architecture Fundamentals
Spring: 12 units
Centered on the activity of making and guided by the clarity of craftsmanship, this studio presents a series of problems focused on buildings and context. A hallmark of the spring semester is the design and construction of a piece of furniture. The studio exercises are complemented with continuing study in computer-aided design. Traditional means of representation are used along side computational means, relying on the skills learned in Computer Modeling 1. Prerequisites: 48-100

48-120 Computer Modeling I
Fall: 9 units
This course addresses the use of the computer in architectural design and visualization. Introductions to three classes of software: page layout, image manipulation, and solid modeling, provide the foundation for design exercises. A lecture coupled with lab sections provides hands-on instruction. The first four weeks of the course cover a general introduction to computing environments and fulfills the University Computing Skills Workshop requirement. Course open to students in other disciplines.

48-125 Computer Modeling 2
Spring: 6 units
This course is a continuation of 48-120 and introduces students to a second set of computer-based tools that are useful for students during their studies and later in their professional careers. The course is divided into three modules, each of which concentrates on a specific tool: 1) the ?mark-up? language HTML and its use in the development of web sites; 2) the CAD system MicroStation to introduce students to 2D drafting with a commercial CAD system; and 3) 3D modeling with MicroStation. Prerequisites: 48-120

48-130 Drawing
Fall: 6 units
48-130 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 are 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
Spring: 9 units
Architectural Drawing is a studio course that builds upon the free-hand drawing experience within 48-130 (or 48-131) Introduction to Architectural Drawing. It is aimed at building students’ knowledge of the appearance and representation of architecture in detail. 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.
Course Descriptions

Topics are introduced through lecture demonstrations, in-class exercises (often using the figure) 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 & Composition
Fall: 18 units
This studio is an introduction to architectural composition, how the parts of a building can be assembled to form a meaningful whole. Understanding the compositional principles which characterize the buildings of the past and present and applying them with intent and significance in the design studio are the central thrusts of this course. Prerequisites: 48-105

48-205 Architecture Design & Materials
All Semesters: 18 units
This studio is concerned with the development and refinement of the design of small buildings as informed by the aesthetic and technical knowledge related to the use of materials and the processes of construction. The studio instructors of the second year studio present a lecture series and conduct roundtable discussions that examine specific aspects of this theme. The lecture topics range from investigations of the elements of architecture to case studies of the work of specific architects. Prerequisites: 48-200 and 48-210 Corequisites: 48-215

48-210 Statics
Fall: 9 units
Introduction to vector mechanics; force systems; equilibrium of rigid bodies; centroids and moments of inertia; and applications to beams and trusses. Prerequisites: 21-115 and 21-116 and 33-106

48-215 Materials and Assembly
Spring: 9 units
This course, taught in parallel with 48-205, allows in-depth exploration of the fundamentals of contemporary construction systems and methods. 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 and preliminary sizing of construction systems in wood, masonry, steel, sitecast concrete, and precast concrete; the fundamentals of enclosure systems; and the process of constructing. Prerequisites: 48-210

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 48-210 Statics. Prerequisites: 12-207 or 48-210

48-230 Drawing 3: Perspective
Fall: 9 units
Following a brief review of perspective construction from orthographic views at the outset of the course, the course addresses the subject of perspective on the basis of three distinct understandings of perceptual psychology. Each of these three perspectives is introduced in lecture, developed through in-class exercises, and expanded through out of class work. At the conclusion of each topic, in-class and out-of-class works are assembled into portfolio subma-sions for in-class review. The class concludes with a summary application of free-hand perspective as a part of the design process. The class is conducted in four paired sessions that rotate with each topic. Prerequisites: 48-105 or 48-130

48-232 Drawing 3: Perspective (For Drama Students)
Fall: 6 units

48-240 Historical Survey of World Architecture and Urbanism
Fall: 9 units
This lecture course is the first in the architectural history sequence. It is a broad survey of key buildings from ancient Egypt to the present. Greatest attention is accorded to European and American examples, but lectures are also devoted to the architecture of Pre-Columbian, Islamic, and Asian Cultures. Among the issues addressed in the lectures and reading assignments are the various systems employed to order architectural compositions, the role of buildings as vehicles for the expression of social ideas, and the history of the architectural profession. The goals of this course are to establish a chronological framework for future studies in architecture; to develop skills of description and formal analysis; and to develop basic skills for historical research and writing. Prerequisites: 48-105 and 79-104

48-300 Architecture Design & Site
Fall: 18 units
Focusing on topics of soils, earthwork, roadways, foundation systems, retaining walls, pavements, water management, and planting, and guided by studies in ethnography and ecology, this studio explores buildings and landscape and the stewardship of natural resources. Prerequisites: 48-205 Corequisites: 48-310

48-305 Architecture Design Structure & Construction
Spring: 18 units
This studio is concerned with the development and refinement of the design of buildings, characterized by a structural type as informed by the aesthetic and technical knowledge related to the design of enclosures, the use of materials, and the processes of construction. The studio instructors of the third year studio present a lecture series, with topics that range from investigations of structural and enclosure systems to case studies of the work of specific architects. Students are expected to demonstrate an understanding and application of the knowledge gained from the studio lectures and the preceding technology courses in their work. Projects will be judged in relation to the development of their structural system, enclosure system, material selections, constructability, and clarity of presentation. Prerequisites: 48-300 and 48-312

48-310 Structures 2
Fall: 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 foundations established in 48-210 Statics. Prerequisites: 12-207 or 48-210

48-312 Site
Fall: 9 units
This course examines basic characteristics of soils, stress and displacement, lateral pressure, consolidation, bearing, and slope stability. Investigation, recording, and analysis of site conditions is also discussed, as well as the design of dams, footings and stabilizing structures. Above ground factors having a major effect on design and construction will be examined, including management of surface water and ground water, manipulation and distribution of soil and the life of plants. Prerequisites: 48-217

48-315 Environment I: Climate & Energy
Spring: 9 units
This course introduces architectural design responses for energy conservation, human comfort, and the site-specific dynamics of climate. Students are expected to combine an understanding of the basic laws of comfort and heat flow with the variables of local climate, designing the most viable energy measures from sitting, massing, organization, enclosure detailing, opening control, to system integration and management. To stress the significance of architectural design decisionmaking on energy consumption and comfort, full design specifications and hand calculations are completed for a residential scale building. An overview of world energy consumption in buildings and energy design standards is challenged by lectures of the state of the art in building energy conservation and passive heating and cooling technologies. The course ends with a focus on the design integration of natural conditioning systems and the potentially dynamic interface of mechanical systems in small and large-scale buildings. Prerequisites: 33-106

48-340 Modern Architecture
Fall: 9 units
This architectural history course surveys the modern buildings and literature of the first half of the twentieth century, focusing primarily on Europe but extending also to non-western countries. It begins with a look at the crisis of modernity that plagued most of the western civilization in the late 19th century, up to the present. It then focuses on the major movements of both the avant-garde and other responses to modernity from 1900-1945. The course includes discussions of formal tendencies, theoretical issues, biographical sketches, new technology, political motivations, social & cultural influences that led to the development of modern architecture. Emphasis will be placed on the relationships of buildings to the more general cultural, intellectual, and historical circumstances in which they were created. Special attention will be devoted throughout the course to the important manifestoes, theoretical and critical writings that so determined the project of modern architecture. Prerequisites: 48-240

48-341 History of Theory
Spring: 9 units
This architectural history seminar will study in roughly chronological order some of the major theories and theoreticians of architecture, from Vitruvius, through the Renaissance, the Enlightenment, the 19th-century, up to the present. Working under the premise that architecture is not only building, technology, drawings, etc., but also discourse, meaning, communication, concept, representation and theory, we will attempt to define what constitutes “theory” in architecture, how it relates to other writings such as criticism and history, and especially how (if at all) it relates to the intellectual context and built works of its day, as well as to theories that came before and after it. Prerequisites: 48-240

48-343 American Built Environment Since 1860
Spring: 9 units
This course will explore how buildings and settlements are artifacts and signifiers of social, cultural, political, economic, and aesthetic issues. Concentrating on architecture and urban form, this course will examine changes in the American built environment since 1860. Stylistic properties, building types, technological developments, the architecture of different social and ethnic groups, the role of the designer, and the patterns of urban, suburban, and company town planning will be introduced as vehicles for interpreting the historic meanings of the American built environment. Prerequisites: 48-240
48-344 Architecture of Henry Horbostel
Fall: 9 units
This course will address the architectural career of Henry Horbostel (1867-1961) from the beginning of his architectural education at Columbia University in the late 1880’s through his retirement from the profession in 1939, until the revival of interest in his work in the 1980’s. Unlike the Modernist heroes—Wright, Mies, Corb, Aalto, etc.—even some of their Beaux-Arts predecessors—Hunt, Richardson, White, Potthast, there is not a single monograph on Horbostel, let alone a substantial bibliography of recent publications. The exciting counterbalance to this death of secondary literature is the presence of many nearby significant buildings, and a major archive of original drawings and other documents at CMU. These will play an important role in the course.

48-351 Psychology of Habitation
Spring: 9 units
The Psychology of Habitation is an investigation of what makes buildings tick for people. Not just buildings in fact, but the internal spaces, transitional spaces, with building structures; 2) sound transmission between rooms; e) design space, and most importantly, occupied space. We will quickly review basic precepts of psychology to consider our 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 projects 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 & Occupancy
Fall: 18 units
The premise of this studio is that under certain conditions individuals? and groups? 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. Problems are of a moderately complex nature and size (about 70,000 sf.). Prerequisites: 48-305

48-405 Architecture Design & Systems Integration
Spring: 9 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 disciplinary objectives - structure, enclosure, interior, mechanical, and life safety systems - addressing the issues of constructability and technical innovation. Prerequisites: 48-400 and 48-412 Corequisites: 48-415

48-410 Acoustics
Fall: Mini Session - 4.5 units
This course introduces theoretical foundations and computational methods in architectural acoustics and lighting. Topics in acoustics include: a) review of physiological and psychological acoustics; b) computation of outdoor and indoor airborne sound propagation; c) interaction of air-borne and structure-borne sound with building structures; d) sound transmission between rooms; e) design methods in room and building acoustics; f) fundamentals of vibration control; g) application of computer-aided simulation tools in building and room acoustics. Topics in lighting include: a) review of visual comfort criteria and lighting psychology, b) analytical and numeric methods for the computation of lighting conditions in interior spaces, c) application of computer-aided simulation lighting tools in architecture, d) lighting engineering and design methods. Prerequisites: 33-106

48-412 Environment 3: 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) sizing and selection of equipment; 4) heat loss and gain calculation; 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 of systems, tests, and development of a reference notebook. Prerequisites: 48-105

48-415 Advanced Building
Spring: 9 units
This course introduces the mechanical engineering expertise in supporting building design for the control of heating, air quality, and air conditioning (HVAC) component of the course will include: the role of HVAC systems within the broader context of energy effective and environment-mentally responsive building design; the range of system and hardware alternatives for the generation, distribution, and terminal delivery of space heating, cooling, and ventilation; innovations in the design of HVAC systems and system interfaces (with structure, enclosure, interior, and envelope systems); and an introduction to the calculations and evaluation of system alternatives in relation to thermal performance, air quality, and acoustics. This expertise should be reflected in the studio setting through early design resolution of the HVAC space requirements, network configuration, and aesthetic implications.

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 architectural profession, 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 cultural, social, and economic trends in America. Prerequisites: 48-240

48-441 Frank Lloyd Wright
Spring: 9 units
This architectural history seminar investigates the career, context, and legacy 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 which stimulated and fed off of his designs. The seminar will focus on topics including: 1) Wright’s buildings and projects; 2) the context 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, origins of systems, radical social, political theories, broad urban experiments, and publishing process; 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. Prerequisites: 48-240

48-447 History and Preservation
Spring: 9 units
DESCRIPTION This course investigates issues in historic preservation from a variety of historical, theoretical, and practical view points. Through intensive readings, as well as active participation with field trips and guest speakers, you will be developing the analytical and technical skills needed to communicate your informed preservation positions. The second goal is to use these developing skills to prepare a draft National Register nomination for a building in a yet-to-be-determined Pittsburgh neighborhood. These drafts will be submitted to the appropriate local authorities and community organizations. Prerequisites: 48-240

48-448 1920’s-1930’s: Multidisciplinary Perspectives on the Arts
Intermittent: 9 units
This architectural history seminar will be a study of the period in Arts in Society, the program will also feature guest speakers from the College of Fine Arts and the College of Humanities and Social Sciences.
Course Descriptions

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 analyzing the economic implications 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 the design is emphasized throughout the course. Topics include site selection, building design, construction cost estimation, and real estate finance. Prerequisites: 73-100

48-453 Urban Design
Spring: 9 units
This seminar will explore urban design as a discipline within the profession of architecture and the role architects can play in the continuing evolution of our cities. This seminars 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 and Urban Design
Fall: 9 units
The fifth year urban design studio 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 societal interest are welcomed as the true source of complexity in architecture. This course focuses 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. Prerequisites: 48-405

48-505 Architecture Design in the Urban Context
Spring: 18 units
This course focuses on changing projects presented by fifth year faculty. The goal of the studio is to take a project from a contextural beginning to a fully explored design. The studio is organized around a series of digital charrettes, based on commercial software, to develop manual skills these exercises also require the exploration of new digital design issues. Generally two or three short duration exercises are given in the first half of the semester. These are followed by a furniture construction project developing manual skills these exercises also require the exploration of new curved elements in furniture. Prerequisites: 48-105

48-456 Explorations in Design and Construction of Practical Objects
Spring: 9 units
In the spring the shop elective course is an independent studio in which students will design and fabricate objects of their own choosing using processes which they research on their own. While there are regular class times, with required attendance, and common reviews of progress the course of study is self-designed. The course of study does not necessarily have to result in the construction of a single functional object. It may involve the fabrication of a group of objects or the exploration and development of a process, or the investigation of a historical period or style. A written and approved plan of study is required at the beginning of the semester and a final presentation of the semester’s work is required at the end.

48-507 Sustainable Design and Development
Intermittent: 9 units
This course explores the theory and practice of sustainable design and development, and the creation of high performance, green buildings. Regional and community issues, building design and construction, and the operation and maintenance of ecologically sensitive projects are addressed in a lecture/discussion format. Emphasis is placed on the process by which these projects are undertaken, developed and constructed. Case studies are used extensively in concert with numerous guest lectures and field trips to provide the student with a comprehensive overview of the subject. All material is intended to assist the student in pursuing green design and the tenets of sustainability in their remaining academic and professional experience.

48-508 Autocad/3d
Fall: 9 units
This course is designed to introduce a person to the fundamentals of Autodesk’s AutoCAD software and 3D Studio MAX. Topics include Coordinates, Lines, Circles, Arcs, Zooms, Snaps and Grids, Text, Views, Edit Command, Layers, Planes, Crosshatching, Blocks, Reference Files, Dimensioning, Setting Up and Plotting a Drawing, Model Space and Paper Space, Grips, Isometrics, Translating Drawings, 3D Commands, Animations, Materials, Rendering, Camera Matching, and much more. A complete understanding of how to set up CAD standards for layers, plotting, and symbol libraries will be covered as well as how to use AutoCAD drawings for WEB viewing. Students will learn how to properly set up and manipulate CAD projects combining AutoCAD and 3D Studio MAX software. Animation, materials and rendering concepts will allow students to create realistic animations and realistic renderings. At the conclusion of this course, students will have a project and animations created and architectural CAD standards outlined. Prerequisites: 48-120

48-509 GIS/CAFM
Spring: 9 units
Geographic Information Systems (GIS) use both spatial information (maps) and databases to perform analytical studies on urban models. This course covers underlying geographic concepts (world coordinate system and projections, vector map topology, tiled and layered maps, standard computer map files 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 data is organized and retrieved in different formats accessible to everyone. EIS (Executive Information Systems) and data/drawing access via the WEB will show students how CAFM is used by organizations as a central storage location using many types of infrastructure data.

48-510 Computer Modeling
Fall and Spring: 9 units
This course expands the use of computers as a tool for design and presentation. Lectures emphasize the conceptual understanding of computer techniques and the role computational plays in the fabric of graphic communication. Exercises are organized around a series of digital charrettes, based on commercial software, to give students concrete experience in using the computer as a primary design tool, to develop skills to design efficiently, to explore design alternatives quickly, to develop presentation skills, and to introduce students to animation and virtual reality. Prerequisites: 48-120

48-511 Ethics and Decision Making in Architecture
Spring: 9 units
This course is an introduction to decision-making methods in architectural design. It aims to develop an understanding of concepts of decision-making in architectural design, rational methods and their use in architectural problems, and the relationship to the intuitive design process. Design professionals systematically analyze architectural problems for which decision-making methods are useful, and critically viewing the design process in relation to personal and professional terms are key objectives. Instruction is done using the case study approach and through group projects carried out by students.

48-512 Shop Elective
Fall: 9 units
The fall course is structured through assignments and demonstrations which allow the students to review and develop the basic woodworking skills and knowledge of processes in which they were introduced to in their first year. While developing manual skills these exercises also require the exploration of new design issues. Generally two or three short duration exercises are given in the first half of the semester. These are followed by a furniture construction project for the entire class which comprises the work for the second half of the semester. Some recent exercise topics which have been explored are: 1) The creation of pattern through lamination and inlay, particularly the creation of a repeatable module; 2) The integration of pattern into stick and frame built furniture; 3) The experimentation with concavity and convexity; 4) The integration of straight and curved elements in furniture. Prerequisites: 48-105

48-513 Solar Energy House
Intermittent: 9 units
This elective will take a fresh look at the housing delivery process in response to global and regional change. From climate change, to power deregulation, to suburban sprawl to the rapid proliferation of information technology, change is occurring at a more rapid pace than at any other time in our history. Students will examine both the domestic and international home building industries and synthesize these findings in the form of proposals for innovative housing. Projects include documenting your personal energy and environmental performance; documenting current zero plus energy project global and domestic case studies; proposing new approaches to building systems, new power technologies, new construction techniques and new operational strategies for housing in Pittsburgh. Prerequisites: 48-105 and 48-315

48-514 Japanese Architecture
Fall: 9 units
Japanese architecture is renowned through Asia and the rest of the world as being uniquely progressive while still retaining a sense of cultural identity and uniqueness. This course will focus on the decoding of today’s avant-garde Japanese designers work by learning the historical development of the built environment and understanding the evolution of traditional construction methods. A major component of this course is the interlacing of Japanese art and artifact-making with contemporary design. Prerequisites: 48-105

48-515 Powering the Campus of the Future
Intermittent: 9 units
This seminar course conducted by a multi-disciplinary team of faculty will use the proposed addition to Margaret Morrison Carnegie Hall as an ecological case study of flows and infrastructures on the campus. The design, construction,
operation and de-commissioning of this facility will be investigated on global,
regional, campus, building, system and object levels, with a focus on the impact
of the integration of on-site power generation and recommendations for best
building practices for today's practice. The third of the semester will be conducted in a lecture
format and the remaining time in the semester will be concerned with the
development of multi-disciplinary team projects with regular presentations.

48-582 Topics in 20th Century Architectural Theory
Intermittent: 9 units
This course intertwines a history and an applications thread of lectures and
workshops to ground students in the internal aspects of building design. There is a
focus on understanding quality in selecting and detailing materials, finishes,
equipment, and the methodologies in specification and documentation of these
components. During the semester long "Chair Lab?7, students study history and
functionality of sitting and seating, and reupholster a stuffed chair as a
practicum-slice of topics in furniture and furnishings.

48-583 History and the Literature of the Contemporary Architectural
Speech
Intermittent: 9 units
This course will explore some of the history and literature that supports certain
terms that have particular currency in today's architectural vocabulary and
debates. This class will explore the use and origins of such terms as "New
Urbanism," contextualism, postmodernism, sustainability, functionalism,
technology, and space. The course will show that our current lexicon has origins
in specific authors and events, but that the various meanings applied to such
terms do not imply the consensus that users often imagine. Most authors will be
Western, dating from the twentieth century, but there will be some from the
nineteenth (and a few from the twenty-first) century. The first third of the semester will be
a seminar. Students will be assigned approximately three to six articles or excerpts
to read each week, which they are expected to read closely and critically.
Students will take turns leading discussion of the readings. All students will be
expected to be prepared to participate in discussion each class. In addition to
reading assignments, students will write four short papers.

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 perceptual and
expressive abilities that allow for thorough interpretation of design problems.
Students work as individuals and as members of teams to develop an under-
standing 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: 51-101

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
the use of design techniques related to the design process. Students learn
methods of representation, communication, idea generation, and form develop-
ment. 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
course 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 create. This course is organized as a
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: 51-121

51-132 Introduction to Photographic Design
Spring: 9 units
Introduction to photography for designers through slide-making. Using color slide
film, students learn how to extend their "seeing" with the 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 portfolios of their two-dimensional and three-dimensional work. In addition
to making photographs, we will look at different kinds of existing photographic
imagery, e.g. documentary, advertising, scientific, fine art-to gain an overview of
the medium and learn how photographs effectively communicate information.
Shooting assignments in and out of the studio, critiques, and library research.
Required for all design majors; lab fee; 35mm camera necessary. Prerequisites:
51-101

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 address the scope and scope of the design professions. The course will
be taught seminar style. All students will be expected to read the readings
carefully and critically. The course will consist of class discussions, lectures,
and written assignments, with readings and extensive visual materials. Required for
all design majors.

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 such 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's Lab Press and a guided visit to the Hunt Library's Rare
Book Room. Prerequisites: 51-102

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 how 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 visual 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: 51-201

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 with different means and technologies such as
darkroom working, working with four different materials, computer
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
program. Students explore product aesthetics and basic formal issues as they
pertain to industrial design. This course integrates the principles of three-
dimensional design, drawing and prototyping as they apply to the generation of
product form. Emphasis is placed on issues that dictate the form of products
and their creation. Students develop basic prototyping, conceptual drawing, and
communication skills for the purpose of exploring, analyzing, refining and
communicating design concepts. Required of ID students; lab fee.
Prerequisites: 51-102

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 that 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: 51-211
Course Descriptions

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 communication designers who make and work with images. Extensive shooting and darkroom work and jury reviews are required for communication design majors. 35mm camera necessary; lab fee. Prerequisites: 51-122

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: 51-201 or 51-211

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 preparation of finished art will be emphasized. Field trips to a printer and an electronic pre-press facility, as well as guest lectures from industry, keep this course up-to-date; lab fee.

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: 51-122

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: 6 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 letterform structure 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, monographs, 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: 6 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: 51-231

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 when discovering 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: 51-211

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, hierarchy, flexibility, legibility, 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 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.

51-262 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 evolution of the competitive free market system at national and global levels. The second goal is to demonstrate how design emerged as a powerful tool for corporate and cultural identity in this period. The third goal is to develop an understanding of the basic influences on the formation of design theory and practice in the twentieth century. This is accomplished through the presentation and discussion of primary economic and cultural forms, philosophical ideas, artistic and social movements, and significant individuals and artifacts that represent the period. The course traces both the chronological and the contextual development of design, providing students with an understanding of design as an evolving concept.
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 symbols 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: 51-202

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 the making 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 seeming 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.

51-331 Advanced Calligraphy I
All Semesters: 6 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 selected repertoire of scripts such as Roman, Italic, Sans Serif. Prerequisites: 51-232

51-332 Advanced Calligraphy II
All Semesters: 6 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: 51-331

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 Diagraming
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.

51-337 Using the Human Factors Design Tool
Intermittent: 9 units
51-337 & 51-737 Using the Human Factors Design Tool This course is an introduction to physical and psychological factors of being human, an introduction to the literature on human factors and using the factors to assess and improve existing products. 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 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 aesthetics involved 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 effective as printed pieces, and 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 manufactur- ing 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 assumes literacy in the basic practices of human factors. It focuses on methods for collecting, analyzing, and applying information pertaining to design for human-product interaction. Particular attention is placed on the understanding of how users' current needs and trends that will affect future needs. The primary goal is the translation of that understanding into design criteria (specifications) that will be useful during the formative stages of product development. The variety of formats used in the class includes project work, discussion, presentations and lectures. While the course is directed toward the needs of design students, participation by students from other disciplines may be permitted at the discretion of the instructor.

51-343 Product Morphology
Intermittent: 9 units
"Morphology" refers to 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 reading, modern made and natural, large and small. One major goal of the course is to understand the effects of 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: 51-243 or 51-324

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: 51-211

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: 51-341

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 drawn and painted and we will get to know the student’s individual way of seeing. 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 modalities of visual arguments condition the way we think and see the world.

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 approaches to layout, text, and supporting imagery, will place in context the skills achieved. Prerequisites: 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 an exploration of 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 of drawing may play in the complex process of visual thinking and notation. Consistent with the credits allocated to this course a total of 5 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 Revealing Place: Photographers & Writers Working Together
Intermittent: 9 units
Revealing Place: Photographers and Writers Working Together 9 units Instructors: Jane McCafferty, English Department; Charlee Brodsky, School of Design Photographers and writers have worked together throughout the 20th century to produce powerful and creative documents. We are interested in how photographs and words describe people and places, and the dialogue that happens when words and images come together. Students will work individually and in teams, doing field research in the community as photographers and writers. There will be variety of projects, both on- and off-site, completing a semester-long project. Course is open to Design and English juniors, seniors and grad students by instructor’s permission

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 broadens understanding of the design process. Students will 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 and support his or her ideas, and gain greater familiarity with a wide range of contemporary design work to spend many hours. Prerequisites: Extensive readings, lectures, and discussions of the work of contemporary industrial and communication designers.

51-373 Language in Design
Intermittent: 9 units
Language in Design concerns the "languages" that designers and writers employ from the beginning to the end of the project. In this class, we will apply that knowledge in order to create a project for an outside client. Our use of language changes as we address our clients, our creative collaborators, our pre-press vendors, and our printers. In these situations, language must be tailored to the particular audience if it is to be persuasive. As a part of this class, we will study the persuasive effect of language that lives outside the project in order to improve the project itself. In order to help us accomplish our goals in this project based class, we will read or refer to the work of Linda Flower and John Hayes, Ray Jackendorff and Barbara Landau, Joel R. Levin, Ellen Lupton and J. Abbott Miller, E. H. Gombrich, and S. Hagan. Additionally, we will study and analyze examples of parallel play and how those examples differ from visual/verbal interplay, as we consider the tools needed to create these strong meaningful connections.

51-378 History of the Book and Printing
Intermittent: 9 units
Course Introduction This course studies the evolution of the printed book through a survey of the origin 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 different way. Instead of locating emotion in the responses of an audience, we will try to locate emotion or emotional expression within the design itself. Assignments will involve extensive reading. This course will be conducted as a research seminar, with each student preparing a paper on a subject of personal interest in design.

51-380 Dignity, Design and Action
Intermittent: 9 units
Dignity, Design and Action How would we design to help people realize their dignity and rights as human beings? To answer this question, we will explore what human dignity is, how to design for it and why action is significant to the achievement of this end. Drawing from prominent work in the fields of anthropology, psychology, philosophy, and design studies, the course will develop a definition of human dignity and explore ways it has or has not been designed for in the past, and propose future possibilities with this new theme in mind. Please join us if you are a junior, senior or graduate student, like to speak-up in class, and want to challenge your understanding of design and process. Class size: limit 10 people
Course Descriptions

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 interaction design of graphic forms and the expression of meaning through the use of motion through animation.

51-451 Fundamentals of Joinery & Furniture Design
Fall: 9 units
Intensive introduction to traditional joinery techniques and the properties of wood throughout the entire design program. Students learn the techniques and properties influence design decisions. This course requires the formulation of workmanship in design, and on how the behavior of the user is influenced by the form or aesthetic language of the artifact. Lab fee required. Prerequisites: 51-243

51-452 Furniture Design II
Spring: 9 units
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 form or aesthetic language of the artifact. Lab fee required. Prerequisites: 51-451

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 senior design majors.

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: 6 units
A knowledge and 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 stage 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 stage study. The beginning development of the students creative resources.

54-103 Speech I
Fall: 6 units
(Speaking Voice) The freshman 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 the phonetic alphabet, 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.

54-104 Speech I
Spring: 6 units
(Speaking Voice) The freshman 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 the phonetic alphabet, 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.
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 I Fall Semester Spring Voice I 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. 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 Freshman 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 Blanché introduces them to a highly disciplined, purely physical form and gives students the opportunity to apply techniques in this distinctive style.

54-108 Movement I
Spring: 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. 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 Freshman 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 Blanché introduces them to a highly disciplined, purely physical form and gives students the opportunity to apply techniques in this distinctive style.

54-111 Text
Spring: Mini Session - 3 units
This class is in conjunction with Acting I in the School of Drama. The actor/director learns how to investigate the written text and translates it actively for performance.

54-113 Ballet, Advanced and Beginning
Fall: 6 units
Section A - Advanced An intermediate/advanced level ballet class with a focus on clean, clear, correct execution of the classical dance vocabulary. Section B - Beginning A beginner level ballet class with emphasis on proper body alignment while learning fundamental ballet steps.

54-114 Ballet for Non-Majors
Spring: 6 units
Section A - Advanced An intermediate/advanced level ballet class with a focus on clean, clear, correct execution of the classical dance vocabulary. Section B - Beginning

54-119 Music Theatre Workshop I
Fall: Mini Session - 3 units
An introduction to the integration of the techniques of dance, singing and acting as required for the various forms of musical theatre. Coaching in the ability to work spontaneously and with reality in the imagined world of the musical.

54-120 Music Theatre Workshop I
Spring: Mini Session - 3 units
An introduction to the integration of the techniques of dance, singing and acting as required for the various forms of musical theatre. Coaching in the ability to work spontaneously and with reality in the imagined world of the musical.

54-121 Introduction to Directing
Fall: 12 units
A one year exploration of the directors art through research and performance projects in Art, Music, and Dance.

54-122 Directing I
Spring: 12 units
A one year exploration of the directors art through research and performance projects in Art, Music, and Dance.

54-123 Dance I
Fall: 4 units
The freshman year is devoted to issues of posture, body alignment and placement to dealing with issues of weight distribution and weight change, as well as elementary positions and movements. Non-drama Majors may not register for this course without the permission of the instructor.

54-124 Dance I
Spring: 4 units
The freshman year is devoted to issues of posture, body alignment and placement to dealing with issues of weight distribution and weight change, as well as elementary positions and movements. Non-drama Majors may not register for this course without the permission of the instructor.

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.

54-134 Directing for Non-Majors
Spring: 6 units
Directing for Non-Majors - An introductory course that examines some of the basic tools of the director. Emphasis is completely on theatrical work although some elements are applicable to television and film. You are required to direct at least three of the assignments and you are also required to perform in other students scenes. This directing course is a prerequisite to any other directing courses in the department.

54-151 Electrics Stagecraft
Fall: Mini Session - 3 units
An introduction to the technical elements of lighting. Students will gain practical experience in the operation and maintenance of lighting instruments, control boards, dimmers, electricity, wiring and safety.

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 patterning, the machinery used for costumes and the craft orient elements that might be involved.

54-163 Introduction to Production
Fall: 6 units
Entry level course in the safe use of tools and equipment used in the production of live theater. Areas covered include: scene shop, costume shop, lighting, paint shop, rigging and props. Evening crew assignments in the Rauh Studio Theater provide practical use of the skills learned in the class. No prior experience required.

54-164 Introduction to Production
Spring: 6 units
Entry level course in the safe use of tools and equipment used in the production of live theater. Areas covered include: scene shop, costume shop, lighting, paint shop, rigging and props. Evening crew assignments in the Rauh Studio Theater provide practical use of the skills learned in the class. No prior experience required.
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 drawings; 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 drawings; 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 Freshman course which introduces the Dramatic Text as central to the art of theatre 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 Freshman course which introduces the Dramatic Text as central to the art of theatre 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.

54-187 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.

54-190 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. Prerequisites: 54-187

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.

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.

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.

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. The Neutral Mask work is immediately reinforced with applications to their scene work in Acting class.

54-208 Movement II
Spring: 6 units
This term is divided between 2 classical 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), learn their psychology and physically, 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 is nothing to do with the American Barnum and 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.
Course Descriptions

54-214 Singing for Actors
   Intermittent: 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 as lab example for study in Music Skills. The dynamics of ensemble singing will aid in the experience of developing disciplined musicianship.

54-219 Music Theatre Ensemble Singing
   Fall: 6 units
   The students will review and build upon Freshman 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 Music Theatre Workshop II
   Spring: 3 units
   Beginning study for sophomores. Lectures on the marriage of text and music for the actor. Treating the song as a monologue; developing the text of the song through exercises including story-telling, body awareness and unlocking emotional inner life of song text. Project includes a cabaret performance.

54-221 Directing II
   Fall: 9 units
   In the fall semester all sophomore drama students are enrolled in one of three sections. The course is an exploration of time and space as they relate to the theatre. The students learn and practice fundamental staging techniques and play analysis is studied from the director’s perspective. The course considers how technique and analysis come together in dramatic story telling. The spring semester is for directing majors and BHA students with a directing concentration. This course takes the first semester issues and examines them in more detail, with frequent practical applications and individual critiques.

54-222 Directing II
   Spring: 9 units
   In the fall semester all sophomore drama students are enrolled in one of three sections. The course is an exploration of time and space as they relate to the theatre. The students learn and practice fundamental staging techniques and play analysis is studied from the director’s perspective. The course considers how technique and analysis come together in dramatic story telling. The spring semester is for directing majors and BHA students with a directing concentration. This course takes the first semester issues and examines them in more detail, with frequent practical applications and individual critiques.

54-223 Dance II
   Fall: 2 units
   The sophomore year is all about the dance vocabulary: teaching the proper execution of dance steps. Non-drama Majors may not register for this course without the permission of the instructor.

54-224 Dance II
   Spring: 2 units
   The sophomore year is all about the dance vocabulary: teaching the proper execution of dance steps. Non-drama Majors may not register for this course without the permission of the instructor.

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
   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.

54-231 Design for the Stage
   Fall: 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 Intro to Scene Painting
   Fall: 6 units
   This is a beginning course in the foundations of scene painting for the theatre. Students will complete projects covering some basic issues in technique, aesthetics, and shop protocol. Some of the topics covered include: painting textures, trompe l’oeil, transluscence, working in scale; subjects for painting could include landscape, architecture, the human figure, drapery and cloth, and close-up views of natural and manmade textures and objects.

54-238 Introduction to Scene Painting
   Spring: 4 units
   This is a beginning course in the foundations of scene painting for the theatre. Students will complete projects covering some basic issues in technique, aesthetics, and shop protocol. Some of the topics covered include: painting textures, trompe l’oeil, transluscence, working in scale; subjects for painting could include landscape, architecture, the human figure, drapery and cloth, and close-up views of natural and manmade textures and 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 IMPROV course covers the basics for comedy improv performance. Will give students a basic improv vocabulary and sense of comedy timing, will increase students sense of play and freedom on stage, foster imagination and culminate in an original comedy improv performance on campus.

54-242 Improvisation
   Spring: 4 units
   This IMPROV course covers the basics for comedy improv performance. Will give students a basic improv vocabulary and sense of comedy timing, will increase students sense of play and freedom on stage, foster imagination and culminate in an original comedy improv performance on campus.

54-245 History of Clothing
   Fall: 4,6 units
   History of Clothing traces the development of garments of the Western World from Egypt to the beginning of the 20th Century. A two-semester course that involves lectures, slides, research projects, quizzes and exams, either fall or spring can be taken separately. 4 unit option without research projects available for non-majors.

54-246 History of Clothing
   Spring: 4,6 units
   History of Clothing traces the development of garments of the Western World from Egypt to the beginning of the 20th Century. A two-semester course that involves lectures, slides, research projects, quizzes and exams, either fall or spring can be taken separately. 4 unit option without research projects available for non-majors.

54-251 Introduction to Lighting Design
   Fall: 6 units
   Basic theories of stage lighting emphasizing technical and aesthetic aspects, leading to practical planning of light plots for individual plays. Coursework includes evaluation of lighting of departmental productions.

54-252 Introduction to Lighting Design
   Spring: 6 units
   Basic theories of stage lighting emphasizing technical and aesthetic aspects, leading to practical planning of light plots for individual plays. Coursework includes evaluation of lighting of departmental productions.

54-259 Production Prep II
   Fall: 9 units
   Hands on experience in most aspects of building and running a production.

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
   This course 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 for Non-Majors
   Spring: 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.
54-281 History of Drama
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 I
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: 9 units

54-292 Speech and Phonetics Instruction and Outreach
All Semesters: 9 units

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
Basic techniques of stage make-up and their adaptation to theatrical styles.

54-299 Special Topics in Playwriting
Fall: 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: 54-189

54-300 Advanced Studies in Playwriting
All Semesters: 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.

54-301 Junior Studio
Fall: 3, 4, 6, 9 units
Exploration of the actors personal process. Exercises to strengthen the actors use of self through the development of the inner emotional and imaginative resources. A full, natural connection to the text through action. The use of classical texts to develop the individual actors abilities with tragic and comedic techniques as a support to the natural, creative talent.

54-302 Junior Studio
Spring: 3, 4, 6, 9 units
Exploration of the actors personal process. Exercises to strengthen the actors use of self through the development of the inner emotional and imaginative resources. A full, natural connection to the text through action. The use of classical texts to develop the individual actors abilities with tragic and comedic techniques as a support to the natural, creative talent.

54-303 Speech III
Fall: 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
Course Descriptions

54-304 Voice and 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 semester 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: Monostent personal writing projects, assigned monologues and independent vocal projects on voice related subjects.

54-307 Movement III
Fall: 4 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: 4 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: 4 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: 4 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 with his/her peers, in a creative and experimental atmosphere, the principles and techniques developed in the classroom.

54-313 Shakespeare
Fall: Mini Session - 3 units
An acting mini slated for the second mini fall semester 2002 for Junior and Seniors actors in the School of Drama. Guest director Jon Van Burek will teach.

54-319 Cabaret
Fall: 6 units
Advanced study for juniors in the integration of dance, singing, and acting as three equally necessary components of the musical theatre. Projects include musical theatre scene study and performance.

54-320 Music Theatre Scenes
Spring: 6 units
Advanced study for juniors in the integration of dance, singing, and acting as three equally necessary components of the musical theatre. Projects include musical theatre scene study and performance.

54-322 Directing Seminar
Spring: 4 units
An advanced workshop exploring the principles of directing varying forms of theatre, and the steps necessary in the creative and collaborative process. Acting students perform in scenes that are researched, planned and realized by the directors. Various levels of showings and discussions follow.

54-323 Dance III
Fall: 2 units
In the junior year we work on expanding the dance vocabulary and developing a higher level of technical skill. In this year we also try to develop a fuller sense of movement, i.e., taking our knowledge of vocabulary and technique and using to DANCE. Non-drama Majors may not register for this course without the permission of the instructor.

54-324 Dance III
Spring: 2 units
In the junior year we work on expanding the dance vocabulary and developing a higher level of technical skill. In this year we also try to develop a fuller sense of movement, i.e., taking our knowledge of vocabulary and technique and using to DANCE. Non-drama Majors may not register for this course without the permission of the instructor.

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, scriptural 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 periodic 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 fulful 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
Advanced Scene Painting is a year long course designed to explore some of the more complex problems of scene painting, including 3-D work, painting on materials that demand difficult painting techniques, more intensive subject matter, collaborative projects, shop techniques and working on pieces for public display. The student will be expected to work outside of the classroom. Prerequisites: 54-237

54-338 Advance Scene Painting
Spring: 4 units
Advanced Scene Painting is a year long course designed to explore some of the more complex problems of scene painting, including 3-D work, painting on materials that demand difficult painting techniques, more intensive subject matter, collaborative projects, shop techniques and working on pieces for public display. The student will be expected to work outside of the classroom.

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
Course follows a chronological sequence dealing with the transaction of historical costume forms and details into theatrical terms. Emphasis on the use of design principles to communicate and express character, mood, style, etc. Figure, drawing and painting techniques are incorporated into the course. Studies in
design techniques with a basic approach to the figure and how it is costumed to suit the production. Emphasis on interpretation, director-designer communication, and the design process.

54-342 Costume Design I
Spring: 9 units
Course follows a chronological sequence dealing with the transaction of historical costume forms and details into theatrical terms. Emphasis on the use of design principles to communicate and express character, mood, style, etc. Figure drawing and painting techniques are incorporated into the course. Studies in design techniques with a basic approach to the figure and how it is costumed to suit the production. Emphasis on interpretation, director-designer communication, and the design process.

54-343 Costume Construction I
Fall: 6 units
Study of and practical work in primary costume construction principles; emphasis on the development of patterns from the basic costume shapes through history.

54-344 Costume Construction I
Spring: 6 units
Study of and practical work in primary costume construction principles; emphasis on the development of patterns from the basic costume shapes through history.

54-349 Automated Lighting Technology
Fall: 6 units
Automated Lighting Technology covers all aspects of moving lights and other intelligent fixtures for the entertainment industry. Hardware operation and programming as well as offline software available in the genre will be explored in a hands-on environment.

54-350 Automated Lighting Technology
Spring: 6 units
Automated Lighting Technology covers all aspects of moving lights and other intelligent fixtures for the entertainment industry. Hardware operation and programming as well as offline software available in the genre will be explored in a hands-on environment.

54-351 Lighting Design I
Fall: 9 units
Emphasis on developing a design process through script analysis and the practical application of lighting in lab exercises. Includes problems of design for different theatrical spaces and explores the genres of drama, musical theatre, architectural lighting and television. Lighting designers for departmental productions are chosen from this class. Prerequisites: 54-251

54-352 Lighting Design I
Spring: 9 units
Emphasis on developing a design process through script analysis and the practical application of lighting in lab exercises. Includes problems of design for different theatrical spaces and explores the genres of drama, musical theatre, architectural lighting and television. Lighting designers for departmental productions are chosen from this class.

54-353 Structural Design I
Fall: 9 units
This course is the first of two semesters teaching the process of Allowable Stress Design, specifically for theatrical applications. Students learn the design of discrete structural components (beams and columns) in both wood and steel. There are no specific Prerequisites, but those enrolled must be conversant with Algebra and Trigonometry.

54-354 Structural Design II
Spring: 9 units
This course is the first of two semesters teaching the process of Allowable Stress Design, specifically for theatrical applications. Students learn the design of discrete structural components (beams and columns) in both wood and steel. There are no specific Prerequisites, but those enrolled must be conversant with Algebra and Trigonometry.

54-361 Production Prep III
Fall: 12 units
Advanced students are assigned positions as head or assistant head of various technical crews, i.e., lights, costumes, properties, paints.

54-362 Production Preparation III
Spring: 12 units
Advanced students are assigned positions as head or assistant head of various technical crews, i.e., lights, costumes, properties, paints.

54-365 Machine Design I
Fall: 9 units
The fundamentals of moving scenery through the use of machinery. An examination of the theory, physics and mathematics applied to stage machinery, combined with hands-on experimentation with mechanical devices. The course will cover various forms of power, including electric motors and fluid actuators, as well as methods of control of devices.
Course Descriptions

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
Fall: 9 units

54-394 Speech and Phonetics Instruction and Outreach
Spring: 9 units

54-395 Internship
Fall: 6-36 units

54-396 Internship
Spring: 2-36 units

54-399 Special Topics in Playwriting
Fall: 9 units Prerequisites: 54-189

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 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.

54-404 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 do 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 do 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: 6 units
In the Senior year, students may study stage combat, including hand-to-hand, quarterstaff, and single rapier, leading to scene work incorporating these skills. Other studies might include dramatic acrobatics, circus skills, and Eastern disciplines such as yoga, Tai Chi, etc. Focus on personal physical style; application of movement training on the mainstage in performance.

54-408 Movement IV
Spring: Mini Session – 3 units
In the Senior year, students may study stage combat, including hand-to-hand, quarterstaff, and single rapier, leading to scene work incorporating these skills. Other studies might include dramatic acrobatics, circus skills, and Eastern disciplines such as yoga, Tai Chi, etc. Focus on personal physical style; application of movement training on the mainstage in performance.

54-409 Theatre Lab
Fall: 4 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: 4 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.

54-423 Dance IV
Fall: 3 units
The senior year is about being ready to put it on the stage, becoming well-rounded dancers and covering any special material (dancing with a partner, for example) that may still need to be covered. Non-drama Majors may not register for this course without the permission of the instructor.

54-424 Dance IV
Spring: 3 units
The senior year is about being ready to put it on the stage, becoming well-rounded dancers and covering any special material (dancing with a partner, for example) that may still need to be covered. Non-drama Majors may not register for this course without the permission of the instructor.

54-431 Scene Design II
Fall: 9 units
Scene Design II is a two-semester investigation in the processes, challenges and techniques for the development of scenic environments within the context of theatrical production. The fall semester of Scene Design II focuses on an exploring “pragmatic solutions” (from time to time, discussions will broaden to include the media of film and video) in design development. Disciplines of collaboration, conceptualization and communication as fundamental to successful professional development are explored, discussed and evaluated within the context of class projects and departmental production assignments. Projects will emphasize problem-solving goals in text analysis, research and the selection of period styles; clarity of presentation as well as organization and graphic skill development is emphasized. Discussion of period styles and historical production design will be on-going. Prerequisites: 54-331.
Course Descriptions

54-432 Scene Design II
Spring: 9 units
Scene Design II is a two-semester investigation in the processes, challenges and techniques for the development of scenic environments within the context of theatrical production. The fall semester of Scene Design II focuses on an exploring “pragmatic solutions” (from time to time, discussions will broaden to include the media of film and video) in design development. Disciplines of collaboration, conceptualization and communication as fundamental to successful professional development are explored, discussed and evaluated within the context of class projects and departmental production assignments. Projects will emphasize problem-solving goals in text analysis, research and the selection of period styles; clarity of presentation as well as organization and graphic skill development is emphasized. Discussion of period styles and historical production design will be ongoing.

54-433 Producing for TV and Film
Fall and Spring: 6 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 process of The Creative Team (Designers and Directors) in creating imaginary commercials, corporate material, documentaries and dramatic pieces. This is a one-semester course in clarifying and enriching the collaborative development and refinement. Prerequisites: 54-341

54-442 Costume Design II
Spring: 4.0 units
Costume Design II is a two-semester investigation in the processes, challenges and techniques for the development of visual character within the context of theatrical production. The fall semester of Costume Design II focuses on an exploring “pragmatic solutions” (from time to time, discussions will broaden to include the media of film and video) in design development. Disciplines of collaboration, conceptualization and communication as the fundamentals of successful professional development are explored, discussed and evaluated within the context of class projects and departmental production assignments. Projects will emphasize problem-solving goals in text analysis, research, the selection of period detail and project organization, as well as graphic skills development and refinement. Prerequisites: 54-341

54-444 Costume Construction II
Spring: 6 units
Advanced work in costume building; individually assigned to strengthen the skills of the students. Prerequisites: 54-343

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.

54-450 Scenic Crafts and Materials
Fall: 6 units
An introduction to casting and moldmaking techniques and materials including various gypsum, mold rubbers, plastics, and vacuum processes.

54-451 Lighting Design II
Fall: 9 units
Advanced problems of design in a variety of genres: dance, opera, musical theatre, and concerts. This course includes hands-on lab projects and discussion and evaluation of the design process. Integration of computer lighting software. Designers for departmental productions are chosen from this class.

54-452 Lighting Design II
Spring: 9 units
Advanced problems of design in a variety of genres: dance, opera, musical theatre, and concerts. This course includes hands-on lab projects and discussion and evaluation of the design process. Integration of computer lighting software. Designers for departmental productions are chosen from this class.

54-453 Production Management Workshop
Fall: 9 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.

54-461 Production Preparation IV
Fall: 15 units

54-462 Production Preparation IV
Spring: 15 units

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.

54-476 Automation Control Systems
Spring: 9 units
This class introduces and explores the fundamentals of the automation control systems used for moving scenic elements and effects in a live production environment. Manual, PLC and PC Servo based control systems are investigated and compared. Closed and Open Loop control systems are defined and compared. Proprietary theatrical control systems are reviewed, compared and contrasted.

54-477 Technical Design II
Fall: 6 units
This course continues a project-based exploration of creative solutions to tricky stagecraft problems. Students will complete weekly assignments detailing their solutions to the challenges presented. This is an upper-level class which seeks to unify the “toolbox” of the Technical Designer. Prerequisites are Structural Design, Scenic Construction Practices, Rigging, and Production Planning. AutoCAD is also a Prerequisite for this course.

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 theatre, opera and ballet repertory will be studied. Interfacing with current projects on campus and in the community will be provided as permitted.

54-481 History of Drama
Fall: Mini Session - 3 units
Two Senior level minis.

54-482 History of Drama
Spring: 3 units
Two Senior level minis.
Course Descriptions

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.

54-485 Speech and Phonetics Instruction and Outreach
Fall: 9 units

54-486 Speech and Phonetics Instruction and Outreach
Fall: 9 units

54-491 Theatre Studies Thesis
Fall: 9 units

54-492 Theatre Studies Thesis
Spring: 6-8 units

54-494 Business of the Business
Fall and Spring: 3 units
BUSINESS OF THE BUSINESS 54-494 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’s professional publications and web sites. Occasional tests are administered on the subject of current Broadway and Off-Broadway seasons. Prerequisite : Successful completion of 54-301 and 54-302.

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 and Fall: 3 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 Singing Lesson/Lab
Fall and Spring: 6 units
A conversation in which musical theatre students may perform musical pieces for one another. This time is designed to give the student a testing ground for studio repertoire or possible audition material. Private voice instruction designed to develop the fundamentals and techniques of the singing voice.

54-502 Junior Auditioning
Fall and Spring: 2 units
This is a two-semester course for Junior Actors to learn how to Audition. Specific goals are: to learn the givens of the Audition process; to learn how to choose audition pieces that work for you; to learn how to contrast Audition pieces; to learn how to shape an effective Audition; to learn how to deal with cold readings; to learn to present yourself in a professional manner.

Music
Undergraduate Courses

57-090 Basic Theory Skills
Fall: Mini Session - 0 units
This course is designed to prepare students with little or no theory background to succeed in the sequence of harmony and counterpoint classes (course numbers 151-154). Topics covered include clefs, scales of all types, intervals, simple chord types, basic notation and terminology, and fundamental concepts of analysis.

57-101 Introduction to Music Technology
All Semesters: Mini Session - 6 units
This course serves as an introduction to music technology. The curriculum was designed to target the end user with lots of practical hands-on projects. Music technology concepts such as MIDI and digital audio are introduced and specific music topics are covered in detail including MIDI sequencing, music notation, digital recording, production and computer-aided learning for music theory, ear training, and improvisation.

57-111 Dance I
Fall: 3 units
Dance I is a dance technique unique to the United States. The warm-up activities are designed to prepare the body for the specific demands of its style of movement. The music, while basically jazz, may range from gospel to punk rock. This course is designed for voice majors. Levels one and two consist of intensive body stretching, body awareness, body discipline, understanding the use of technique and conditioning.

57-112 Dance II
Spring: 3 units
Dance II is a dance technique unique to the United States. The warm-up activities are designed to prepare the body for the specific demands of its style of movement. The music, while basically jazz, may range from gospel to punk rock. This course is designed for voice majors. Levels one and two consist of intensive body stretching, body awareness, body discipline, understanding the use of technique and conditioning. Prerequisites: 57-111

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. All dissonant and chromatic harmony is to be explored and learned. Prerequisites: 57-152

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: 57-153

57-161 Eurhythmics I
Fall: 3 units
Daleroce 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. Eurhythmics II introduces combinations of binary and ternary metric units, mixed meters, changing meters, and notation and performance of cross-rhythms.

57-162 Eurhythmics II
Spring: 3 units
Continuation of 57-161. Prerequisite: 57-161

57-163 Eurhythmics III
Fall: 3 units
Eurhythmics III focuses on rhythmic transformation, rhythm patterns based on small note values, irregular sub-divisions of metric units and more complex cross-rhythms. Eurhythmics IV focuses on changing metric units within a composition, polymeter and asymmetric rhythmic augmentation diminution based on Messiaen techniques. Prerequisites: 57-162

57-164 Eurhythmics IV
Spring: 3 units
Continuation of 57-163. Prerequisite: 57-163

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.
This course is designed to improve the student’s ability to analyze music aurally and to sing at sight music in traditional meters and tonalities using the fixed “do” system. Section assignment is determined by a placement test given at the time of the audition or prior to the start of classes.

Solfege II
Spring: 6 units
Continuation of 57-181. Prerequisite: 57-181

Solfege III
Fall: 6 units
Solfege is the integration of the three cognitive skills: reading music, hearing music and writing what one hears. In the Fall Semester, students are given assignments of classical music written in the treble, bass, soprano, alto, and tenor clefs. Writing consists of two-part contrapuntal dictations. In the Spring Semester, students learn to read atonal music and practice three-part contrapuntal dictations as well as harmonic dictations. Prerequisites: 57-182

Solfege IV
Spring: 6 units
Continuation of 57-183. Prerequisite: 57-183

Advanced Solfege I
Fall: 6 units
Advanced work for experienced students and those with perfect pitch.

Advanced Solfege II
Spring: 6 units
Advanced work for experienced students and those with perfect pitch. Prerequisites: 57-185

Keyboard Studies I
All Semesters: 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, sight-reading, solo and ensemble repertoire, transposition and a variety of creative activities such as harmonization and improvisation.

Keyboard Studies II
All Semesters: 3 units
Continuation of 57-191. Prerequisite: 57-191

Skills of Accompanying I
Fall: 3 units
A required course for first-year piano majors. The skills themselves include sightreading, basic keyboard harmony and 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 andclass presentations. The presentations are critiqued by the instructor and by other students.

Skills of Accompanying II
Spring: 3 units
Continuation of 57-193. Prerequisite: 57-193

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 Sixteenth century to the Twentieth 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, but reading and thinking ability are emphasized on tests and exams.

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 Eighteenth 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, but reading and thinking ability are emphasized on tests and exams.

18th and 19th Century Music
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, but reading and thinking ability are emphasized on tests and exams. Prerequisites: 57-173

20th Century Music History
Spring: 9 units
This course explores the main currents of musical thought and style in the 20th century, starting with Debussy. Of special importance are the emergence of popular music as a separate category, the concept of randomness, and the new relativistic view of musical time and space. Reading assignments and listening to music are equally important for class sessions, but reading and thinking ability are emphasized on tests and exams.

Secondary Studio
All Semesters: 3-9 units
Provides the opportunity for students to pursue study in a secondary instrument or area. By special permission only.

Dance III
Fall: 3 units
Jazz is a dance technique unique to the United States. The warm-up activities are designed to prepare the body for the specific demands of its style of movement. The music, while basically jazz, may range from gospel to punk rock. This course is designed for voice majors. Levels one and two consist of intensive body stretching, body awareness, body discipline, understanding the use of technique and conditioning. Levels three and four emphasize technique. Prerequisites: 57-112

Dance IV
Spring: 3 units
Continuation of 57-211. Prerequisite: 57-211

English Diction
Fall: 3 units
The objective of this one-semester course is to help singers sing English songs from the Classical and Musical Theater repertoire with clarity, accuracy, ease, uniformity and expressiveness; to illuminate meaning and improve tonal quality through diction.

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 coaching.

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.

German Diction
Spring: 3 units
A study of the fundamentals of German 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 coaching.

Contemporary Ensemble
All Semesters: 3 units
This ensemble program includes 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.

Jazz Ensemble
All Semesters: 3 units
These are Jazz Ensembles (Section A and Section B) incorporate a comprehensive approach to Big Band performance and study. Both ensembles perform from four to six times a year as part of the School of Music 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 where there is a concentration on a specific genre. Jazz ensemble is carefully coordinated with the Jazz Performance Minor program, the Jazz Vocal Ensemble and the other major ensembles as a part of a philosophy to continually challenge and prepare students for professional music careers. Admission to both jazz ensembles is by competitive audition and actual placement in one or the other ensembles is determined by the director. Grading is based on attendance, preparation and consistent progress.

Chamber Music
All Semesters: 3-6 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 interpretive conclusions that are stylistically sound, yet individualistic and creative. A jury is required each semester.

Course Descriptions
Course Descriptions

57-232 Chamber Music (Guitar)
All Semesters: 3-6 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 interpretive conclusions that are stylistically sound, yet individualistic and creative. A jury is required each semester.

57-240 Acting I
Fall: 6 units
The basics of acting will be established throughout the first year following the guidelines 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
Continuation of 57-240. Prerequisite: 57-240

57-257 Orchestration I
Fall: 6 units
This is an introductory course for all music majors. It is 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: 57-152

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. Tonal, serialism and aleatoric devices will be studied. Compositional techniques of the Twentieth 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: 57-153

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, the student writes a Fugue for string quartet. Prerequisites: 57-154

57-271 Orchestration II
Fall: 6 units
This course is designed for junior composition majors; others are admitted by evaluation of the professor. The students will analyze music from the Classical to the Avant-garde and use the knowledge acquired to orchestrate piano scores in the appropriate style. Style, practicality, color, and imagination are encouraged. Prerequisites: 57-257

57-272 Orchestration III
Spring: 6 units
This course is designed for junior composition majors; others are admitted by evaluation of the professor. It is an extension of Orchestration II and combines orchestration and composition. Prerequisites: 57-271

57-273 Piano Pedagogy I
Fall: 6 units
This course offers an historical overview of piano pedagogy including its significant developments over the past thirty 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. Questions 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-majors will be discussed. Prerequisites: 57-273

57-275 Piano Pedagogy III
Fall: 6 units
Continuation of 57-274. Intermediate literature, analysis, teaching and performance will be covered. Prerequisites: 57-274

57-276 Piano Pedagogy IV
Spring: 6 units
Continuation of 57-275. Early advanced literature, analysis, teaching and performance will be covered. Prerequisites: 57-275

57-291 Keyboard Studies III
All Semesters: 3 units
Continuation of 57-191/192. Prerequisites: 57-192

57-292 Keyboard Studies IV
All Semesters: 3 units
Continuation of 57-191/192. Prerequisites: 57-291

57-303 Bagpipe Literature and Repertoire
Intermittent: 3 units
This course will cover the origins of the bagpipe and Piobaireachd, bagpipe music in competition, military, and dance. We will also cover major piping competitions, famous bagpipe players and piping today.

57-306 World Music
Fall: 6 units
An exploration of the diversity and complexity of music from around the world. The class will have three sections: 1. Classical music from India, Iran, Indonesia, and Asia. 2. Native and folk music from Africa, Europe, Australia, and the Americas. 3. The influence of world music on Western classical music. This class will include some reading, listening to CDs, watching videos, and papers and/or presentations. If time permits, there will be special musical activities and invited guests.

57-315 Dance V
Fall: 3 units
Jazz is a dance technique unique to the United States. The warm-up activities are designed to prepare the body for the specific demands of its style of movement. The music, while basically jazz, may range from gospel to punk rock. This course is designed for voice majors. Levels one and two consist of intensive body stretching, body awareness, body discipline, understanding the use of technique and conditioning. Levels three and four emphasize technique. Levels five and six stress full body control and dance combinations varying in style. Also, the art of auditioning is explored. Prerequisites: 57-212

57-316 Dance VI
Spring: 3 units
Continuation of 57-315. Prerequisite: 57-315

57-328 Jazz Chamber Music
All Semesters: 3 units
This course familiarizes students with basic techniques of arranging for high sounds. The class will have three sections: 1. Classical music from India, Iran, Indonesia, and Asia. 2. Native and folk music from Africa, Europe, Australia, and the Americas. 3. The influence of world music on Western classical music. This class will include some reading, listening to CDs, watching videos, and papers and/or presentations. If time permits, there will be special musical activities and invited guests.

57-331 Principles of Education
Fall: 9 units
This course introduces the student to basic issues in education. Content includes views of the academic and social structure of the school and the review and application of widely recognized theories of learning. Special emphasis is placed on the study of pedagogy as a series of options from which the educator constructs learning activities.

57-332 Introduction to Conducting
Fall: 6 units
This course is aimed towards the development of the basic skills needed to conduct instrumental ensembles or a small orchestra. It is primarily focused on conducting technique, body language and body coordination and communication. It also deals with learning and translating an instrumental or orchestral score into actual music. The goal is to achieve a clear and communicative technique upon which an artistic interpretation can be built. The student works periodically with a pianist or a small chamber ensemble.

57-333 Band and Choral Arranging
Spring: 6 units
This course familiarizes students with basic techniques of arranging for high school choral and instrumental ensembles. Individual instruments and voices are reviewed for their best scoring properties, and a systematic process of score analysis is used to reveal approaches to scoring both traditional and unusual sounds.

57-334 Fundamentals of Marching Band
Fall: 3 units
A marching band, due to its visibility and high degree of student involvement, is an integral part of secondary school music programs. The well schooled music education graduate must have knowledge of this unique form of music performance. This course, designed 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 eighteenth, nineteenth, and twentieth centuries with an emphasis on the music of the twentieth 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: 57-154

57-336 Instrumental/Choral Conducting
Spring: 6 units
This course is a continuation of Introduction to Conducting. Thus, basic training in conducting is required. The course starts going into 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: 57-332

57-337 Sound Recording
All Semesters: Mini Session - 6 units
The major emphasis is on stereo recording of a wide range of classical instruments in a concert hall situation. The equipment includes analog and digital tape recorders, an eight-channel mixer, and a modest array of outboard devices (digital reverber, noise reduction, equalizers, etc.) Tape editing and splicing, using both spoken voice and music as source materials will also be covered.

57-338 Sound Editing and Production
All Semesters: Mini Session - 6 units Prerequisites: 57-337

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-school 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: 57-241

57-340 Acting IV
Spring: 6 units
Continuation of 57-339. Prerequisite: 57-339

57-347 Electronic and Computer Music
Fall: 6 units
Elementary techniques of composition utilizing the synthesizer and other sophisticated electronic equipment. Required for composition majors. The purpose of this course is to introduce the students to the Computer-Electronic Music Studio. Different digital and analog devices such as tape recorders, mixers, various synthesizers, as well as various computer music software applications will be demonstrated and discussed. Prerequisites: 57-101

57-349 Supervised Theory Teaching
All Semesters: 6 units
This course is designed to provide 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. Class enrollment limited to a maximum of two students per class.

57-350 Dalcroze Piano Improvisation I
Fall: 3-6 units
These courses are designed to give the candidates in the Dalcroze Certification program development of the keyboard skills necessary for the teaching of Eurhythmics to young people.

57-351 Dalcroze Piano Improvisation II
Spring: 3 units
Continuation of 57-350. Prerequisite: 57-350

57-352 Dalcroze Piano Improvisation III
Fall: 3-6 units
Continuation of 57-350/351. Prerequisites: 57-351

57-353 Dalcroze Piano Improvisation IV
Spring: 3 units
Continuation of 57-350/351.

57-354 Piano Improvisation
Intermittent: 3 units
By instructor permission only.

57-355 Secondary Guided Teaching
Spring: 3 units
This course is designed to develop 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.
Co-requisites: 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.
Co-requisites: 57-375

57-360 Brass Methods
Fall: 3 units
This music education course is designed to develop 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 is designed to give the non-percussion major a background in the fundamentals of teaching percussion. The main focus of the course is the 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 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 is designed to develop 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 is designed to prepare 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.

57-375 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. Co-requisite: 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 school 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: 57-332 and 57-336 and 57-360 and 57-361 and 57-375 and 57-607 Co-requisites: 57-375

57-381 Accompanying I
All Semesters: 3-9 units
This course is a hands-on series of courses, which allow the student to accompany 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
All Semesters: 3-9 units
Continuation of 57-381. Prerequisite: 57-381

57-383 Accompanying III
All Semesters: 3-9 units
Continuation of 57-381. Prerequisites: 57-382

57-384 Accompanying IV
All Semesters: 3-9 units
Continuation of 57-381. Prerequisites: 57-383
64-385 Accompanying V
All Semesters: 3-9 units
Continuation of 57-381. Prerequisite: 57-384

64-386 Accompanying VI
All Semesters: 3-9 units
Continuation of 57-381. Prerequisite: 57-385

64-391 Keyboard Studies V
All Semesters: 3 units
These courses develop piano skills necessary for work in the elementary and secondary schools. Special emphasis is placed on transposition, score reading, harmonization and sight-reading. Required for the music education minor. Prerequisites: 57-292

64-392 Keyboard Studies VI
All Semesters: 3 units
Continuation of 57-391. Prerequisite: 57-392

64-396 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 comprehend the role of culture and formation of culture beyond national boundaries and disciplinary divisions. The course addresses the relationship between music, culture, society, and politics, fostering active engagement with the world of ideas and stressing the role of the learner in shaping his/her own education.

64-398 Global Heartbeat
Intermittent: 9 units
This course will introduce students from any discipline to selected works of arts, song, and political behaviors of the world. Following the interdisciplinary principles, which guide our program, topics will include: native concepts about music, instruments, aesthetics, genres, 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.

64-408 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 is designed to provide 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: 57-154

64-415 Dance VII
Fall: 3 units
Jazz is a dance technique unique to the United States. The warm-up activities are designed to prepare the body for the specific demands of its style of movement. The music, while basically jazz, may range from gospel to punk rock. This course is designed for voice majors. Levels one and two consist of intensive body stretching, body awareness, body discipline, understanding the use of technique and conditioning. Levels three and four emphasize technique. Levels five and six stress full body control and dance combinations varying in style. Also, the art of auditioning is explored. Levels seven and eight explore advanced jazz and ballet technique. Prerequisites: 57-316

64-416 Dance VIII
Spring: 3 units
Continuation of 57-415. Prerequisite: 57-415

64-417 Major Choral Ensemble
All Semesters: 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 unsold size. Emphasis is placed on vocal technique and development, musical skills in the rehearsal with minimum performance requirements. Audition required. Co-requisites: 57-500, 57-501, 57-502, 57-509, 57-521, 57-522

64-418 Major Instrumental Ensemble
All Semesters: 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. Co-requisites: 57-501, 57-502, 57-503, 57-505, 57-506, 57-507, 57-508, 57-509, 57-510, 57-511, 57-512, 57-513, 57-514, 57-516, 57-517, 57-519, 57-520, 57-521, 57-522

64-420 Jazz Vocal Ensemble
All Semesters: 3 units
A highly selective group of mixed voices who perform contemporary jazz and pop vocal arrangements. Open to all CMU students. Audition required.

64-428 Theatre Orchestra
Intermittent: 6 units
Instrumental ensemble which accompanies vocal productions in the School of Music or the School of Drama.

64-429 Beginning Piano for Children
All Semesters: 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 theory and analyzing pedagogical problems, and developing communication skills with both young pupils and their parents. Prerequisites: 57-273

64-431 Italian Literature and Repertoire
Fall: 3 units
The course is designed to provide 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.

64-432 French Literature and Repertoire
Spring: 3 units
This course will examine French songs for solo voice. Representative works from 19th through 20th centuries will be studied in the context of music history, style and programmatic considerations. Classes will consist of individual performance, listening to recordings and group survey of repertoire. Reading and written assignments will serve to establish historical perspective as well as programming considerations.

64-433 Music Theater Literature and Repertoire
Fall: 3 units
This class is designed to cover music theater repertoire for two semesters (28 weeks). This includes historical data, the composer's background, education, plot synopsis, and characters from their musicals. Each student will be assigned songs to prepare from these musicals. These songs can also be used for music theater 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.

64-434 Music Theater Literature and Repertoire
Spring: 3 units
Continuation of 57-433. Prerequisites: 57-433

64-435 German Literature and Repertoire
Fall: 3 units
The course examines German repertoire composed for solo voice. Representative works from the Baroque period through the Twentieth Century are studied in the context of musical style, vocal demands and programmatic considerations. Repertoire focuses upon 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.

64-436 English/Contemporary Literature and Repertoire
Spring: 3 units
The course is designed to provide a bibliography of repertoire in the English language. Material will be limited to art songs and will be presented via individual student performances in class, 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.

64-437 Literature and Repertoire
All Semesters: 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, Tuba, Violin, Viola, Cello, Double Bass, Percussion.
Course Descriptions

57-459 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: 57-154

57-465 Eurythmics Applications for Performing and Teaching
Fall: 3 units
Dalcroze Eurhythmics: Applications for Performance and Teaching is a two semester required course for those students enrolled in the Dalcroze Certification Program. It is offered as an elective to juniors and seniors who have completed the two-year core curriculum sequence. The Eurhythmics Applications course is open to all graduate students with no previous experience required. New students may enter in the Spring semester. Dalcroze Eurhythmics is a comprehensive approach to musicianship based on connecting kinesthetic awareness with accurate and sensitive listening and analysis. Eurhythmics experiences reinforce the understanding of music concepts while focusing awareness on the physical demands of an artistic performance. This approach to musical problem solving is applicable to studio and classroom teaching. Prerequisites: 57-164

57-466 Eurythmics Applications for Performing and Teaching
Spring: 3 units
Dalcroze Eurhythmics: Applications for Performance and Teaching is a two semester required course for those students enrolled in the Dalcroze Certification Program. It is offered as an elective to juniors and seniors who have completed the two-year core curriculum sequence. The Eurhythmics Applications course is open to all graduate students with no previous experience required. New students may enter in the Spring semester. Dalcroze Eurhythmics is a comprehensive approach to musicianship based on connecting kinesthetic awareness with accurate and sensitive listening and analysis. Eurhythmics experiences reinforce the understanding of music concepts while focusing awareness on the physical demands of an artistic performance. This approach to musical problem solving is applicable to studio and classroom teaching. Prerequisites: 57-465

57-479 Beginning Piano for Children
All Semesters: 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. This course is designed for all pianists who wish to gain experience in the general principles of piano teaching. Prerequisites: 57-466

57-487 Advanced Solfege IV
Fall: 6 units
Follows same basis as Solfege IV in more challenging material, from Bach chorales in “open score” to music excerpts by Bartok, Honnerger, Stockhausen, or Boulez. Dictations are three-part contrapuntal and difficult harmonic three and four parts. Prerequisites: 57-186

57-488 Advanced Solfege IV
Spring: 6 units
Follows same basis as Solfege IV in more challenging material, from Bach chorales in “open score” to music excerpts by Bartok, Honnerger, Stockhausen, or Boulez. Dictations are three-part contrapuntal and difficult harmonic three and four parts. Prerequisites: 57-487

57-500 Major Studio (Voice)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors. Co-requisites: 57-417

57-502 Major Studio (Organ)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors. Co-requisites: 57-417, 57-418

57-503 Major Studio (Harp)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors. Co-requisites: 57-418

57-505 Major Studio (Violin)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors. Co-requisites: 57-418

57-506 Major Studio (Viola)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors. Co-requisites: 57-418

57-507 Major Studio (Cello)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors. Co-requisites: 57-418
Course Descriptions

57-508 Major Studio (Double Bass)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-509 Studio Major (Guitar)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-417, 57-418

57-510 Major Studio (Flute)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-511 Major Studio (Oboe)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-512 Major Studio (Clarinet)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-513 Major Studio (Bassoon)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-514 Major Studio ( Saxophone)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-515 Major Studio (Horn)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-516 Major Studio (Trumpet)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-517 Studio Major (Euphonium/Baritone)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-519 Major Studio (Tuba)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-520 Major Studio (Percussion)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-418

57-521 Major Studio (Composition)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-417, 57-418

57-522 Major Studio (Bagpipe)
All Semesters: 9-12 units
A one hour private lesson per week for all music majors.
Co-requisites: 57-417, 57-418

57-604 Practice Teaching
All Semesters: 12-36 units
Cooperating teachers in selected area schools supervise fifth year music education majors in practice teaching. Elementary, junior high (middle), and high school experiences are covered over the course of a semester.

57-607 Vocal Methods
Fall: 3 units
This course is designed to enable 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 during the sophomore year with concurrent registration in 57-331.

57-611 Independent Study in History
All Semesters: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a 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
All Semesters: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a 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
All Semesters: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a 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
All Semesters: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a 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
All Semesters: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a 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
All Semesters: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a 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
All Semesters: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a 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
All Semesters: 3-9 units
Students undertake a critical examination of some aspects of music on an independent basis under the supervision of a 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
All Semesters: 3 units
Candidates for the Dalcroze Certification Program are required to submit a research paper on Dalcroze principles supported by appropriate literature. It should also include personal statements on the application of Dalcroze principles pertinent to their main field of interest.

57-691 Dalcroze Pedagogy/Practice Teaching
All Semesters: 3 units
This course is designed to provide supervised practice teaching experience in applying Dalcroze principles with elementary age children in a school setting.

Art

Undergraduate Courses

60-101 Concept Studio I
Fall: 10 units
“The Self and the Human Being”—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 in the School of Art, or by instructor permission.

60-102 Concept Studio II
Spring: 10 units
“Space and Time”—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.
Course Descriptions

60-104 Contemporary Issues Forum  
Fall: 6 units  
Introduces students to contemporary issues in the visual arts with a 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.

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 applications and/or hardware. 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 in 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.

60-151 2D Media Studio II: Drawing  
Spring: 10 units  
A continuation of 60-150. 2D Media Studio I: Drawing. Includes an expanded exploration of 2D materials, techniques, and processes. Emphasis on drawing as a foundation for various forms of art-making. Open to freshmen in the School of Art, or by instructor permission.

60-201 Concept Studies III  
Fall: 10 units  
"Systems and Processes"—A continuation of Concept Studies 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 instructor permission.

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, or by instructor permission.

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: 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. Students explore video art production with a focus on the skills needed to realize intended video projects. Utilizes demonstrations of processes and techniques from pre-production to post-production. Includes discussions of aesthetic issues relating to multi-media, computer effects and digital audio. Includes the traditional narrative and may also include experimental, performative and/or installation work. Prerequisite: 60-110. Open to sophomores in the School of Art, 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. Prerequisite: 60-130. 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. Prerequisites: 60150 and 60151. Open to sophomores in the School of Art, 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 and 60-302 Art in Context  
Fall and Spring: 10 units  
Students affiliate artmaking with a context outside of the university and within the Pittsburgh community. Students develop a relationship with an organization or art-making is carried out within the context of that organization. Students may take this 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 that encourages students to develop independently generated projects. Open to juniors in the School of Art with a minimum QPA of 3.0, or by instructor permission.

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, 60-210, 60-215, 60-216). 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); and The History and Philosophy of Museums.

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 an Art History/Theory Independent Study course, the student must submit an "Independent Study Proposal Form," signed by both the student and the faculty member, to the Assistant Head of the School of Art. Open to juniors and seniors in the School of Art, or by instructor permission.

60-401 and 60402 Senior Project  
Fall and Spring: 10 units  
Students initiate a comprehensive two-semester project in the first semester of their senior year (60-401) to be completed in the second semester (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  
An introduction to the techniques of 3D computer modeling and animation including techniques for lighting, mapping and rendering to video. Explores the history of animation emphasizing 3D object animation done with and without the computer. Students 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  
Students engage in a personally directed exploration of the creative, conceptual and tactical possibilities of interactive scenarios within their own art practice. The term "interactivity" will be used in its broadest possible context, and students will be encouraged to explore a wide range of digital and non-digital approaches to user orientated strategies. Included for discussion are a range of historical and contemporary strategies employed by art makers who have used formats 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 and 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 include: histories of experimental video, contemporary trends in the field, technological developments, performative perception, manipulation of time, and theories of representation. Also provides instruction in advanced production and post-production techniques, including lighting, editing, compositing, 2D animation, graphics and sound design. Prerequisites: 60-110 and 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 creative projects. Materials fee is required. Prerequisites: 60-110 and 60-210, or by instructor permission.

60-422 Advanced ETB: Robotic Art Studio
Intermittent: 10 units
Robotic Art Studio is an introduction to conceptual strategies and techniques related to the practice of art-making with micro-controllers with the goal of producing a micro-controlled sculptural project. Micro-controllers offer a myriad of opportunities for creating “smart” kinetic sculptures/machines. Some of the topics covered in this class include micro-controlled movement, sensing the outside world, mechanics and machine design. Students learn how to program a Basic Stamp and are introduced to basic electronic practice and theory. Programming is a component of this course. Materials fee required. Priority to students who have taken 60-421 Gizmology.

60-423 to 60-429 Advanced ETB: Special Topics
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.

60-430 Advanced SIS: Sculpture
Intermittent: 10 units
A broad-spectrum studio encompassing the diversity of contemporary sculptural activities, including objects, installations, and site work. Prerequisites: 60-130 and 60-230, 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. Prerequisites: 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. Materials fee required. Prerequisite: 60130, or by instructor permission.

60-434 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.

60-435 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. Materials fee required. Prerequisites: 60-130 and 60-230, or by instructor permission.

60-437 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.

60-438 Advanced SIS: Intimate Objects
Intermittent: 10 units
Explores the issues of small scale sculpture. This class deals 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. Prerequisites: 60-130 and 60-230, or by instructor permission.

60-445 to 60-449 Advanced SIS: Special Topics
Fall and Spring: 10 units
Each semester the sculpture, installation and site work faculty offer special topics courses to supplement the regularly scheduled cycle of courses associated with sculpture, installation and site work. Prerequisites: 60-130 and/or 60-230, or by instructor permission.

Advanced SIS: Special Topics courses have included: Model, Module, Montage; Time-based Sculpture; and Audio/Installation (with ETB).

60-450 Advanced PDP: Drawing
Fall and Spring: 10 units
Studio focus on drawing experiences designed to develop observational, compositional, technical, expressive and conceptual skills. Prerequisites: 60150 and 60151, or by instructor permission.

60-451 Advanced PDP: Anatomy/Drawing
Intermittent: v 10 units
Studio focus on the human figure as a source of expression in drawing. Introduction to the landmarks of anatomical bone and muscle structure. Prerequisites: 60-150 and 60-151, or by instructor permission.

60-453 Advanced PDP: Painting
Fall and Spring: 10 units
Studio focus on the development of painting concepts and skills, understanding interrelationships between form and content in painting, and understanding historical and contemporary issues as they pertain to personal vision and poetic and practical aspects of painting. Prerequisite: 60-250, or by instructor permission.

60-455 Advanced PDP: Intaglio
Intermittent: 10 units
Studio focus on the processes and issues of intaglio printmaking. Included are photo intaglio, carborundum print and collaglyph. Materials fee required. Prerequisite: 60-251, or by instructor permission.

60-456 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.

60-457 Advanced PDP: Idea Generation
Intermittent: 10 units
Studio focus on the development of skills involved with the generation of ideas as a central component in the processes of art-making. Pre-requisites: 60-250 and 60-251, or by instructor permission.

60-458 Advanced PDP: Serigraphy
Intermittent: 10 units
Studio focus on processes and art-making issues related to water-based/ acrylic serigraphy. Emphasis on individual conceptual/artistic development. Materials fee required. Prerequisite: 60-251, or by instructor permission.

60-466 to 60-470 Advanced 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; and Conventional & Experimental Figuration.

60-499 Studio Independent Study
All 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 a Studio Independent Study, the student must submit an "Independent Study Proposal Form," signed by both the student and the faculty member, to the Assistant Head of the School of Art. Open to juniors and seniors in the School of Art, or by instructor permission.
**Undergraduate Courses**

**62-102 Modern Dance Workshop**
- **Fall**: 6 units
- A modern dance class based on the philosophy of the Martha Graham technique. The class is designed to encourage exploration and discovery of the roots of physical movement and control. The class also covers fundamental and technical aspects of modern dance as a classical performing arts form.

**62-103 Modern Dance Workshop**
- **Spring**: 6 units
- A modern dance class based on the philosophy of the Martha Graham technique. The class is designed to encourage exploration and discovery of the roots of physical movement and control. The class also covers fundamental and technical aspects of modern dance as a classical performing arts form.

**62-141 Black and White Photography I**
- **Fall and Spring**: 9 units
- This course will teach you the basic craft of photography from exposure of the negative through darkroom developing and printing to print finishing and presentation. We will concentrate not only on the technical aspects of photography, but also the aesthetics of seeing with a camera. The course is primarily centered on independent shooting and printing of the photographic image toward inclusion in a final folio, but topics will also include a student presentation of a photographer’s work and discussion of students’ work. A fee and 35mm manual camera required. Each student is responsible for the cost of paper and film. No prerequisites. Course is by special permission. Please contact Emily Gustavsen at emilyg@andrew.cmu.edu. Spaces are reserved for CFA and Photo Minor students.

**62-148 Art and Culture**
- **Fall**: 6 units
- This course is a survey of world visual art from Pre-History to the present, with an emphasis on the development of currents of art in the Western World. The history of the art presented will be substantially couched and based in attendant material concerning religion, science, mythology, literature, politics, society, and the environment, along with reference to developments in other art forms. Material will be imparted via slides and lectures, and students will be required to do readings, tests, and writing, and keep a journal exploring their personal interests in the history of art.

**62-161 Photography, Video and Filmmaking**
- **Fall**: 9 units
- Any course offered by Pittsburgh Filmmakers. Courses are designed to give students training in the media and photographic arts. Students share in a broad range of experience through courses in photography, filmmaking, video productions, digital imaging, and other media-related courses. These courses are open to all students. There are prerequisites for some courses. Registration is on first-come/first-serve basis. Listing of specific courses along with additional information is available in the Fine Arts Deans Office, CFA 100.

**62-162 Photography, Video and Filmmaking**
- **Spring**: 9 units
- Any course offered by Pittsburgh Filmmakers. Courses are designed to give students training in the media and photographic arts. Students share in a broad range of experience through courses in photography, filmmaking, video productions, digital imaging, and other media-related courses. These courses are open to all students. There are prerequisites for some courses. Registration is on first-come/first-serve basis. Listing of specific courses along with additional information is available in the Fine Arts Deans Office, CFA 100.

**62-190 BHA/BSA Integrative Seminar**
- **Fall**: 9 units
- This course is designed to create an environment for interdisciplinary learning and collaboration. It provides a forum for BHA/BSA freshman and sophomores to discuss their own projects and begin collaboration with other students. The course will involve guest presentations, discussions, slide/video presentations and reading assignments. The course also offers a collaborative research project with the Pittsburgh Children’s Museum. BHA & BSA Integrative Seminar will begin the connection of students within BHA & BSA to the interdisciplinary/multidisciplinary culture at CMU and beyond. Instr. Maudeises

**62-241 Black and White Photography II**
- **Spring**: 9 units
- A continuation of topics explored in Black and White Photography I with an emphasis on aesthetic and image development skills. Includes both technical tutorial/classroom demonstration and group critique structure. Follo and artist's book will be completed during the semester. Prerequisites: Black and White Photography I, 62-141 or consent of instructor. This course is by special permission. Please contact Jennifer Morris at jmard@andrew.cmu.edu. Spaces are reserved to CFA and Photo Minor students. Prerequisites: B&W Photography I 62-141 or equivalent black and white darkroom experience.

**62-245 Portrait Photography**
- **Spring**: 9 units
- “Portrait Photography” explores the emotional and visual process of collaboration between subject and photographer that creates a photograph. We’ll use cameras of all formats and levels of sophistication to create portraits in the studio and on location. We’ll find and exploit available light and create artificial light to complete our vision, and we’ll explore a wide range of darkroom strategies to support and add richness to our final print. Through film and video we’ll meet some of the masters of this form like Arbus, Newman, Avedon and Penn, and we’ll take advantage of any opportunities to visit exhibitions and photographers studios. This course is by special permission. Please contact Jennifer Morris at jmard@andrew.cmu.edu. Spaces are reserved to CFA and Photo Minor students. Prerequisites: B&W Photography I 62-141 or equivalent black and white darkroom experience.

**62-248 Music in American Society: From Stephen Foster to Stephen Sondheim**
- **Fall**: 9 units
- From Stephen Foster to Stephen Sondheim; this interdisciplinary course will survey the history of musical experiences in the United States beginning with the music of the Native American, carrying it through to the present. The tracing of evolutions and influences of major musical movements will be discussed as well as the major figures in American music throughout its history. Recorded and live performances will be an integral part of the course. The live performances will be by professional musicians, students of the University and participants of the course. Undergraduates only. Note: Even though this is an interdisciplinary course, because of its content it will count as a music support course.

**62-299 CFA-Interdisciplinary Workshop**
- **All Semesters**: 9 units
- This course promotes interdisciplinary interaction and collaboration within the College of Fine Arts. Students will develop from their experience in this course an understanding of the creative potential of interdisciplinary work and will thus be encouraged to pursue this type of collaboration in their future endeavors. There will be roundtable discussions and presentations by faculty, group discussions that will include both faculty and students; cross-disciplinary assigned readings, and a maximum of two main assignments, which will promote interdisciplinary collaboration. There will also be in-class collaborative assignments. CFA sophomores have priority, then open to CFA juniors and seniors.

**62-300 CFA Interdisciplinary Summer Study**
- **Summer**: 18 units
- This multidisciplinary program provides an opportunity for you to transcend your own areas of academic expertise. In learning and understanding the languages of the disciplines and cultures and the potential connections between them, you can live and work in the world from a more informed and imaginative position. The integration of this knowledge and experience will enhance your decision-making skills, creativity, and your efficacy in the world. This program immerses you in a foreign culture to foster sensitivity to the diversity of people’s ideas, values, and beliefs. With a heightened multi-cultural awareness, you will be better able to: envision yourselves as multidisciplinary thinkers and learners; express ideas clearly in a variety of media and circumstances; develop, attract and ultimately affect diverse audiences; and explore various professional, cultural, and social contexts as they relate to your goals. Using Rome as a living laboratory, our goal is to discover the city as a way of better understanding people and places as well as the relation between them. We will be exploring issues that have great potential impact on decisions and policies affecting quality of life for both residents and tourists which ultimately affects the cultural and commercial health of a society. The city will be explored in all scales and sensory dimensions so that you may develop a personal mapping of your experience. Objectives are to: transcend personal, geographic and disciplinary boundaries, study form, space, material and texture and their cultural specificity as well as their historical, experiential and aesthetic significance under the effect of light, color and sound in the environment on an urban population understand modes of communication as they pertain to sharing the rich history and culture of a city with a variety of audiences

**62-311 Rhythm: An Interdisciplinary Link Among the Arts?**
- **All Semesters**: 9 units
- This course has been created for the purpose of exploring the concept of rhythm as a potential tool for interdisciplinary exchange and discussion. The course is project oriented; the main approach to class exploration is through interactive presentations designed and created by the students. Class discussion and projects will be informed by presentations from faculty in each of the Fine Arts disciplines.

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**Course Descriptions**

- **62-102 Modern Dance Workshop**
- **62-103 Modern Dance Workshop**
- **62-141 Black and White Photography I**
- **62-148 Art and Culture**
- **62-161 Photography, Video and Filmmaking**
- **62-162 Photography, Video and Filmmaking**
- **62-190 BHA/BSA Integrative Seminar**
- **62-241 Black and White Photography II**
- **62-245 Portrait Photography**
- **62-248 Music in American Society: From Stephen Foster to Stephen Sondheim**
- **62-299 CFA-Interdisciplinary Workshop**
- **62-300 CFA Interdisciplinary Summer Study**
- **62-311 Rhythm: An Interdisciplinary Link Among the Arts?**
62-312 Rhythm: An Interdisciplinary Link Among the Arts? Fall: 9 units
This course will explore the concept of rhythm as a potential tool for interdisciplinary exchange and discussion. The course is project-oriented; the main approach to class exploration is through interactive projects designed and created by the students. Class discussion and projects will be informed by presentations from faculty in each of the Fine Arts disciplines.

62-358 The Art of Biology: the Biography of Art All Semesters: 9 units
The goal of this studio laboratory course will 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 a biological laboratory. It 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, the course will include 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 microscopy. Instr: Maurices

62-360 Photographers and Photography Since World War II Fall: 9 units
Photographers and Photography since World War II. This course explores in depth the work of significant imagemakers W. Eugene Smith, Helen Levitt, Diane Arbus, Robert Frank, Minor White, William Wegman, Cindy Sherman, Vik Muniz and others while simultaneously looking at trends in the world of photography over the past 50 years. Several class sessions will be held off-site, including one evening at The Andy Warhol Museum and another at Silver Eye Center for Photography.

62-381 Color Photography I All Semesters: 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 the larger negative size and the ability to control the exposure and development of each sheet of film make possible and image of extraordinary clarity detail. This class will investigate the various technical and design aspects of the view camera as compared to the 35mm SLR. Topics include perspective and focal plane control, bellows extension factor, and basic b&w sheet film handling and processing. Prerequisite: Students should enter the course already possessing thorough knowledge of photographic processing and printing.

62-465 Introduction to Hot Glass Studio All semesters: 10 units
This semester long course introduces college students to the medium of hot glass through the creative process. It is designed to give the student the beginning knowledge of working with glass and the confidence to begin to experiment with the medium. Live demonstrations and hands on experience are emphasized. Class meets every Saturday from 9:30-4:30pm with an hour break for lunch.

H&S Interdisciplinary Undergraduate Courses

66-149 Stats/English FS: Words and Numbers: Composing and Analyzing Texts Spring: 9 units
This course is an H&S Freshman Seminar. It is only open to H&S and SHS freshmen. In this course, team taught by an English and Statistics Professor, you will learn how small decisions, made by authors, can lead to big differences in the texts that result. You will learn some major fault lines along which a written text varies and how this variation can be described and analyzed through numbers. You will learn how this knowledge about texts can help you play literary detective and solve classic literary problems, such as author attribution (who was the real author of a text whose authorship is unknown or disputed) and genre classification (what makes the mystery novel different from the newspaper editorial, what makes fiction different from non-fiction?). Finally, you will learn how you can classify authors through numerical techniques and you can reflect on how this compares and contrasts with the way you classify authors as a competent reader of English.

66-181 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 critiques of this amendment and its current interpretations.

66-184 Topics in Law: The Bill of Rights Intermittent: 9 units
This course examines the history and place of the Bill of Rights in our nation’s constitutional framework. It begins 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 will be examined in terms of its original intentions, and then through cases that have challenged and been interpreted through the Bill’s articles.

66-198 H&S Interdisciplinary Research Training Fall and Spring: 9 units
This course is part of a set of 100-level courses offered by H&S 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 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 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&S Academic Advisory Center. For H&S students only; only for second-semester freshmen, or first- or second-semester sophomores with a cumulative GPA of 3.0 (at the time of registration) required for approved entry; additional requirements (e.g., language proficiency) may arise out of the particular demands of the research project in question.

66-210 Science, Technology and the Environment Spring: 9 units
This course begins with the premise that it is essential to understand a few important 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 environment. The goals 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.

66-260 Religion and Star Trek: Approaches to the Study of Religion
Summer: 9 units
Star Trek, as science fiction, takes place in the future but presents ideas that can
bring a greater understanding of the past and present. In class, we will watch
Star Trek episodes that will be helpful in examining themes central to the study
of religion. For example: What end does religion serve? How is religion used by
both the ruling elite and the popular masses? How are religions developed? How
is religion related to social, political, gender, ethical, and economics issues? By
reading religious theorists such as Marx, Berger, Freud and Eliade, we will learn
to think critically about these and other issues. During the second half of the
semester, we will focus on episodes that portray the expression of religion
through ritual, symbol, sacred texts, mystery, and mysticism.

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 religion at Case Western Reserve
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 Polkinghome 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 classroom
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 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 culminating year-long independent research project. Research topics are selected by faculty and students. Prerequisites: 66-501

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: 66-501

Course Descriptions

67-101 Colloquium: Perspective in Information Systems
Spring
This course is an introduction to the Information Systems major and to its
potential career directions. Topics covered include overviews of systems design
and development, project management, the logic of the IS curriculum, industry
trends, and the professional workplace. It includes presentations by IS faculty
and students and by professionals from Pittsburgh area firms. As a colloquium, it is a mini-semester course and will meet once a week for a passing grade (P). It is for IS freshman students only, and they can register for either the first-half mini section or the second-half (both sections are identical in content). This is an elective course and is not required in the IS curriculum.

67-211 Introduction to COBOL Programming
Fall and Spring: 9 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 PC’s 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.

67-271 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 user 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 system 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 assign-
ments together with midterm and final examinations. Expected section size is 60.
Prerequisites: 15-111 or 15-121 or 15-200 or 15-211. Co-requisite: 67-272

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
contents, 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 combining assignments together with midterm and final examinations.
Expected section size is 60
Prerequisites: 15-111 or 15-121 or 15-200 or 15-211. Co-requisite: 67-271

67-301 Networks and Telecommunications
Spring: 9 units
This course will introduce students to the basics of telecommunications, including
voice, data, and video, with 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 the terminology of networks, including internet
network models, and to the 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. Prerequisites: 67-271, 67-272

67-366 Social Issues in Computing
Spring: 9 units
When people use electronic information systems to conduct social relationships,
those relationships assume characteristics that are strongly influenced by the
medium through which they are conducted. Although there is some understanding of
these influences, the social context of computing is a relatively new area of study.
This course will consider relationships in which electronic media, principally the
information networks made possible by computers, provide a significant context
for social and public engagement. The course will examine social issues arising
in this context and explore various analytical perspectives on these issues.
Among topics for consideration: (1) the Internet and personal identity; (2)
implications of electronic media on individual and human rights; (3) effects of
computing on personal and public security; (4) social justice in a digital
evironment; and (5) changes in personal lifestyles and work styles in a
networked world. Classes will include lectures, discussion and group reports.
Course Descriptions

One take-home, essay exam will be given. In addition, students will form a project team to research case studies and recommend public policy or other constructive social responses to issues arising in a world of pervasive electronic networking. This course is cross-listed with 89-396 (Dept of Social & Decision Sciences) and 05-499 (Human-Computer Interaction). Prerequisite: Junior or senior standing.

67-370 Intelligent Decision Support Methods
Spring: 6 units
This is a course about emerging and advanced computer-based applications for management support. You will see how these technologies can help people make better decisions. Traditional MIS and Decision Support solutions such as relational database, management science and operations research approaches have played, and continue, to play an important role in informing managerial decisions. However, various methodologies - including data warehousing, data mining, and various Artificial Intelligence (AI) based techniques have emerged in recent years as powerful, cost effective solutions. Significant recent advances in the price, performance, and usability of all of these knowledge-intensive information technologies have enabled their adoption in organizations of all sizes.

Students will learn about these important technologies through a combination of readings, case analyses, short projects, software demonstrations, guest speakers, and a term project.

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. Prerequisites: 67-271 and 67-272

67-490 Independent Study in Information Systems
All Semesters: 0-18 units

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. Prerequisites: 66-373 or 67-373

67-501 Information Systems Honors Thesis I
Fall: 9 units

67-502 Information Systems Senior Honor Thesis II
Spring: 9 units

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 inexperienced 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 Cross Training
Fall and Spring: Mini Session - 3 units
Weather and facilities pending: Weight lifting, running, swimming, circuit training, Ab-training, (Roller-blading and rock climbing if time and equipment are available). Any other outdoor activity that time and class participation will allow.

69-120 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 give the student all the skills necessary to play 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.

69-150 Beginning Swimming
Fall and Spring: 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 water entry and some elementary forms of rescue.

69-151 Advanced Beginner's Swimming
Fall and 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.

69-152 Basic Water Skills
Fall and Spring: Mini Session - 3 units
This course is designed to lay a foundation for Beginning Swimming, providing a pleasant water experience where safety, floating, and basic swimming movement will be learned.

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: 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.
You must know how to swim to take this class; this is not a learn-to-swim class.

Spring:

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.

Course Descriptions

70-160 Introduction to Graphic Communications I
Fall: 9 units
This course provides a foundation for the study of graphic media management 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, electronic publishing, video, and interactive media.

70-161 Introduction to Graphic Communications II
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 projects. In addition to the traditional printing technologies, electronic printing methods are examined. The course also examines the origins of photography, cinema, video and the Internet and their applications in multi-media graphics today. Prerequisites: 70-160

70-194 Publishing 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 processes, career opportunities, and electronic publishing. Guest lecturers, 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
All Semesters: 9 units
Elementary ideas in probability, statistics and data analysis presented in the context of their importance to modern business management. Prerequisites: 21-121

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: (21-121 or 21-116 or 21-112) and (36-202 or 70-207 or 36-310 or 36-220 or 36-247) and (73-100 or 73-110)

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 and Society
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: 76-100 or 76-101 or 76-104 or 82-085

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.
Course Descriptions

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, 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: (70-340) and (76-100 or 76-101 or 76-104)

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: 70-340

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: 70-340 and (76-100 or 76-101 or 76-104)

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, business property, employment, coporation 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, and international law. The course covers: 1.) 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 manage students report to a board of directors who review performance, set compensations, 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: (70-121 and 70-371 and 70-381 and 70-391) or (70-122 and 70-371 and 70-381 and 70-391)

70-414 Technology-Based Entrepreneurship
Spring: 9 units
Technology-based Entrepreneurship, primarily for non-Business Administration students, includes most of 70-415 and assumes no background courses in business. Therefore it involves additional sessions in core concepts in business. Students with majors in science, technology, engineering, the humanities, or the arts are exposed to fundamental concepts and issues in business and gain a basic understanding of functional areas such as accounting, finance, marketing, sales, and organizational behavior.

70-415 Entrepreneurship
Fall: 9 units
This course is designed primarily to provide an overview of entrepreneurship, develop an entrepreneurial frame of mind, and learn the rudiments of how to differentiate an idea from an opportunity. Students come up with a business idea and explore its potential for becoming a viable business. They learn to do market research and seek the first-hand the rewards and difficulties in dealing with people in the real world. They will meet entrepreneurs and business professionals as part of the course and learn how to make effective presentations? both written and oral. Other important aspects of the course is the assessment to determine one’s strengths and weaknesses, understanding the ‘magic’ of leadership, and gaining an entrepreneurial perspective on life.

70-416 Entrepreneurship II
Spring: 9 units
This course exposes students to the nuances of financing new ventures, getting the business legally, and marketing their products or services. Students pull together all the ideas and information from different functional aspects of their projects into coherent and persuasive mini-business plans that serve as roadmaps for building their businesses; and useful instruments to find sufficient financing for the new ventures, so that they can convince the outside world that these opportunities are viable, with substantial potential for success. Prerequisites: 70-414 or 70-415

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. ‘Experiential Entrepreneurship’ is a concept which was founded at CMU - and has shown that students can have real insight and
real input into the day to day issues surrounding local entrepreneurial ventures. Students work in very small groups (or one-to-one with the instructor) to study in depth particular entrepreneurship topics 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: 70-415 or 70-416

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, adn 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

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 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 interaction 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: 70-122

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, changes in international investment patterns, the world financial environment, business policy and strategy for firms competing in the global marketplace, and theory behind international business. The student will be exposed to the culture and management practices within the context of global marketing, multinational finance, accounting, and taxation are also examined.
Prerequisites: 73-100 or 73-110

70-440 Business Leadership & 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: 70-122 and 70-371 and 70-381 and 70-391

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: 15-100 or 15-111 or 15-112 or 15-120 or 15-125 or 15-127

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 analysis, 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: 70-451

70-455 Information Resource Management
Spring: 9 units
The objective of this course is to explore information resource management issues from a managerial perspective. In this course students learn how information resides in a variety of sources and define corporate strategies 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 these needs, and how managers address significant issues concerning that support.
Prerequisites: (15-120 and 70-451) or (15-120 and 88-200) or (15-120 and 88-271 and 88-272)

70-456 Telecommunication and Network Management
Fall: 9 units
This course introduces students to telecommunication and computer network technologies. We discuss computer telecommunication, local area networks and wide area networks. To 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: 70-451

70-459 Web Business Engineering
Spring: 9 units
In this course students will learn how to set up a business on the Internet (World Wide Web) and how to use the internet and other telecommunications technologies to tie businesses together to form a virtual business.
Prerequisites: (15-120 and 70-451) or (15-120 and 88-200) or (15-120 and 88-271 and 88-272)

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, expert systems, 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: 21-257 or 21-292

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: 70-371

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 concerns methods of data analysis. In particular, we learn the statistical techniques used to make sense of marketing data and to support marketing recommendations.
Prerequisites: 70-208 or 70-381 or 73-360

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 client situation through the development and team presentation of an integrated marketing communications campaign.
Prerequisites: 70-381

70-484 Direct 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 adn a team project to provide a comprehensive understanding of the meaning, uses, and contribution of direct marketing to the firm and consumer.
Prerequisites: 70-381

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: 70-381
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: (70-381) and (73-100 or 73-110)

70-492 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: 70-391

70-495 Corporate Finance
Spring: 9 units
This course focuses on how firms make decisions on investments, financing and dividend payout policies, as well as other advanced topics in finance. Prerequisites: 70-391

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: 70-391

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 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 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.

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.

70-508 Independent Study in International Management
All semesters: Variable units
Students with a special interest in International Management 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.

70-509 Independent Study in Entrepreneurship
All semesters: Variable Units
Students with a special interest in Entrepreneurship 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.

70-513 Independent Study in Business History
Fall or Spring: Variable Units
The purpose of this independent study is to allow students to explore questions and issues of Business History. It does this through structured reading lists that allow students to research an area in some depth and papers that allow them to apply their business education to gaining a greater understanding of the topic. Potential topics include, but are not limited to: The World Economy; Economic History of the Family; The Chinese Economy; Slaver and Capitalism in 19th Century America; The Market Economy in 19th Century America; Labor in 19th Century America. Other topics are possible but must be distinctly historical in nature with the bulk of the readings in the pre-twentieth century period. 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 public relations 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 tp 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, prefligihng, output issues. Prerequisites: 70-160 or 70-161

70-637 Interactive Media Design & Production
Fall: 9 units
Interactive media offers a powerful communication method by providing an immersive, self-guided multi-media environment. This course provides an introduction to project management methods for interactive media and an introduction to the methods used to create effective interactive media. Classroom instruction is supported by laboratory exercises. Students learn how to conceptualize, manage, and execute an interactive media project that combines text, illustrations, photographs, animations, sound and video. Prerequisites: 70-160 or 70-161
Economics

Undergraduate Course Descriptions

73-099 Introductory Economics
AP Credit: 9 units
Course credit for AP coursework satisfying the H&SS General Education requirement DCR2.

73-100 Principles of Economics
Fall and Spring: 9 units
An overview of economic theory, analysis, and policy issues for both majors and non-majors, emphasizing a graphical approach to understanding economic models. Topics include: markets as mechanisms for the allocation of scarce resources, supply and demand analysis, consumer theory (using both indifference curves and marginal utility analysis), the theory of the firm, perfect competition, markets with small numbers of firms (monopoly, oligopoly), and multi-market issues. Not open to students who have received credit for 88-220. 2 hours lecture, 1 hour recitation.

73-101 First-year Seminar in Economics
Fall or Spring: 9 units
A topics-based course for students who intend to major in economics. The subjects discussed vary from year-to-year and from instructor-to-instructor. Check with the Economics Department or their website (http://econ.gsia.cmu.edu/undergrad) for descriptions of recent and current offerings.

73-148 Environmental Economics
Fall or Spring: 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 allocation of environmental resources in practice are investigated. (Same as the course previously numbered 73-248). Prerequisite: 73-100, 88-110 or 88-220.

73-200 Macroeconomics
Fall and Spring: 9 units
A calculus-based introduction to modern macroeconomics. The objective of this course is to develop a practical understanding of the global economy, with special emphasis on the impact of macroeconomic developments on international financial markets and business. Topics include aggregation and measurement, national income accounting and the aggregate resource constraint, long-run economic growth, short-run business-cycle fluctuations, the role of money and financial markets, and government monetary and fiscal policies. Students are assumed to have a good grasp of single-variable calculus, but not necessarily of more advanced mathematical techniques — such as regression analysis and simulation — in the context of real world data decision problems. Classes consist of a combination of cases, lectures, and interactive discussions. Prerequisites: (21-211 and 21-116) or (73-100 and 88-220).

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 decision problems. Classes consist of a combination of cases, lectures, and interactive discussions. Prerequisites: (21-256 or 21-259) and (38-217, 36-225, or 36-325) and 73-200. Co-requisite: 73-250 or 73-251.

73-250 Intermediate Microeconomics
Fall and Spring: 9 units
The process by which the decisions of business firms and households interacting through a price system, influence the allocation of resources in a market economy. To be discontinued and replaced by 73-251 in Fall 2003. Prerequisites: 73-100 and (21-212, 21-116 or 21-112).

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: (73-100 and 88-220) and (21-256 or 21-259).

73-260 Econometrics
Fall: 9 units
Introduction to random variables, sampling theory, estimation of uni-variate and multi-variate linear models, forecasting, statistical inference, confidence intervals and hypothesis testing. Not a part of the current curriculum, this course will be discontinued after Fall 2002. Students under the old curriculum still needing this course after that date should consult with the Economics Department for other ways of meeting this requirement. Prerequisite: (38-202 or higher) and (73-100 and 88-220) and (21-112, 21-116 or 21-121).

73-261 Econometrics
Fall: 9 units
A detailed introduction to econometric theory and its principle applications: quantifying economic relationships, testing competing hypotheses, and forecasting. Matrix algebra is used to derive finite and asymptotic properties of estimators, with special attention paid to the method of moments, maximum likelihood and the ordinary least squares estimators. Other topics include: model mis-specification and identification, measurement error, heteroskedasticity, simultaneous equations, quantile response models, the analysis of time series data and panel data. Replaces 73-360. Prerequisites: 15-100 and 73-226 and 73-251.

73-270 Writing for Economists
Fall or Spring: 9 units
Introduction to Professional and Technical Writing is designed specifically for declared majors in Economics. The main work of the course is a series of situation-based writing assignments covering both business/professional writing and technical writing. The range of assignments in the course is designed to give the student experience with a variety of writing situations that economic analysts might encounter. Prerequisites: (76-101 or 76-104) and 73-251.

73-300 Intermediate Macroeconomics
Fall and/or Spring: 9 units
A critical evaluation of empirical and theoretical findings of economists with respect to such problems as unemployment, inflation, business cycles, technological change, and growth. The roles of aggregate consumer spending, business investment, money and government spending and taxation in determining the level of gross national product are emphasized. The course examines alternative fiscal and monetary policies aimed at promoting such goals as full employment, stable prices, and long-run economic growth. 2 hours lecture, 1 hour recitation. Discontinued in Fall 2003 and replaced by 73-200. Prerequisite: 73-250 or 73-251.
Economics

73-325 Experimental Economics
Fall: 9 units
The goal of this course is to explore the interface between models and reality, by constructing and analyzing computer assisted laboratory experiments within class. This course does not explicitly aim to validate rationality postulate, nor establish the laws of supply and demand, and it is certainly not a test of your statistical expertise, although during the experiments you may find a working knowledge of these concepts quite useful. More than that, however, both as participant, and as an analyst of your own experiments, you will experience the dynamics of market play, the value of playing smart strategies, and in the process become more knowledgeable about how the world’s resources are allocated. Formerly numbered 73-325. Prerequisites: (73-250 or 73-251) and (99-101 or 99-102).

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 decision problems. Classes consist of a combination of cases, lectures, and interactive discussions. Prerequisites: (21-256 or 21-258) and (36-217, 36-225, or 36-325) and 73-200. Co-requisite: 73-250 or 73-251.

73-328 Health Economics
Intermittent: 9 units
Economic analysis is used to examine the functioning of the health care sector and questions as to appropriate public policy. The topics may include: health care costs, medical care as compared with other commodities, the supply and demand for health and health insurance, competition in medical markets, managed care, and the role of the public sector. The topic list is flexible and may vary so as to include items of current interest. Prerequisite: 73-250 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, investment in training or education, and choosing an occupation; (2) firms’ decisions about hiring, training workers, and setting wage rates; and (3) the resulting wage and employment outcomes influenced by union contracts and implicit employment contracts. Also considered are public policy recommendations concerning minimum wages, job training programs, hazards on the job, race and sex discrimination, and income inequality. Prerequisite: 73-250 or 73-251.

73-351 Public Finance
Spring or Fall: 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 a variety of specific cases, such as education, environmental issues, defense, crime, and common resources. The common thread in these situations is that individual optimizing behavior does not necessarily 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. Prerequisite: 73-250 or 73-251.

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: 73-250 or 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: 73-250 or 73-251.

73-358 Economics of the Environmental and Natural Resources
Intermittent: 9 units
The economic theory of environmental degradation and public policies designed to deal with it, the theory of renewable and nonrenewable resources including the EPA’s allocation over time. Implications from a long-term perspective (25 to 50 years hence) are modeled. Prerequisite: 73-250 or 73-251.

73-359 Benefit-Cost Analysis
Fall or Spring: 9 units
The evaluation of public and 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 individual life) and the social rate of discount. Applications are considered in detail. Prerequisite: 73-250 or 73-251.

73-360 Econometrics 2
Fall or Spring: 9 units
Econometrics 2 is a continuation of Econometrics 1. 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 corrections should be made if they are violated. To be discontinued and replaced by 73-261 in Fall 2004. Prerequisite: 73-260 or 36-226.

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, application to actual markets are considered. Prerequisite: 73-250 or 73-251.

73-371 International Trade
Intermittent: 9 units
This course examines the economics 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, production 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 principal analytical concepts and results relevant to the special problems of developing nations. Prerequisites: (73-250 or 73-251) and (73-200 or 73-300).

73-372 International Money and Finance
Intermittent: 9 units
This course is devoted to economic analysis of exchange rate behavior, balance of payments adjustments, the financing of payment 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 versus 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 European Monetary System. Prerequisites: (73-250 or 73-251) and (73-200 or 73-300).

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 determination of asset prices for both complete and incomplete-markets settings. In addition, the course will cover topics in corporate financial decision making and the micro-structure of financial markets. Prerequisites: (36-208, 36-217, 36-225, 36-325, or 70-208) and (73-250 or 73-251).

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 student have learned in intermediate macroeconomics, which 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: (36-200, 36-208, 73-226, 73-260, 73-380, or 88-250) and (73-200 or 73-300) and (73-250 or 73-251).

73-420 Monetary Theory and Policy
Fall or Spring: 9 units
This is concerned with various topics in monetary and macroeconomics including anticipated inflation, hyperinflation, output effect 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 but explicit dynamic models incorporating rational expectations. In addition, attention is devoted to alternative types of monetary systems, commodity versus 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: (73-200 or 73-300) and (73-250 or 73-251).

Course Descriptions
378 Economics

English

Course Descriptions

Economics

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 listings and information available from your advisor each semester for details.

76-101 Interpretation and Argument
All Semesters: 9 units

Fulfills HASS COR2 and the Designated Writing Requirement for other colleges. This course will give students a comprehensive grounding in communication processes. The class focuses on the way in which interpretive arguments in the processes of communication and social and personal development. In the class, students will develop these skills by reading and understanding the important issues and arguments regarding those issues advanced by a variety of texts, both fiction and non-fiction. They will then be asked to respond to these positions by developing positions of their own, in their writing and in their speaking. The course thus serves as an introduction to the discourse and arguments of the academic community, as well as serving as an introduction to some of the broader issues that the academic community address.

76-187 Introduction to Playwriting
Fall: 9 units

An introduction to the art of playwriting through the exploration of dramatic action, character development and dialogue. The class will involve reading of classic and contemporary one-acts, exercises to increase language skills and the writing of a short play.

76-188 Introduction to Playwriting
Spring: 9 units

An introduction to the art of playwriting through the exploration of dramatic action, character development and dialogue. The class will involve reading of classic and contemporary one-acts, exercises to increase language skills and the writing of a short play.

76-201 Literature and the Social
Fall and Spring: 9 units

Fulfills HASS DCR4. Courses presented under this title focus on the relationship of literature to its social context and may include courses organized according to literary period, genre, or author. Topics will vary by semester.

A recent example that demonstrates the dual focus on literature and its social context is the course The Early Modern Stage. This course examines the ways in which English playwrights of the early modern period depicted individuals in various states of “self-dispossession” defined as an inability to maintain one’s identity, property, familial or social status - in short a failure to be an autonomous individual. Some versions of self-dispossession that are of particular interest include losing oneself to demonic possession, madness, romantic love, and jealousy. In each case we ask how the moment in which characters fail to determine their own destiny can be seen also be seen as a moment when they begin to participate in a larger social order. Ultimately, we’ll be interested in larger issues of whether the intrusion of “the social” into various facets of early modern life was a disaster - as it sometimes clearly was - or an experience that offered opportunities for individual and communal transformation.

76-206 Introduction to Creative Writing
Fall and Spring: 9 units

Fulfills HASS DCR3. Creative Production & Reflection. Registration Note: 76-206 is an entry-level overview of creative writing intended primarily for freshmen and sophomores. Juniors and seniors interested in a first-level creative writing course should consider 76-260, 76-265, 76-269. This course gives students practice in the reading and writing of various types of creative writing. This particular section will focus on poetry and fiction. We will discuss student submissions in a typical workshop setting, putting into practice the analytical skills necessary to grow as writers and critics. We will also discuss published work and work from poetry readings, which students will be required to attend. Our principle text will be Writing Poems. This course DOES NOT fulfill any requirements for any of the English degrees.

76-300-399 Sophomore and Introductory level courses
76-300-399 Sophomores, Juniors and Seniors and above *
76-400-499 Juniors and Seniors and above *

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73-430 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: (73-200 or 73-300) and (73-250 or 73-251).

73-458 Money and Banking
Fall or Spring: 9 units

This course addresses several issues concerning money in our economic system. These include 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 or 73-300) and (73-250 or 73-251).

73-469 Economics of Electronic 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 transporta-
tion 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 on an unprecedented scale. This course employs the basic tools of economic analysis to understand how and why the changes in information technology are reshaping the economic landscape. Prerequisite: 73-250 or 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 economics institutions or the variety of past economics experience is perhaps the worst shortcoming of many economists. The study of economics 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 applied 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: (73-250 or 73-251) and (73-200 or 73-300).

73-477 Issues in Economic Analysis and Policy
Intermittent: 9 units

The emphasis in this course will be on current issues in economic policy. In particular, readings from current issues of non-technical but high-quality publications such as the Economist (a London-based weekly magazine) will be stressed. Students will be required to present their own economic analyses of current issues, lead class discussions, and engage in critical commentary. In addition, several short written assignments will be required. Prerequisites: (73-250 or 73-251) and (73-200 or 73-300).

73-495 Independent Study in Economics
Fall or Spring: variable 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.

73-497 Senior Project
Fall: 9 units

A fourth-year project course, open only to economics primary and double majors with Senior standing. Prerequisites: 73-226 and 73-251.

73-500 Honors Thesis
Fall: 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 faculty. Prerequisites: Senior standing in the Economics Department and permission of faculty.

73-501 Honors Thesis
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 faculty. Prerequisites: Senior standing in the Economics Department and permission of faculty.
Why did eighteenth-century audiences sit on stage with the actors? Were actresses really prostitutes? How could be explained philosophically—wit reference to natural causes—others preternatural occurrences were becoming the object of overlapping (and monsters, prodigies, demons, and other strange phenomena—many of so-called "primitive cultures" with the empire. We’ll begin with the Enlightenment philosophers, Kant and Hume, and compare them with Hegel’s discourse on the Negro, accompanying these primary texts with contemporary commentary from such figures as Henry Louis Gates Jr., Tejumola Olaniyan, and Tsenay Serequeberhan. Our speculations on the form and function of the Negro Other will be applied against the earliest contemporary discourse with W.E.B. DuBois, Frantz Fanon, and Aime Cesaire. This middle section will help develop ideas about the various strategies deployed in early productions of the black subject before finally moving on the contemporary literature in the African Atlantic and current debates on the nature and meaning of black identity in the West.

76-336 Romantic Age Literary and Cultural Studies
Fall and Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.
Example: Terror, Pleasure and Revolution in the Romantic Age. The course focuses on the period from 1821, when the writer George Gordon “Romantic” depicted the French Revolution as the master theme, and the most traumatic event, of their age. As they represented the revolution in their novels, poetry, and prose, the romantic age dramatically changed the textual forms of modern discourse. We will explore their texts and the media, intense states of feeling (from pleasure to terror), aesthetic modes, and experiments in representing history as revolutionary change. Readings cover a broad range of genres including lyric and narrative poetry, novels, essays, journalism, letters and diaries, drama and theatre and works on aesthetics and literary theory. The course also draws new World Wide Web resources for studying both Romanticism and the French Revolution and includes attention to recent literary and cultural theory that speaks to the late-twentieth-century debate about “revolutions” in politics, culture, and forms of representation or knowledge.

76-337 The Beat
Fall and Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings. This class deals with writing of the works of: Jack Kerouac, Allen Ginsberg, William Burroughs, Gary Snyder, Robert Duncan, Charles Olson, Robert Creely and others. Our speculations on the form and function of the Negro Other will be applied against the earliest contemporary discourse with W.E.B. DuBois, Frantz Fanon, and Aime Cesaire. This middle section will help develop ideas about the various strategies deployed in early productions of the black subject before finally moving on the contemporary literature in the African Atlantic and current debates on the nature and meaning of black identity in the West.

76-338 Communicating in the Global Marketplace
Fall and Spring: 9 units
Many of today’s most exciting employment opportunities are with multinational and international corporations. But are you prepared for the challenge of working with professionals from cultures other than your own? To become effective in these settings, you need to understand the cultural values, beliefs, and assumptions that influence the way in which you communicate. Often, there is a wholly different worldview behind a foreign accent. The same word or phrase in English might actually carry very different 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 have a chance to meet some experienced professionals in this field.

76-339 Renaissance Literary and Cultural Studies
Fall and 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—many of so-called “preternatural” occurrences—were becoming the object of overlapping (and sometimes conflicting) explanations. These phenomena could be explained philosophically—with reference to natural causes 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 Robert Burton’s Anatomy of Melancholy (including 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.

76-330 Medieval Literary and Cultural Studies
Fall and Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.
Example: Medieval Literature. This course starts from contemporary interest in Medievalism as indicated by current images of Robin Hood, chivalric combat, monastic life, and, of course, dragons, but moves on to ask the important question of what is distinctive about the Middle Ages? This course considers this question by looking at several centuries of production—mostly writing in various languages. We will explore medieval literature by finding the deep and wide impact of Darwin’s new evolutionary science on British imperialism and racialist thinking at the height of the Empire.

76-334 19th Century Literary and Cultural Studies
Fall and Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.
Example: American Other: From Counter-Culture to Popular Culture. This course follows the entry of the black into Western discourse as “Other” into contemporary figurations of black identity in the counter-discourse of the “African Atlantic.” We will begin with the Enlightenment philosophers, Kant and Hume, and compare them with Hegel’s discourse on the Negro, accompanying these primary texts with contemporary commentary from such figures as Henry Louis Gates Jr., Tejumola Olaniyan, and Tsenay Serequeberhan. Our speculations on the form and function of the Negro Other will be applied against the earliest contemporary discourse with W.E.B. DuBois, Frantz Fanon, and Aime Cesaire. This middle section will help develop ideas about the various strategies deployed in early productions of the black subject before finally moving on the contemporary literature in the African Atlantic and current debates on the nature and meaning of black identity in the West.

76-335 20th Century Literary and Cultural Studies
Fall and Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings.
Example: Post-War: Cold War Film and Australian Film. In this course we examine the cultural role of film in the 1950s. We will look at the 1950s in terms of the genre of Film Noir, the Social Problem film, the Cold War horror film, musicals, and westerns. We will think
about the role that each of these genres played in shaping and reflecting the cultural imaginary of the period—from post-war geographic and economic expansion, to McCarthyism, to the nascent feminist and Civil Rights movements. For this reason, we will include: 12 Angry Men, To Kill a Mockingbird, Singin’ in the Rain, On the Waterfront, High Noon, Raisin in the Sun, South Pacific, The King and I, Kiss Me Deadly, Imitation of Life, Invasion of the Body Snatchers and Forbidden Planet. Prerequisites: 76-239

76-344 Literature & Environment
Fall and Spring: 9 units
As we look to our environment intensely, there is a growing interest among students across the country in the role that literature can play (and has played) in helping us develop and understand our relationship to our natural and built environments. This class will offer a brief history of literary representations of nature and the idea of wilderness, and will then focus on modern (especially modern American) texts and films. Just as there is no easy social or scientific solution to problems posed by degradation of our environment, it turns out that literature offers no easy fixes. Indeed, it is in the variety and complexity of ‘strategies’ (occasionally contradictory) offered in literature that we can find some means of deepening an understanding of human motivations and systems of evaluating needs, means and goals for life in the next century. Texts will include, amongst others, Thoreau’s Walden (selections), Ted Kerasote’s Blood Ties: Nature, Culture and the Hunt, Faulkner’s The Bear, and Ted DeLillo’s White Noise.

76-346 Modern Poetry
Fall and Spring: 9 units
This course deals with the major poetry of the earlier part of the 20th century. Modernist writers inherited most of the uncertainties and few of the certainties of the avant-garde writers preceding them. New ideas about Nature, human nature and civilization offered occasions of creative tension that led to an outpouring of poetic invention. We shall begin with Thomas Hardy who is the primary and exemplary poet for many later English writers. We spend a fair amount of time looking at the major works of W.B. Yeats, T.S. Eliot, Ezra Pound and William Carlos Williams , and then give some attention to subsequent developments. Prerequisites: 76-294

76-347 American Literary and Cultural Studies
Fall and 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 radically 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.

76-348 19th Century American Literature
Fall and Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings. Example: 19th Century American Literature. This course offers a broad survey of American literature and thought in the 19th century. Our studies will include fiction, poetry, and essays from such writers as Poe, Melville, Thoreau, Stowe, Dickinson, Whitman, Douglass, Twain, James, Crane, and Chopin. As much as possible, we will place works in historical context, and will regard them as interventions in the social and political world.

76-353 Reading Feminisms
Fall and Spring: 9 units
This course considers not feminism, but feminisms. 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 feminist diversity and the general political and cultural aims of feminisms.

76-355 The Rhetoric of Making a Difference
Fall and Spring: 9 units
People who choose to make a difference—out of a commitment to social justice and a desire to connect—must combine commitment with rhetorical skill and intercultural competence. They must be able to speak wisely and persuasively for change in a corporate setting or a classroom. But equally important, they need the ability to “listen” across cultural difference themselves and to interpret alternative ways of reading the world. This class is an introduction to the rhetoric of difference based on the traditions of American Pragmatism starting with Emerson and Thoreau, including John Dewey, Martin Luther King, bell hooks and Cornel West. The course combines theory with a hands-on project in the students’ urban community. There will focus on developing the strategies for listening and inquiry, for dialogue and persuasion that will allow us to mount a Community Think Tank on an urban issue.

76-360 Literary Journalsm Workshop
Fall: 9 units
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 equip 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. Prerequisites: 76-260 or 76-265 or 76-270 or 76-271 or 76-372 or 76-472.

76-363 Readings in Poetry: Projects and Progressions
Fall and Spring: 9 units
This course will focus on American poetry from 1960 to the present. Specific works and topics will vary by semester. The goal of the course is to give the students a deeper understanding and awareness of contemporary American work in poetry.

76-365 Beginning Poetry Workshop
Fall and Spring: 9 units
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. Prerequisites: 76-265 with a grade of A or B.

76-366 Reading Contemporary Fiction
Fall and Spring: 9 units
This course will focus on American novels from 1960 to the present. Specific works and topics will vary by semester. The goal of the course is to give the students a deeper understanding and awareness of contemporary American fiction.

76-369 Playwriting Workshop
Spring, every other year: 9 units
The playwriting workshop will examine several aspects of story-telling for the stage, including dramatic action, the development of character, scene structure, and plot structure. Students will be assigned a series of practical exercises that will lead to the completion of the first draft of a full-length play. Student exercises will be read aloud in class and critiqued on a weekly basis. Prerequisites: 54-188 or 76-188

76-371 Language in Design
Fall: 12 units
Cross-listed with the School of Design In this project-based 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.

76-372 Contemporary Journalism
Fall: 9 units
This course provides practical experience in the reporting skills and techniques employed by professional newspaper and magazine reporters, with an emphasis on ethics, sources, gathering and verifying information, and organizing the material into story form. Students submit 5 or 6 stories suitable for publication and a take a midterm and final. This course is taught by a seasoned news writer and reporter and is appropriate for students with little to no newswriting experience as well as those who have worked on high school and college papers and seek to build on and professionalize their research and writing skills. For Tartan staff members, the course can include an optional 3 unit internship through which students get credit for articles published in the Tartan and receive post-publication evaluations of their published work from the instructor. Prerequisites: 76-271 or 76-270

76-373 Topics in Rhetoric: Argument
Fall and Spring: 9 units
This course is concerned with the theory and practice of argument: with 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 strongly recommended for all students with interests in writing, public policy, law, and government.

76-375 Magazine Writing
Fall and Spring: 9 units
This course gives writers experience in various forms of magazine journalism including planning, researching, investigating 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 communication environments that interact with print and on-line journalism. Prerequisites: 76-260 or 76-270 or 76-271 or 76-372 or 76-472
Multimedia Authoring I
Fall and Spring: 9 units
Required course for H&SS Multimedia Minor and for IS/CD majors. This course will provide an introduction to the technical skills needed for designing and developing interactive multimedia. Current multimedia tools for use in creating CD-ROM and web-based products will be taught alongside ample opportunity for practice. Students learn authoring tools and multimedia techniques while practicing on non-text-based communication, the integration of visuals, the animation of text and graphics, and digital video editing and deployment. Principles of design will be discussed throughout the course. Group design processes and project management issues will also be addressed. The course makes extensive use of web-oriented applications such as Flash and Dreamweaver.

Multimedia Authoring II
Fall and Spring: 9 units
Required course for H&SS Multimedia Minor. Multimedia authoring involves the preparation for a final class project, due at the end of the semester. Prerequisites: 15-111 or 15-112 or 15-125 or 15-127

Introduction to Discourse Analysis
Fall and Spring: 9 units
"Discourse" is language: people talking or signing or writing. Discourse analysts ask how speaker many 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 neutralized by what people say, how 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 speakers and writers make that show 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 in families and among friends. This course takes a selection of theoretical texts and gives students practice in paying close attention to the details of language.
class will also focus attention on the creation of usable and accurate graphs, charts, and diagrams. Students will review various project-management tools and document planning and testing procedures, which they will incorporate in completing three major projects. The goal is to expose students to the challenges involved in real-world document planning, creation, and testing. Prerequisites: 76-270 or 76-271 or 76-379

76-392 Rhetoric and Public Policy
Fall and Spring: 9 units
Rhetoric and public policy have been linked in the public imagination: in the Abbavonian polis, in the politics of Machiavelli, and, more recently, in the history of the Nazi Regime, the Cold War, and the New Global Economy. The term “rhetoric” has become synonymous with the power of language to deceive, control, and manipulate the public. For Cicero, rhetoric, ethics, and public action were inseparable. For Machiavelli, the ends justified the means. But rhetoric’s role in public policy has been far less visible in contexts that are highly contested, uncertain, debatable, and – in some cases — risky. Rhetoric in this sense is not merely words, but 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. 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.

76-393 Rhetorical Traditions
Fall and 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 Western tradition, rhetoric has provided concepts and tools for thinking 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
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 evidence persuasively 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 will be a prerequisite for 400-level seminar courses. Prerequisites: 76-294

76-395 Science Writing
Spring: 9 units
This is a course for any writer who might be interested in writing about scientific subjects for a general audience. We’ll look at science writing as it appears in newspapers, magazines and books, and we’ll discuss how various writers approach their audience. Do they have a clear agenda? What makes one scientific essay exciting to read and another utterly boring? We’ll look at writers like Stephen Jay Gould, Lewis Thomas, Diane Ackerman, Barry Lopez, and many others. We will examine how these writers sometimes combine story-telling and memoir with science writing, and how they use metaphor and analogy to reach wide audiences. Assignments will include doing a radio show, a critique for an article, an essay on a local scientist or their work, and a feature-length article for a newspaper or magazine about a subject of your choice that you research. One need not be a scientist of any kind to take this course. You do need to be a writer who is interested in and curious about at least one of the many sciences and willing to learn about it. Prerequisites: 76-270 or 76-271 or 76-372 or 76-379 or 76-472

76-396 Writing and the Public Interest
Fall and Spring: 9 units
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 public policy issue of special importance to you. The goal of projects will be to 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 an op-ed editorial, an issue-driven news report, 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. Prerequisites: 76-270 or 76-271 or 76-372 or 76-373

76-397 Instructional Development and Design
Fall and Spring: 9 units
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 prospective teachers, but also a good option for anyone interested in fields such as adult education, continuing, human resource, and employee training that involve a substantial instructional component. The course is a combination seminar and workshop. Students study the history, major theories, related research, and issues of instructional design, including a detailed examination of models of how people learn from text and what features enhance learning. Students complete a series of hands-on assignments, including a final project, in which they design, write, and evaluate instruction. Prerequisites: 76-270 or 76-271 or 76-379

76-431 Advanced Seminar in British Literary and Cultural Studies
Intermittent: 9 units
Seminar focusing on British literary movements, forms, periods, or authors. Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings. Example: Fall 2002, Re-Reading the English Renaissance. What was the “Renaissance” and why do so many people now call the period in England between 1500 and 1625 “early modern” instead? Was it the recovery of “human-centered” knowledge from antiquity, the invention of the doctrine of individualism (Jabok Burchikart), or the rise of a new, bourgeois, class (R.H. Tawney)? In this course we will attempt to build a representation of the period by reading and discussing many kinds of texts: arguments about religion, sex roles, and government, love poetry, and religious; and prose fiction from both court and city. Drink your own liquor and as you create our view of the world, let us speak. These materials are very different from each other - some are polished and beautiful, like Sidney’s sonnets, some rough and outrageous like the rogue pamphlets, and some radical like More’s Utopia. Everyone in this course will read in the tradition of the newly privileged English language. Prerequisites: 76-294 Co-requisites: 76-394

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 Ulysses to trace his development as a writer and examine the reasons for his impact on twentieth-century literature. We will also consider know Joyce’s time and culture(s) marked his work, how that work was received when it was published, and how it is understood today.

76-435 Gay and Lesbian Theory
Fall and Spring: 9 units
Lesbian and Gay Studies and, more recently, Queer Studies, have grown in importance in literary, cultural, and historical study. The amount of materials dealing with “deviant” sexualities is huge; we will cut our way through this exciting and diverse territory by focusing on methodology. How is sexuality read? What theories of meaning, identity, and culture inform lesbian, gay, and queer studies? Instead of focusing on lesbians, gay men, transsexuals or transvestites as objects of study, this course will investigate how lesbian, gay, and queer readings - and meanings - are produced, negotiated, and suppressed. We will begin with Freud and those whose ideas about the most relentlessly through recent lesbian/gay and queer theory. Our study will not be confined, however, to theory. We will engage a broad selection of ‘canonical’ texts in lesbian and gay studies - literature, electronic media, and community-organizing and political practices - as objects of study. Moving from the “canon” to more recent texts in queer and media studies, we will try to think through the methodological issues that arise from both the cultural practices and theories that define sexual “deviance.”

76-439 Advanced Seminar in Film Studies
Fall and Spring: 9 units
Topics will vary by semester. Consult the course descriptions provided by the Department each semester for current offerings. Example: Fall 2002, BLOCKBUSTERS: Fiction into Film. In this class we will look at popular novels—from a range of time periods, but have been turned into popular films. Our goal will be to think about adaptation as a mode of interpretation: the ways in which what gets left in, what gets left out, and what gets changed, says something about the historical and cultural moment within which the film is made. Novel/Film combos that we will examine will range from Sense and Sensibility, Frankenstein, and House of Mirth, to Beloved, Waiting to Exhale, and Jurassic Park. You will produce a long research paper on novel/film combo of your own choosing. Prerequisites: 76-239

76-441 Chaucer
Fall and Spring: 9 units
Giovanni Boccaccio is sometimes thought of as the author of universal, timeless fictions containing “God’s plenty” (in Dryden’s famous phrase). This course, however, will stress the ways in which Chaucer’s fictions are situated within specific, but complex and fluid, 14th-century political, social, and religious controversies. We will read The Canterbury Tales and Troylus and Criseyde in Middle English (which is not hard to learn, but fun to know), and look at other representations of medieval English culture as it saw itself and as we see it from a 20th-century vantage point. Prerequisites: 76-294
76-444 Enlightenment Sexualities
Fall and Spring: 9 units
This course studies two kinds of narratives about sexuality: 1) modern historical narratives about the historical construction of human sexuality and its relation to gender identity and sexual orientation, and 2) eighteenth-century British narratives that relate a gendered, personal identity to a story of sexual misconduct or transgression. We begin by looking at how the contemporary commentars narrativize the development of modern sexual identities. We ask questions about how gender is organized: Does it follow developmental patterns? Is it thought of in oppositional terms (masculine and feminine as opposites)? What range of possibilities do these histories allow us to think about gender as an organizing principal of sexual desire? In particular, we will ask what significance the eighteenth century, a particularly crucial period of change in all these historical narratives, has in forming modern categories of gender and sexual orientation. The main business of the course will be to read novels and autobiographies written by authors such as Samuel Richardson, Charlotte Charke, John Cleland, Henry Fielding, and Eliza Haywood. What stories about sexuality are told in these texts? How are these stories related to gendered identities and/or identities of sexual orientation? What roles do these stories play in defining the limits for sexual behavior and in forming identities based on that behavior? In sum, we’ll be looking at modern historical narratives of sexuality and gender, particularly as they figure the eighteenth century, and at eighteenth-century British narratives about sex and identity drawn from popular culture. Prerequisites: 76-294

76-451 Topics in Language Study
Fall and Spring: 9 units
Seminars focusing on topics in linguistics and discourse studies. Topics will vary by semester. Consult detailed course descriptions available from the Department each semester for details. May be repeated for credit. Example: Patterns of English Usage. Beside the conventional “grammar” of English there lurk an unlimited number of patterns that play an important and largely unrecognized role in organizing our language. In this course you will learn some techniques for recovering these patterns from an electronic corpus and making generalizations about their structure and distribution.

76-453 Postcolonial Literature and Theory
Fall and 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, Salman Rushdie, Ngugi wa Thiong’o, Arundhati Roy, M.G. Vissani, Bessie Head, Ben Okri, and Derek Walcott. Theoretical works will include writings by Frantz Fanon and Partha Chatterjee on nationalism; Chandra Mohanty and Ashis Nandy on gender; Homi Bhabha and R. Radhakrishnan on hybridity; and Gayatri Spivak and Edward Said on the postcolonial critic. Prerequisites: 76-294 Co-requisites: 76-394

76-457 Topics in Rhetorical Study
Intermittent: 9 units
Seminars focusing on topics in linguistics and discourse studies. Topics will vary by semester. Consult detailed course descriptions available from the Department each semester 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 on on-line linguistic atlas materials, and fieldwork about the sources and features of accent and speech style in Western 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 and Spring: 9 units
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. Prerequisites: 76-260 with a grade of A or B.

76-461 Personal Essay
Fall and Spring: 9 units
This is an advanced writing course that has been specifically designed for the student who wishes to practice and pursue 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. Prerequisites: 76-260 and 76-460 or 76-462 with a grade of A or B.

76-462 Advanced Fiction Workshop
Fall and Spring: 9 units
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. Prerequisites: 76-460 or 76-461 or 76-462 with a grade of A or B.

76-465 Advanced Poetry Workshop
Fall and Spring: 9 units
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. Prerequisites: 76-265 with a grade of A or B and 76-365.

76-467 Autobiography Workshop
Fall and Spring: 9 units
This workshop develops students’ analytical writing and critical skills in autobiography. The students’ own work will be closely examined by the instructor and other members of the course. Prerequisites: 76-269 with a grade of A or B.

76-470 Advanced Professional and Technical Writing
Spring: 9 units
In this project-based course, students will produce a portfolio of professional and technical writing that applies skills in audience analysis, problem definition, document design, organization and oral and written presentation. For each project, students learn how technical manuals, proposals, correspondence, technical reports, and documentation are influenced by the social, ethical, organizational, technical, rhetorical contexts in which writers work. This course is required for Technical Writing majors and suitable for all writers interested in developing their skills in writing about specialized subjects for general audiences. Prerequisites: 76-270 or 76-271 or 76-379.

76-472 Journalism Workshop
Intermittent: 9 units
Students work closely with the editor of the Carnegie Mellon faculty-staff newspaper, Focus, to report and write a variety of news and feature stories for publication. The weekly sessions include presentations of student projects; discussions of practical problems in newsgathering; 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. Prerequisites: 76-360 or 76-372 or 76-375 or 76-376 or 76-472 or permission of the instructor.

76-476 Rhetoric of Science
Fall and Spring: 9 units
This course will help students understand what it means to talk about rhetoric in the context of science from theoretical and applied perspectives: (1) How do scientists use language to represent the world? (2) How does language help scientists create communities? (3) How do scientists learn to understand knowledge? (4) How does the language of science differ from or build upon language in other disciplines? Throughout the course, we will look at the current debates over the relationship between science and language from the perspective of scientists (who may fear that science will become mere rhetoric) and rhetoricians, who see rhetoric as a tool for understanding the ways that scientific communities use language in their work. Students will work collaboratively and individually on specific assignments throughout the semester that will help them apply and evaluate theories within specific scientific contexts. Through these assignments, students will begin to develop their own theories of the ways that language works in specific scientific contexts.

76-479 Corporate Marketing and Communications
Spring: 9 units
This course, taught by a professional marketing communicator with many years experience in corporate communications, advertising, grant writing, fund development, and consulting, is designed to help students develop the all important communication skills practiced in its related fields. Students will study examples of communication crises and how they were handled. Students learn the value of planning and developing a coherent approach and image for all of an organization’s communications. Typical assignments include news releases, promotional copy for brochures, print and billboard ads, radio and TV spots, annual reports, company newsletters, and even opinion-editorials. As a final project, you’ll develop a strategic marketing plan to promote a business you’ve always dreamed of starting. Prerequisites: 76-270 or 76-271 or 76-372.

Course Descriptions
Course Descriptions

76-480 Document Design
Fall: 12 units
This course is intended to develop your understanding of three concerns related to document design: 1) the theory you need to understand visual/verbal communication, 2) practice in solving design 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 covering basic perceptual composition, basic typographic, basic 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 contemporary features. As you solidify your knowledge through this collaborative 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 in Seminar and a third as a required lab in which students learn and practice required software applications. Prerequisites: 76-270 or 76-271.

76-481 Writing for Multimedia
Fall: 12 units
The growing demand for multimedia applications in 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 develop your ability to conceptualize, design, and create multimedia applications. Areas of focus will include: strategies for understanding and documenting audience needs and expectations; the basics of effective user-interface design; and the typical processes 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. Prerequisites: 76-270 or 76-271; 76-480 is preferred but not required.

76-482 Comparative Rhetoric
Fall and Spring: 9 units
This course serves a two-fold purpose. It attempts (1) to address the theoretical and methodological issues in cross-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 encounter in trying to write, argue, and persuade across languages and cultures. And it aims to take a close look at the need for rhetoric to rethink its own identity, purpose, formation and agenda in an increasingly multicultural and globalized world.

76-487 On-line Information Design
Fall and Spring: 9 units
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, methodological, 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. Prerequisites: (76-270 or 76-271 or 76-379) and (76-480 or 76-382 or 76-383) Students are required to register for both 487 & 488.

76-488 On-line Information Design Lab
Fall and Spring: 3 units
Lab exercises for On-line Information Design. Basic HTML, images, tables, animation, imagemaps, interactive forms, Web interfaces to databases, and basic Java-scripting. All lab exercises are computer-based. The exercises are designed so that those students who already know particular topics (e.g., basic HTML) do not need to attend the Lab session. Students who would like guided practice in doing the lab exercises must attend the computer lab session. Prerequisites: (76-270 or 76-271 or 76-379) and (76-480 or 76-382 or 76-383)

76-494 Medical Communications
Fall: 9 units
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 thorough understanding of the information to make important health care decisions. The course is appropriate for you if you are planning a career in any health-care related profession or, as a writer, you want to build your writing and communication skills in a specific community. You 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 explore the interactions of current theory and practice in medical communication, study an historical overview of medical communication, and explore the provider/patient relationship from rhetorical standpoint. Prerequisites: 76-270 or 76-271 or 76-379 or permission of the instructor.

76-491 Senior Project
Fall and Spring: 9 units
Seniors in all four majors within the English Department may, with faculty permission and sponsorship, design and complete an original, student-planned Senior Project. Creative Writing majors may work on a book-length manuscript in fiction or poetry. Students in all majors within the Department may also, with the permission of a faculty advisor who will supervise and sponsor the project, design and complete senior projects that involve either traditional academic research or investigations of problems 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 culture and power in classical civilizations, and then moves on to address: Byzantine Christianity and Islam; the Spanish and the Aztecs; the emergence of a transatlantic world and the growth of European dominance in the eighteenth and nineteenth centuries; and, finally, the forces of anti-colonialism and new forms of nationalism, as well as ethnic conflicts in the mid to late twentieth century.

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, Whitman, Maya Angelou, 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 contexts: 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.
Intermittent: 9 units
This 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 historical 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.
This course will examine the role violence has played in shaping American race relations. We will consider the dynamics that generate racial violence, how American scholars have often imposed words like "slavery" and "freedom" onto testimonies of "slave's" primary sources. We will, through the eyes of fiction writers, try to capture the essence of what it's like to be a hyphenated-American. The course is an introduction to comparative slavery and emancipation in New World societies. 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 narratives by drug users and perceived problems as described by social reformers and policy makers, will also be read.

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 hallucinogens. 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.

The 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.

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 is a survey of the major theoretical and methodological approaches to the study of American history. Students will learn the importance of a historical perspective on culture, looking at how and why societies change, and considering how we, as anthropologists, should assess these changes.
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 significant recurring issues and events, including the major social and political movements since revolutionary times, and the central role of race, ethnicity, and gender. It reviews the major themes of cultural and social change since the late 18th century. The course includes lectures and discussions, and emphasizes student involvement in analysis, debate, and essay writing.

79-207 Development of European Culture Intermittent: 9 units
Europe is the smallest continent, yet despite its size it has a rich and varied history. The purpose of this course is to introduce students to the history of Europe focusing on the concept of culture as a category of historical analysis. "Culture" in this course is broadly defined as "the totality of socially transmitted behavior patterns, arts, beliefs, institutions, and all other products of human thought and work." We will cover the period from the late Middle Ages until the present, concentrating on general European developments. Among the topics we will consider are: encounters between different cultures (particularly the Europeans' "first contact" with the rest of the world); religion, magic, and science; love; the "civilizing process"; the production and consumption of goods; and, finally, the birth of "modernism."

79-209 Theory and Practice in Anthropology Intermittent: 9 units
How has anthropology changed over its relatively short lifetime? This course will explore 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 explore the paths anthropology 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 resurface in more recent anthropological work, readings will pair classic works with ethnographic readings from the last thirty years.

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, a "truth" that cannot be conveyed in words. In this course we examine ethnographic films as descriptions of unfamiliar (and sometimes familiar) others. We discuss the ways films interpret 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 changes, developments, and achievements, and influences of modern natural science. We concentrate on the major philosophical, methodological, and organizational features in the history of the physical and biological sciences from the Renaissance to the late 19th century.

79-214 Going Places: Tourism in Anthropological and Historical Perspectives Intermittent: Mini Session - 6 units
Tourism is the world's largest industry, involving immense movements of human populations and bringing vastly different systems of meaning into contact and sometimes collision. In the contemporary world, almost every community and nation is influenced in some way by tourism. This course will examine the history of tourism, and the importance of tourism studies to anthropological understandings of culture. We will explore the issue of cultural performance, tourism's role in the construction of identity and nationalism, and the question of cultural authenticity. We will also analyze a number of theories on touristic motivations. In doing so, we will investigate the not-so-clear boundary between tourism and anthropology, asking what, if anything, makes anthropologists differ from tourists.

This is a lecture and discussion course designed for engineering students and students with a general interest in engineering innovation. No technical expertise is required, only a desire to explore the nature of engineering and its grand successes and spectacular failures. Historical case studies, such as the design and construction of the Brooklyn Bridge, the invention of the telephone, the collapse of the Tacoma Narrows Bridge, the development of the digital computer, and the Challenger disaster, provide the means for probing the perennial themes in engineering and the role of art, science, skill imagination, and ambition in this human endeavor.

79-216 Music and the Counter Culture in the 1950s/1960s Intermittent: 9 units
The 1950s and 1960s in America were a time of profound social, political, and cultural change. During this time, a number of people became highly critical of certain aspects of the American way of life, and groups sprung up which were openly opposed to the prevailing views of mainstream American society. This course will examine the formation, development, and growth of these oppositional groups. The course will also focus on the central and defining role that music played in the creation, expansion, and persistence of particular oppositional groups.

79-218 The Roots of Rock & Roll Intermittent: 9 units
This is a course about musical and social revolutions from the 1920s to the present. 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 earliest 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
What can we do to recall 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 examine 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 know 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 orthodox.

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 revolutionary times, but also the historical development of mainstream politics, law, and public opinion regarding radical dissent.

79-225 Religions of Asia Intermittent: 9 units
How have East Asians 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, Japanese, and Koreans. Without neglecting the textual canon, we are particularly
interested in changing styles of ritual organization and practice. We examine mutual borrowing and competition among shamanism, ancestor worship, Confucianism, Buddhism, Daoism, and/ or Shinto, and the adaptation of each to varying social contexts and state policies up to the present. Principal attention will be given to one or two countries in East Asia. Primary and secondary material, film and illustration, lecture and discussion.

79-230 Technology in American Society
Intermittent: 9 units
Some historians believe that what is really distinctive about American society is not its democracy, capitalism, or civil liberties, but the technological advances that have played, and continues to play, in its evolution. This course will look at the way technology has shaped, and has been shaped by, American society, from pre-colonial times to the present. Major themes include the increasing role of science in technological change, and the processes by which society makes its technological choices.

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. The main focus will be on problems and possibilities confronting the world during the Cold War as well as on global political changes in the post-Cold War era. Among important foreign policy strategies which we will discuss are the strategy of containment, NSC-68, the Eisenhower-Dulles “New Look,” the Kennedy-Johnson “flexible response,” “detente” and approaches to contemporary American foreign policy.

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 to 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.

79-240 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, hipsters, 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
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 particular topics (e.g., work, family, and religion) or chronological periods (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 discusses 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 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 the encounter of multiple empires 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 Atlantic slave trade, 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 topics as Negritude and Rastafari, and such media as music and film, 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.

79-258 Introduction to African History: 18th Century to Neo-Colonialism
Intermittent: 9 units
This 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 to 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 archaeology, 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; "tradition" 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 and 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 war and violent political expressions 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 West's 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 American Women and Social Reform
Intermittent: 9 units
American women have long held a unique role as reformers, and this course will explore their contributions. We will examine women's involvement in larger reform movements, such as abolition, temperance, the peace movement, and civil rights. In addition, we will consider women's efforts on their own behalf, as in suffrage, feminism, and women's liberation.

79-288 Racial Violence in America
Intermittent: 9 units
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.

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 any other society. We will 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 writings 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 a little over a century 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 of Japan's history which underlie 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 reminembrances, 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 political background of the Japan/US 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.

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 war 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-Soviet Union. This course will consider the experience of the indigenous Maya under Spanish colonial rule and the Zapatista uprising in southern Mexico, and increasing Mayan migration to the United States. Drawing upon the varied perspectives of archaeology, 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; “tradition” and “modernity”; state violence and human rights; and indigenous political and cultural mobilization at the local, national, and transnational levels.

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 any other society. We will 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 writings 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.
Modern Latin America, 1789-Present  
Intermittent: 9 units  
This course provides an introduction to the cultures, politics, environments and economies of Latin America and the Caribbean. Topics covered will include colonial legacies, the Haitian Revolution and independence movements, slavery and emancipation, the rise of nationalism, environmental transformations, U.S.-Latin relations, twentieth century revolutionary movements, decolonization and new social movements. Regions to be explored include Brazil, the Caribbean, and the United States. Course materials will include the works of Latin American novelists, poets, filmmakers and musicians in addition to scholarly analysis and historical documents.

India: Anthropological and Historical Perspectives  
Intermittent: 9 units  
India is the world’s largest democracy, its second most populous nation, and one of the dominant intellectual, industrial, and military powers in Asia. India has been ruled by Hindu princes, Muslim emperors, and British imperialists, each leaving a distinct mark on the fabric of Indian culture. This course will focus on the role of caste, kinship, and gender in India. We will consider the following questions: What is caste, and what is its relationship to race and class? How are families structured in different parts of India, and what can we say about the politics and emotions of life in Indian families? How is marriage orchestrated and thought about in various cultural contexts? How is gender foregrounded in modern India? How has gender played in the development of Indian cultural consciousness?

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 history of Brazil and many Caribbean societies, including Cuba, Haiti, and Jamaica. The first part of the course will focus on the Atlantic slave trade and slave life in both rural and urban areas. Our goal will be to appreciate the complexities of post-emancipation societies without losing sight of the systemic 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 descendants 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.

Ritual, Culture, and Identity  
Intermittent: 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 subordinating one’s enemies, as a way of establishing group identity and reining 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.

Visual Anthropology  
Intermittent: 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 politics of representation; how pictures construct and analyze the world. Photographs, film, and other media are used as a means of articulating a critical perspective on contemporary visual culture.

The Politics and Culture of Memory  
Intermittent: 9 units  
How do societies remember? Memory is socially, rather than simply individually, in scope. It is cultural, rather than purely psychological, in nature. Its significance is as much as how 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 explores the wide variety of media 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 has been defined and will proceed 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, colonization, and genocide. Finally, we will consider the place and politics of memory in the writing of history by professional historians.

Who Shall Serve? Blacks, Women, and Gays in the Military  
Intermittent: 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? Have American military, social, political, economic and cultural contexts affected the level of participation in the military by these groups?

Culture, Power, and Politics  
Intermittent: 9 units  
This course investigates the relation between cultural meanings and representa- tions and structures of political and economic power from a comparative cross-cultural and historical perspective. The course looks at the uses of cultural symbols, the politics of cultural community and social identity pertaining to gender, class, ethnicity, religion, race, and nationality are invoked to legitimate the power of states and key social groups and how forms of opposition and resistance arise and influence contests for power and authority in a range of societies. To pursue our theme, we will first discuss some broad theoretical and comparative work on some important topics such as nationalism, capitalism, and colonialism and then focus on contemporary and historical case studies from Europe, North Africa, and the Middle East.

Gender Roles and Social Change  
Intermittent: 9 units  
This course examines women’s and men’s roles, behaviors, and beliefs in a variety of societies, including our own. We use an anthropological perspective to examine the relationships between gender and the distribution of power, ideologies and practices that incorporate a notion of “female” and “male” as well as other pertinent issues. The course is comparative; the texts are anthropologi- cal. Students are responsible for learning theories and methods of anthropology, as well as familiarizing themselves with the societies/problems on which we focus.

History, Memory, and Patriotism in America  
Intermittent: 9 units  
Although Alexis de Toqueville 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 Douglas 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 course will focus on how groups remember and reshape their collective past to serve their particular present.

Prerequisites: 79-201

79-305 Representing Pacific Cultures  
Intermittent: 9 units  
Concentrating on the Pacific Islands, the course will discuss issues of observa- tion, interpretation, description, and presentation. Materials will be drawn from Polynesian societies and cultures (Hawai, Tahiti, and others) and will include representations in literature, film, art, history, and anthropology. The intention is to compare modes of describing and relate these to modern developments, like tourism and the appropriation of myths of the Pacific in advertising, movies, and television. Every student will be expected to choose a mode of representation and present a final project utilizing the mode.

79-307 The Anthropology of Europe  
Intermittent: 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 contempo- rary 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  
Intermittent: 9 units  
How do societies remember? Memory is socially, rather than simply individual, in scope. It is cultural, rather than purely psychological, in nature. Its significance is as much as how 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 explores the wide variety of media 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 has been defined and will proceed 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, colonization, and genocide. Finally, we will consider the place and politics of memory in the writing of history by professional historians.

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79-310 Culture, Power, and Politics  
Intermittent: 9 units  
This course investigates the relation between cultural meanings and representa- tions and structures of political and economic power from a comparative cross-cultural and historical perspective. The course looks at the uses of cultural symbols, the politics of cultural community and social identity pertaining to gender, class, ethnicity, religion, race, and nationality are invoked to legitimate the power of states and key social groups and how forms of opposition and resistance arise and influence contests for power and authority in a range of societies. To pursue our theme, we will first discuss some broad theoretical and comparative work on some important topics such as nationalism, capitalism, and colonialism and then focus on contemporary and historical case studies from Europe, North Africa, and the Middle East.

79-311 Gender Roles and Social Change  
Intermittent: 9 units  
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79-315 History, Memory, and Patriotism in America  
Intermittent: 9 units  
Although Alexis de Toqueville 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 Douglas 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 course will focus on how groups remember and reshape their collective past to serve their particular present.

Prerequisites: 79-201
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 context of his assassination, Americans have fought bitterly about who he was and what he continues to mean to different segments of the nation. Honest Ralpilpitter or Slick Lawyer? Great Emancipator or racist opportunist? Savior of the Union or demagogic tyrant? Students analyze Lincoln's own views along with how others have 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, inevitably 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 ourselves. 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 Nanking; Pearl Harbor: Hiroshima and Nagasaki? How do soldiers, 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.

79-320 America in the 1950s
Intermittent: 9 units
What do you think of when you think of the fifties? Is it Elvis or the H-bomb? Rosa Parks or I Love Lucy? This course goes behind the popular icons of the 1950s to explore the social, cultural, political, and intellectual history of America from the end of World War II through the assassinations of Presidents Kennedy and Johnson. We will use a variety of sources to understand the dynamics of cultural change during this era: music, films and television shows, novels and memoirs. We will also look closely at the relationships between memory and history, celebration and criticism in the interpretation of the recent past.

79-324 Modernism and Painting, 1880-1945
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 parallels in 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.

79-326 Other People's Lives: Biography, Autobiography, Microhistory
Intermittent: 9 units
This course looks at early modern history through the experience of individuals. We will be reading a series of rather old-fashioned historical sources, biographies and autobiographies, as well as newer versions of how historians have written and are writing "other people's lives." Some of these newer versions include prosopographies or collective biographies. Another more recent innovation is microhistory-the detailed examinations of a single event or individual. Microhistories often focus on so-called marginal persons such as criminals, transvestites, or religious heretics. We shall also want to study "ego-documents," that is, documents that record individuals' lives (akin to autobiographies) but that were never intended for publication. Finally, we will also examine how films can transmit individuals' experiences. This course will be concerned, first, with viewing early modern biographies, autobiographies, and microhistories. Second, we will be interested in the development of these genres of writing as historical sources and over time.

79-328 Women's Health and Healthcare
Intermittent: Mini Session - 6 units
This course will explore the changing meanings of health and medicine in women's lives over the past 150 years. We will look at doctors' perceptions of female patients, as well as women's own conceptions of their bodies and health. Topics include historical analysis of childbirth and other areas of women's reproductive lives, body image and related health issues, the relationship between gender and disease, and the rise of the women's health movement. We will consider women's roles not only as consumers, but also as providers of health care. These issues will analyzed within the larger context of American social history and the history of medicine.

79-329 Sex, Population, Birth Control
Intermittent: 9 units
This course will explore efforts to control reproduction in 19th and 20th century America. 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 these 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: violence, civil rights, 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.

79-335 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 use 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.

79-336 Epidemic Disease and Public Health
Intermittent: 9 units
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.

79-337 Educational Policy in Historical Perspective
Intermittent: 9 units
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.

79-340 History of Modern Warfare
Intermittent: 9 units
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 and the two World Wars.

79-341 War and Technology
Intermittent: 9 units
Many believe intuitively that war transforms technology, and that technology transforms war, and yet rarely do the historical or sociological processes by which those effects take place receive careful scrutiny. Looking closely reveals not "historical forces" or "technological determinism," but rather familiar and flawed human actors. This course critically examines on two major, 20th century technological innovations: all big-gun battleships (the Dreadnoughts) and mechanized (armored) land warfare. Following analysis of these two technologies, which occupy perhaps three quarters of the course, attention turns to similar arguments about contemporary military technology and strategy.
This course focuses on the Arab-Israeli and Palestinian-Israeli conflicts, and discussion progress with a dual goal: to understand both the historical direction of the conflicts and attempts to resolve them can be charted. Readings beginning with a historical overview and continuing on through current events. Which reshaped the world during and after the Cold War. We will examine 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.

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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 course is concerned with the long history of negotiating episodes designed to dramatically alter 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 dimensions. One is to review the assumptions and propositions of the leading theories of international relations. The 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 conflict in Bosnia. The theories also will be linked to contemporary notions about the post-Cold War order such as globalization and the democratic peace.

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 films have depicted all 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.

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This course will examine the Cold War as a political, ideological, technological, and military contest on global scales. It will give particular 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 is based on use of historical documents and films to study problems of managing contemporary complex technologies and especially, the effects that changing information technologies have had, and may have, both on organizations themselves and on the processes of technological change.

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Course Descriptions

79-379 Women in American History

Intermediate: 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

Intermediate: Mini Session - 6 units

This course explores Japan-U.S. 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 Pacific War, 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.

79-381 Male and Female in Japan

Intermediate: 9 units

We will begin our study by comparing the gender ideals and realities of samurai, peasants, and merchants in the first half of the 19th century. Next we will consider ideal male and female roles constructed by the industrializing Meiji government (1868-1912) in their efforts to re-introduce Japan to the Western world with an emerging self-discovery and romanticism of the twenties urban "new women" and "new man." The years of militarism from the thirties to 1945 will frame yet another version of men and women, followed by further changes in the postwar period. Our sources will be fiction, biography, autobiography, film and scholarly articles from several academic disciplines.

79-383 African History: From the Slave Trade to the Present

Intermediate: 9 units

Focusing on the period of “modern” African history, this is the second course in a sequence that introduces students to African history. By beginning at the height of the trans-Atlantic slave trade, we will connect the changes that African cultures underwent during this period of growing European economic and political influence to the advent of European colonialization. And by ending in the post-independence period, we will follow social processes in Africa and Africa’s role in the global economy into the 20th century.

79-384 Medicine and Society

Intermediate: 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 two 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 (“bringers,” “popular,” “quacks,” “alternatives”); and, finally, the importance of class, race, and gender as categories of historical analysis and as determinants of medical care.

79-385 Issues in Anthropology and History

Spring: 9 units

More than a simple admixture of fields, the joining of anthropology and history has engendered occasional crises in both disciplines, and transformed them. The emergence of anthropology and history as an interdisciplinary area of inquiry is intimately related to wider historical events and processes, and must be placed in a political context to be understood. This course is organized around a series of readings that provide an introduction to anthropology and history as a theoretical, historical and political phenomenon. First we will survey the development of cultural anthropology in the early twentieth-century, with special attention to the colonial politics of anthropology. Then we will consider the increasing contact between anthropology and history beginning in the 1950s, both in terms of anthropologists’ attempts to re-introduce the history of colonialism into the study of culture, and historians’ attempts to bring an anthropologically inspired interest in culture to the study of the past. After exploring the challenges levied at anthropology and its colonial history in the wake of decolonization, we will conclude the course by considering several areas in which interdisciplinary work has been especially productive: the anthropology and history of colonialism; cultural and historical memory; and ethnic, communal, national, and transnational politics.

79-386 The Global Environment: Historical Perspectives and Policy

Dilemmas

Intermediate: 9 units

This course focuses on understanding the relationship between social and environmental change by examining 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 problem 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.

79-377 Evolution and Genetics in American Thought and Culture

Intermediate: 9 units

This course will explore the reception and interpretation of Darwinian evolution, Mendelian genetics, and the Watson-Crick model of DNA by the scientific community and the general public. We will discuss the controversies that have arisen over these theories, examine their applications in science and society, and consider the implications for American public policy. Topics include: social Darwinism, sociobiology, creationism, eugenics, the nature-nurture debate, genetic testing, and the humane genome project. These issues will be analyzed within the larger context of American social history and the history of science.

79-376 Making of the Modern Family

Intermediate: 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.

79-375 Children and Childhood in America

Intermediate: 9 units

What does it mean to be a child in America, and how has that meaning changed over the past 300 years? This course investigates the social construction of childhood from the colonial period to the present day. We will examine adult perceptions of and prescriptions for children, and we will consider the factors of gender, race, ethnicity, and class in shaping the lives of children. More broadly, we will use the lens of childhood to view social and cultural change in American history. Students will develop skills in historiography as part of our exploration of the historical experience of childhood.

79-374 African History: From the Slave Trade to the Present

Intermediate: 9 units

We will adopt a perspective that incorporates history, anthropology and medical sociology on the history of medicine; the existence of a wide range of practitioners (“bringers,” “popular,” “quacks,” “alternatives”); and, finally, the importance of class, race, and gender as categories of historical analysis and as determinants of medical care.

79-373 Evolution and Genetics in American Thought and Culture

Intermediate: 9 units

This course will explore the reception and interpretation of Darwinian evolution, Mendelian genetics, and the Watson-Crick model of DNA by the scientific community and the general public. We will discuss the controversies that have arisen over these theories, examine their applications in science and society, and consider the implications for American public policy. Topics include: social Darwinism, sociobiology, creationism, eugenics, the nature-nurture debate, genetic testing, and the humane genome project. These issues will be analyzed within the larger context of American social history and the history of science.
Course Descriptions

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 deconstructed the concept of nation 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 to the changing roles of gender boundaries within the family. How a couple negotiates their resources—both productive (activities which bring a wage into the household) and reproductive (how the household supports the needs of the wage-earner) in Pittsburgh. The History Department will pay for students’ admission to all museums and concert halls. However, students will be charged a supplemental fee of $35 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 contributes 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 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 concert halls. However, students will be charged a supplemental fee of $35 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.

79-397 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 East 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 Research Seminar in Anthropology and History
Fall: 12 units
This is a culminating seminar for the major in Anthropology and History, and it applies and develops the theoretical and methodological tools presented in lower-level courses. However, the primary aim of the course is to allow students to develop a research project that enables them to bring the knowledge and methods of the two disciplines to bear on a particular problem or topic. Research may be based on ethnographic fieldwork, archival work, or a combination of the two and serves as the basis of a substantial final paper. Prerequisites: 79-200 and 79-201

79-410 History and Policy Project Course
Fall: 12 units
This course is the capstone of the History and Policy major. Students do individual and group research in a policy area that profitably can be studied historically. Students in the seminar deliver both written and oral reports to faculty and an outside panel of experts. Prerequisites: 79-200

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 Social and Cultural History Colloquium
Fall: 12 units
The Social History Colloquium will focus on a theme, concept, or category that is 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 (ethnicity, religion), political 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 explore how theories change over time. The colloquium 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 & Development
Intermittent: 9 units
The rise of industrial 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? 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.

Philosophy

Undergraduate Courses

80-100 What Philosophy Is
Fall and Spring: 9 units
This is an introduction to Philosophy in which we survey three major areas: Ethics, Metaphysics, and Epistemology. We read and discuss ethical theories proposed by Plato, Mill, and Kant. In Metaphysics we consider the problems of a free will, and debate whether computers can be intelligent. In the concluding section on Epistemology, we examine the views of Descartes, Locke, Berkeley, and Hume about the scope and limits of human knowledge. The course has no prerequisites.

80-101 Mathematics in Context
Alternate years (Spring): 9 units
The course explores historical, scientific, and philosophical contexts in which mathematics is developed, and the ways in which mathematics enables us to obtain precise descriptions of various aspects of human experience. Topics include the emergence of Non-Euclidean geometry and Riemann’s theory of manifolds with applications in cosmology, and the theory of computability with applications in cognitive psychology. Students will become familiar with basic set theoretic notions, as well as Turing machines and cellular automata. Prerequisites: none.

80-102 Honors Program in What is Philosophy
Fall and Spring: Mini Session - 6 units
for those students that are selected who excel in 80-100 and are chosen by the instructors to take this course
80-103 Freshman Seminar on Pragmatism
Intermittent: 9 units
80-103 Freshmen Seminar on Pragmatism Teddy Seidenfeld This is intended as an introduction to a philosophic tradition, Pragmatism that is problem oriented and concerned with how does it differ, for example, from the rival philosophies associated with Descartes or Hume? We shall study selected writings of C. S. Peirce, William James, and John Dewey to see how these pioneers of Pragmatism addressed such diverse issues as justification of the scientific method and the status of ethical theories.

80-105 Freshman Seminar on Mysticism
Fall: 9 units
This course explores historical, scientific, and philosophical contexts in which mathematics is developed, and the ways in which mathematics enables us to obtain precise descriptions of various aspects of human experience. Topics include the development of non-Euclidean geometry, Riemann’s theories of manifolds, and analysis, with their applications in cosmology; and the theory of computability, with its applications in cognitive psychology.

80-110 Nature Mathematical Reasoning
Spring: 9 units
This course focuses on understanding mathematical reasoning, not on mastering a particular mathematical theory like linear algebra or calculus. We will explore instances of mathematical reasoning and rigorous argumentation, with examples from the history of science and mathematics. We will also study the axioms of each branch of math theory as a foundation for mathematics, and use them to explore the nature of the infinite.

80-120 Reflections on Science
Intermittent: 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 the 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
As an introduction to Ethics, the course is designed to be both historical and thematic. Key representatives of the history of ethics will be discussed in detail and major ethical theories will be analyzed in relation to concrete situations. The moral philosophies of Aristotle, Hume, Kant, Bentham and Mill, etc. will be presented as background to the thematic problems of ethical relativism, egoism, utilitarianism, and other concepts of ethical theory.

80-135 Introduction to Political Philos
Fall: 9 units
As an introductory course, 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
This course is designed to give students some 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 research project in question. There are no prerequisites, but students with some philosophical sophistication and/or formal ability will be more comfortable with the material.

80-151 God in the West
Intermittently: 9 units
80-151 God in the West **Intermittently: 9 units This course surveys the rise of Christianity from pagan origins, 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 more than a billion people? How did doctrinal practice become transformed by institutionalization and circumstance? How and why did the two movements respectively fragment? What is “fundamentalism” and why do people support it? Ethical and doctrinal issues will also be considered, in some cases at length.

80-180 The Nature of Language
Fall and Spring: 9 units
Producing and understanding language is something that we usually take for granted. However, when we begin to inquire into the mechanisms that make this possible, it becomes clear that the human ability to use language is a rather remarkable and highly complex phenomenon. This course will provide an introduction to central topics in the contemporary study of language. We will develop descriptive and theoretical frameworks for the analysis of various aspects of language, including: language change and variation; the structure of language at the level of sounds, words and sentences; and the ways in which meaning is conveyed through language. Our focus will not be on describing or analyzing one particular manifestation of understanding the properties and nature of language as a human phenomenon.

80-181 Language and Thought
Fall: 9 units
It is a remarkable aspect of human nature that we are able to conceive of and express new ideas through the use of language. This course will address issues relating to the connections between thought and language, particularly the ways in which we express thoughts through language, is it always necessary for thought? Do speakers of different languages perceive the world differently because of their language differences? We know that languages are very tightly constrained systems, yet at the same time there seems to be no limit to the thoughts which may be expressed. This course will focus on topics relating to the expression of thought through language and the impact of language on our thoughts. The first part of the course addresses classical issues related to truth and meaning, pragmatics and propositional attitudes. The second part of the course focuses of more recent proposals in cognitive semantics.
80-211 Arguments and Mathematical Inquiry  
Spring: 9 units  
Since ancient times, mathematical arguments have been viewed as paradigms of clarity and rigor. The goal of this course is to examine the features of mathematical reasoning that give it this distinctive character and that allow it to be systematically organized through the axiomatic method. Topics include propositional and predicate logic, and their semantics; formal deduction; axioms for a set and the theory; and formal models of computation. Prerequisites: none.

80-212 Logic and Philosophical Analysis  
Fall: 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 methods by which arguments justify its conclusion, as well as various subtle ways in which other 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. Prerequisites: none.

Issues in Multimedia Authoring 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 multimedia devices (e.g., Alan Turing and Marshall McLuhan) 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 documents. It is a course in the meaning of multimedia authoring in its contemporary societal context.

80-220 Philosophy of Science  
Spring: 9 units  
Alternate years Spring Philosophers have always been interested in the possibility and nature of knowledge. If we have any knowledge of the world around us, then the best example of such knowledge is modern science. The philosophy of science confronts general, philosophical ideas about the significance, justification and production of science with the details of real scientific practice, attempting to formulate a "reflective equilibrium" in which idealized practice accords with the general principles. 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 confirmation? Is space a substance or a relation? Is scientific rationality objective or culture-relative?

80-221 Philosophy of Social Science  
Spring: 9 units  
Alternate years The concept of social norm is central in the social sciences. This course explores how different social sciences have understood the concept, how it has been used in a variety of explanatory models, and whether we have robust experimental evidence about the conditions under which conforming behavior occurs.

80-222 Measurement and Methodology  
Fall: 9 units  
Alternate Years (Fall): 9 units This course is intended as an introduction to the theory of measurement. How are scientific units chosen? Under what conditions do comparative relationships determine quantitative ones? Why, for example, is the zero-point a conventional choice for measuring temperature, but not so for the measurement of weight with rulers? We shall investigate theories of extensive measurement, and with and without error. Applications will be taken from the natural and social sciences, including the development of some "psychometric" scales, such as measuring personality differences. Prerequisites: Discrete math. or some equivalent introductory course.

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 attempt to explain the source of their value and their relationship to one another. We will therefore examine alternative accounts of concepts such as welfare or happiness, basic moral rights, and the different moral virtues by analyzing their role in utilitarian moral theories, Kantian ethics, Aristotle's ethical 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 the distinction between moral 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. Prerequisites: none.

80-235 Political Philosophy  
Spring: 9 units  
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 interwoven 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  
Philosophy & Law: Homicide Instructor: Professor Preston K. Covey, Philosophy Director, Center for the Advancement of Applied Ethics Baker Hall 150A 288-8493 covey@andrew.cmu.edu Office hours: Tues./Thurs. or by appointment. 80-236 Philosophy & Law Offered every spring semester. Spring: 9 units While philosophy and human values may seem intractable realms of disagreement and conflict, philosophical concepts and human values underlie the most prosaic laws of the land. While the law is continually contested and subject to revision, it remains a relatively stable and consensual framework of rules and principles for regulating life and negotiating conflict in civil society. Thus, while the law is structured on the intratability of individual human values, contemporary practices in legal practical and decisive. While the law must weigh and balance human values, it must also embody rigorous evidentiary standards for findings of fact. This course will examine the nature of law as an institution, rationales for limiting liberty and the justification of coercion, methods of legal reasoning, processes of legal decision-making, and crucial contested concepts such as our rights and justice under law. For depth of perspective on these general topics, we will focus on controversial cases and problematic defenses to charges of criminal homicide (such as insanity, duress, self-defense, the battered woman syndrome) underlying which are perennial philosophical issues of justifiability, culpability, and responsibility.

80-241 Ethical Judgments in Professional Life  
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 discussion.

80-242 Conflict, Dispute Resolution  
Fall and Spring: 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 discussion.

80-243 Business Ethics  
Spring: 9 units  
Alternate Years (Spring): 9 units Various moral mores 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: 9 units

This course provides a detailed 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 role of health as a social good and the responsibilities in access to health care, and questions of individual liberty and social responsibility at the ends of life including issues such as cloning, 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. While the course engages such substantive ethical issues it also attempts to sharpen students’ skills in practical reasoning through argument analysis, logical reasoning, and the application of theory and principles to particular cases. Prerequisites: none.

80-246 The Criminal Justice System in America: Ideals and Realities
Spring: 9 units

This course will cover Ancient Greek philosophy from the pre-Socratics to the later Hellenistic writers. We will prepare the background for Socrates and Plato by examining the various historical and intellectual movements that led up to and through the flourishing and downfall of Periclean Athens. A study of Socrates (as represented in Aristophanes’ comedy and Plato’s early dialogues) will lead to an in-depth reading of Plato’s Gorgias, Symposium and sections of the Republic. We will approach Aristotle through his practical philosophy as presented in his Nicomachean Ethics. The final sessions will discuss the Epicurean, Skeptic, and Stoic movements as well as the work of Cicero. Excerpts from other works of Plato and Aristotle as well as Martha Nussbaum’s recent work on Aristotle and Hellenistic philosophy will accompany selected parts of the course.

80-250 Ancient Philosophy
Spring: 9 units

This course provides students with an overview of key historical and philosophical developments of this time contributed to the new questions and methods of the modern philosophers, and how their philosophical ideas influenced their scientific and social communities. Please note that this course complements Modern Philosophy II but may be taken independently of that course.

80-252 19th Century Philosophy
Intermittently: 9 units

This is a survey of some important philosophical and scientific, including mathematical, developments in the 19th century. We will examine works of several of the most important philosophers of the 19th and early 20th centuries. Central figures of this time include Descartes, Hobbes, Locke and Leibniz. These philosophers and their contemporaries launched what is now considered the modern period of philosophy, which has continuing influence on the philosophy and social and natural sciences of our own time. We will explore both the new sorts of questions that these early modern philosophers raised and their new methods of doing philosophy, which together mark a fundamental break with the philosophical tradition that preceded them. We will devote special attention to the new theories of knowledge and the new moral theories proposed during this time. The philosophical revolution of the 17th and 18th centuries occurred during a time of great political upheaval and scientific progress. As part of our course, we will consider how certain social and scientific developments in the 19th century contributed to the new questions and methods of the modern philosophers, and how their philosophical ideas influenced their scientific and social communities. Please note that this course complements Modern Philosophy II but may be taken independently of that course.

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 contemporary philosophical portrayal of science which he dismissed sharply as being too “circular.” Peirce responded by constructing a comprehensive philosophy emphasizing the scientific importance of community, fallibility, and action. Pragmatism was also developed and vigorously popularized by William James, who aspired to be a painter and ended up as an acknowledged founder of modern empirical psychology. James extended Peirce’s position by defending the role of values in even the purest of empirical sciences. John Dewey, who is also well-known for his role in education, interpreted science as an evolving social system and developed a theory of aesthetics based on what we now call the psychology of problem solving. The pragmatists made and continue to make lasting contributions to the social and intellectual sciences and their emphases on community, fallibility, action, and value in science are still primary in importance in philosophy and in the ongoing dialogue between the scientific and humanistic cultures. Prerequisite: 80-100, or an equivalent introduction to Philosophy.

80-260 Modern Moral Philosophy
Spring: 9-12 units

This course engages such substantive ethical issues it also attempts to sharpen students’ skills in practical reasoning through argument analysis, logical reasoning, and the application of theory and principles to particular cases. Prerequisites: one Philosophy course Alternate Years (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 meaning, 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 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. Prerequisites: one Philosophy course.

80-270 Philosophy of Mind
Fall: 9 units

This 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 evalutability 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 do the intentionality and thought of individual agents connect with the social 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 traditional and associationist models of the mind (d) the nature of desires and emotions.
Course Descriptions

80-275 Metaphysics
Spring: 9 units
Alternate Years (Spring): 9 units The topical agenda 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. Prerequisite: An introductory Philosophy course, e.g., 80-100.

80-276 Philosophy of Religion
Fall: 9 units
Alternate Years (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 return to some more traditional arguments for and against religion, 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
Spring: 9 units
Alternate Years (Spring): 9 unit 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 a core set of topics including: 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 Issues in Multimedia Authoring
Fall: 9 units
Issues in Multimedia Authoring 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 Marshall McLuhan) 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. Robert Cavalier Department of Philosophy Center for the Advancement of Applied Ethics 155 Baker Hall Carnegie Mellon University Pittsburgh, PA 15213 412/268-7643 Spring Office Hours: Mondays at 2pm and by appointment.

80-300 Minds Machines, and Knowledge
Fall: 9-12 units
We examine important presuppositions in several contemporary essays that debate the scope and limits of artificial intelligence. Specifically, the class discusses contemporary views on foundational versus coherence models of human knowledge. (Does human knowledge have a basic or is it a mere "web of beliefs"?) These questions about the organization of knowledge are contrasted with objections raised, for example, by Searle and Dreyfus against the “strong AI” thesis of Newell & Simon. Also, we examine several models of knowledge which incorporate probability and other measures of uncertainty, including some recent work on “parallel” systems. Prerequisite: 80-100 or some equivalent introduction to Philosophy.

80-305 Rational Choice
Fall: 9-12 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. Possible topics may include, and are not limited to: individual decision making under uncertainty, problems of public choice in which a group of individuals must collectively make a decision; problems of conflict and coordination, and alternative approaches to the problem of fair division of goods. This course will stress 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: 9-12 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. Possible topics may include, and are not limited to: individual decision making under uncertainty, problems of public choice in which a group of individuals must collectively make a decision; problems of conflict and coordination, and alternative approaches to the problem of fair division of goods. This course will stress 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.

80-311 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. Prerequisites: 15-151 or 15-399 or 21-228 or 21-300 or 80-210 or 80-211 or 80-310 or 80-317.

80-312/612 Philosophy of Mathematics
Alternate Years (Spring): 9-12 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 then 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 usefules in applications. Prerequisites: familiarity with logic and basic notions of modern mathematics (as provided, for example, by 80-212, 80-310, 21-127 or 21-300).

80-314 Logic and Artificial Intelligence
Spring: 9-12 units
Alternate Years (Spring): 9-12 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 logics of knowledge and belief and our applications in distributed AI. Several methodological problems in AI are discussed. Prerequisites: A basic course in logic is recommended but not required.

80-315 Modal Logic
Spring: 9-12 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 modalities (like ‘after the computation terminates’). Several conceptual problems in formal ontology 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 modal axioms without using possible worlds. Special attention is devoted to Scott-Montague model's of the so-called 'classical' modalities. Prerequisites: 80-210, or 80-211, or instructor’s permission.

80-316 Probability and AI
Fall: 9-12 units
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 probability and representations of causal relations, and how probabilities and representations of causal relations have been incorporated into recently developed expert systems. We will examine the following questions: What do causal 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. Prerequisites: 36-226 or 36-202 or 36-217.

80-317 Constructive Logic
Fall: 9 units
80-317/817 Constructive Logic Alternate Years (Fall): 9-12 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 properties. Some of the topics to be covered are intuitionistic logic, inductive definitions, functional programming, type theory, realizability, connections between classical and constructive logic, decidable classes. Prerequisites: 80-210 or 80-211 and a programming course.

80-318/618 Proof Search and Mechanisms
Alternate Years (Fall): 9-12 units
The course first presents the roots of mechanical reasoning in the 17th and 18th centuries, for example in the work of Leibniz, and the conceptual analysis of mechanical procedures in the 20th century through the work of, i.a., Church, Gödel, Post, and Turing. Then it investigates particular logical calculi (sequent and intercalation calculi) and their relation to proofs in natural deduction. The framework of natural deduction is used to formalize strategies to logic and mathematical proof search. Prerequisites: familiarity with basic logic and computation theory.
We will begin by clarifying what causal hypotheses mean and how they connect to statistical data. We will then explore a variety of techniques for establishing causal claims, e.g., randomized experiments and regression. For each of the techniques we will discuss when it is reliable and when it is not. We will consider all of these issues in the context of case studies ranging from the causes of war to the causes of social cooperation.

### 80-335 Seminar: Philosophy Politics and Economics

**Spring: 9 units**

**Alternate Years (Spring): 9-12 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

**Spring: 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 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.

### 80-341 Computers, Society and Ethics

**Spring: 9 units**

*80-341 CI Computers, Society and Ethics **Alternate Years (Spring): 9-12 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**

**Alternate Years (Spring): 9 units 80-342 Ethics and Oppression 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 we should learn about oppression. Review of efforts to free human interactions and social structures from oppression and to ameliorate the consequences of oppressive systems and societies are also explored.

### 80-346 Value Fact and Policy

**Fall: 9-12 units**

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. 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 common framework for deliberating and evaluating public policy will be proposed and critiqued.

### 80-371 Philosophy and Psychology

**Spring: 9-12 units**

Why should people cooperate? Why should they trust and reciprocate? Why should fairness matter in social interactions? These questions are important ones in both social and political philosophy, but philosophers have not paid much attention to empirical research done by social psychologists and economists to understand under which conditions we behave cooperatively, trust and reciprocate or act in fair and just ways. Though philosophy takes a normative approach, it cannot ignore empirical evidence about how people in fact behave, and what motivates them. The course will examine various social psychology theories and the experimental evidence that grounds them in the light of possible contributions they may offer to traditional philosophical questions.

### 80-380 Philosophy of Language

**Spring: 9 units**

Alternate years spring 9 units Philosophy of language involves the attempt to understand the nature of language and its relationship with speakers, their thoughts, and the world. As part of this attempt, philosophers have asked questions such as: What is language? How does language convey meaning? Is it a language itself which determines meaning, or the intentions of speakers? What different kinds of meaning are there? Philosophers and linguists have also asked questions about the meanings and functions of particular linguistic forms, such as definite noun phrases, conditional sentences and words like ‘I’ and ‘now’. This course is designed to be based on readings from the philosophical literature, and will provide an introduction to the contemporary treatment of a number of these issues.

### 80-405 Game Theory

**Spring: 9-12 units**

*Alternate Years (Spring): 9-12 units*

This first part of the 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: 80-305 and 80-605

### 80-411 Proof Theory

**Spring: 9-12 units**

An introduction to proof theory that addresses philosophical, mathematical, and computational aspects of the logical foundations of mathematics. Topics may include: the emergence of Hilbert’s program, and proof theory’s more general reductive goals; deductive systems, double-negation translations, cut elimination, and normalization; the ordinal analysis of arithmetic; functional interpretation and the extraction of programs; information in proof-theoretic semantics; and substructural logic. Ideally, students taking this course should be familiar with the syntax and semantics of first-order logic (covered in 80-310/610), and the basics of computability and coding of syntax (covered in 80-311/611). Students should have taken at least one of the two courses just mentioned, or the equivalent.

### 80-412 Intuitionism and Constructive Mathematics

**Intermittent: Variable units**

9-12 units no CD available at this time.

### 80-413 Category Theory

**Spring: 9-12 units**

80-413/713 Category Theory Alternate Years (Spring): 9-12 units Category theory, a branch of abstract algebra, has found many applications in mathematics, logic, and computer science. Like such fields as elementary logic and set theory, category theory provides a basic conceptual apparatus and a collection of formal methods useful for addressing certain kinds of commonly occurring formal and structural problems, particularly those involving structural and functional considerations. This course is intended to acquaint students with these methods, and also to encourage them to reflect on the interrelations between category theory and the other basic formal disciplines. Prerequisites: one course in logic or algebra

### 80-421 Cognitive Architecture and Bayesian Networks

**Intermittent: Variable units**

Offered intermittently: 9-12 units

Bayes networks are the modern representation of causal relations in computer science. They have important applications in representation and in discovery in developmental psychology, cognitive psychology, cognitive neuropsychology and social psychology. This course will introduce the networks and discuss their use in theoretical representations and discovery procedures in each of these areas. Prerequisites: Permission of the Instructor

### 80-481 Formal Semantics

**Spring: 9 units**

*80-481/781 Formal Semantics of Natural Language Alternate Years (Spring): 9- 12 units*

This course is a high level introduction to the theory of linguistic meaning and interpretation. When we look at how language is used in communication, we see two interacting systems of knowledge. On the one hand is the purely linguistic, or semantic, information: the meanings of words and morphemes, and the linguistic rules which govern how these meanings are combined to give the nature of language and its relationship with speakers, their thoughts, and the world. As part of this attempt, philosophers have asked questions such as: What is language? How does language convey meaning? Is it a language itself which determines meaning, or the intentions of speakers? What different kinds of meaning are there? Philosophers and linguists have also asked questions about the meanings and functions of particular linguistic forms, such as definite noun phrases, conditional sentences and words like ‘I’ and ‘now’. This course is designed to be based on readings from the philosophical literature, and will provide an introduction to the contemporary treatment of a number of these issues.

### 80-482 Formal Semantics II

**Fall: 9-12 units**

*80-482/782 Topics in Formal Semantics **Alternate Years (Fall): 9-12 units**

This is a topics course in formal semantics for natural language. It is aimed at students with a basic familiarity with this field, and provides them with an opportunity to explore some central issues in semantics in some detail. In the course of the semester, about four topics will be covered, based on readings from recent literature or recent research. The course is intended to participate actively in discussion and exploration of the topics. Topics covered will vary each time the course is offered, but may include: plurals; indefinites; negation; quantification; presupposition; conditionals; modals; ideally, students should have completed 80-481. Other interested students should consult with the
80-511 Thesis Seminar
Spring: 9 units
Spring: 9-12 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. Prerequisite: for students working on a philosophy thesis

80-512 Seminar on Philosophy and Methodology
Intermittently: 9-12 units
Intermittently: 9-12 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.

80-513/813 Seminar on the Philosophy of Mathematics
Alternate Years (Spring): 9-12 units
The seminar discusses mathematical, logical, and philosophical work that is important for issues related to the foundations of mathematics. That may range from detailed presentations of constructive consistency proofs through conceptual analyses of central mathematical notions to the discussion of categorical and epistemological issues. Prerequisites: dependent on the chosen topic.

80-514 Seminar on Philosophy of Science
Intermittently: 12 units
Intermittently: 9-12 units A graduate level, critical review of standard issues in the philosophy of science. Topics will include determination, predictability, confirmation, probability, causation, lawlikeness, explanation, the aims of science, the content of scientific claims, the rationality of belief in scientific claims.

80-515 Statistical Approaches to Learning and Discovery
Spring: 9-18 units
**Alternate Years (Spring): 9-12 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 Savages position is located within the current Bayesian program. Other seminal thinker 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
Intermittently: 9-18 units
Intermittently: 9-12 units We will use Hilary Putnam's essays (vol. 2 of his Philosophical Papers) and a related book (Reason, Truth and History) systematically to examine some contemporary views about broad, metaphysical questions concerning mind, language, and reality. We consider how and whether work in the philosophy of language can resolve traditional problems in the philosophy of mind. Since you can't do metaphysics without confronting reality, that's on the table too. Prerequisites: This is an advanced undergraduate/graduate level class.

80-517 Seminar in Social and Political Philosophy
Fall: 9-12 units
Fall: 9-12 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
Fall: 9-12 units
**Alternate Years (Fall): 9-12 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 included '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.' The seminar discusses not only issues in 'classical' epistemology, but also more recent naturalistic and pragmatist approaches.

80-519 Seminar History of Philosophy Aristotle's Ethics
All Semesters: 9-18 units
Offered intermittently: 9-12 units This seminar offers detailed investigations on particular philosophers or particular periods in the history of philosophy. Prerequisite: permission of instructor.

80-520 Categorical Logic
Fall: 6-12 units
580/520/820 Categorical Logic Seminar Alternate Years (Fall): 9-12 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 assignment 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 topos. 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. Prerequisite: 80-413/713 or equivalent

80-595 Senior Thesis
Fall and Spring: 3-18 units

80-600 Minds Machine and Knowledge
Fall: 9-12 units
Fall: 12 units We examine important presuppositions in several contemporary essays that debate the scope and limits of artificial intelligence. Specifically, the class discusses contemporary views on foundational versus coherent models of human knowledge. (Does human knowledge have a secure basis or is it a mere "web of beliefs"?) These questions about the organization of knowledge are contrasted with objections raised, for example, by Searle and Dreyfus against the "strong AI" thesis of Newell and Simon. Also, we consider several current models of knowledge which incorporate probability and other measures of uncertainty, including some recent work on "parallel" systems. Prerequisite: 80-100 or some equivalent introduction to Philosophy

80-602 Journal Seminar
Spring: 6 units
This course surveys modern philosophical issues by discussing a different journal every week with guest discoverers from the Department's faculty, visiting scholars, or faculty from nearby universities.

80-610 Logic & Computation
Fall: 12 units
Fall 12 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 Löwenheim-Skolem theorems, nonstandard models of arithmetic, definability, other logics, and automated deduction. Prerequisites: 15-251 and 80-210 and 80-211

80-611 Computability and Incompleteness
Fall: 9-12 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. Prerequisites: 80-210 or 80-211, or an equivalent course in Mathematics or Computer Science. 12 units

80-612 Philosophy of Mathematics
Spring: 12 units
alternate years spring 12 units
Problems in the foundations of mathematical analysis prompted, around the turn of the century, renewed philosophical reflection on mathematics and related mathematical and logical work. Set theoretic and constructivist foundations for analysis are discussed; Hilbert's program is analyzed in detail. Finally, a structuralist position is defended: this position is philosophically influenced by the work of Bernays and mathematicially by developments in mathematics (as reflected in Bourbaki's treatises and category theory); it incorporates important insights from the main foundational schools.

80-614 Logic Artificial Intelligence
Spring: 9-12 units
Alternate Years (Spring): 9-12 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 logics of knowledge and belief and consider applications in distributed AI. Several methodological problems in AI are discussed. Prerequisites: A basic course in logic is recommended but not required.

80-617 Constructive Logic
Fall: 12 units
Alternate Years (Fall):12 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 properties. Some of the topics to be covered are intuitionistic logic, inductive definitions, functional programming, type theory, realizability, connections between classical and constructive logic, decidable classes. Prerequisites: 80-210 or 80-211 and a programming course

80-635 Seminar: Philosophy Politics and Economics
Spring: 9-12 units
**Alternate Years (Spring): 12 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. Prerequisites: 80-135
Course Descriptions

80-680 Philosophy of Language
Spring: 12 units
Alternate years. Spring: 12 units Philosophy of language involves the attempt to understand the nature of language and its relationship with speakers, their thoughts, and the world. As part of this attempt, philosophers have asked questions such as: What is language? How does language convey meaning? Is it language itself which determines meaning, or the intentions of speakers? When different kinds of meaning are there? Philosophers and linguists have also asked questions about the meanings and functions of particular linguistic forms, such as definite noun phrases, conditional sentences and words like “I” and “now.” This course, which will be based on readings from the philosophical literature, will provide an introduction to the contemporary treatment of a number of these issues.

80-705 Game Theory
Spring: 9-18 units
*Alternate Years (Spring): 9-12 units The first part of this course will be a standard introduction to game theory and formal models that take into account social preferences, fairness and reciprocity motives.

80-711 Proof Theory
Spring: 9-12 units
An introduction to proof theory that addresses philosophical, mathematical, and computational aspects. Major topics may include: the emergence of Hilbert's program, and proof theory's more general reductive goals, deductive systems, double-negation translations, cut elimination, and normalization; the ordinal analysis of arithmetic; functional interpretation and the extraction of computational information from proofs; and some result-order arithmetic. Ideally, students taking this course should be familiar with the syntax and semantics of first-order logic (covered in 80-310/810), and the basics of computability and coding of syntax (covered in 80-311/611). Students should have taken at least one of the two courses just mentioned, or the equivalent.

80-712 Intuitionism and Constructive Mathematics
Intermittent: 9-12 units
12 units no CD available at this time

80-713 Category Theory
Spring: 9-12 units
Category theory, a branch of abstract algebra, has found many applications in mathematics, logic, and computer science. Like such fields as elementary logic and set theory, category theory provides a basic conceptual apparatus and a collection of formal methods useful for addressing certain kinds of commonly occurring formal and informal problems, particularly those involving structural and functional considerations. This course is intended to acquaint students with these methods, and also to encourage them to reflect on the interrelations between category theory and the other basic formal disciplines. Prerequisites: one course in logic or algebra **80-414 Computation** 

80-717 Statistical Approaches to Learning and Discovery
Spring: 12 units
Spring: 12 Units This course (crosslisted as 10-602/15-802/36-712) is the second in a core sequence for the M.S. in CALD's Knowledge Discovery and Data Mining. It builds on the material presented in 10-601, introducing new learning methods and going more deeply into their statistical foundations and computational aspects. Applications and case studies from statistics and computing are used to illustrate each topic. Aspects of implementation and practice are also treated. Often, the course is team-taught using faculty from SCS and H&SS. Prerequisites: This is a graduate-level course designed for students in the KDD Masters program. 10-601 is a required prerequisite as is as a graduate-level introduction to statistics, e.g. 36-705 or its equivalent. Prerequisites: (15-781 or 10-601) and (36-705 or 36-725)

80-721 Cognitive Architecture and Bayesian Networks
Intermittent: 9-12 units
Offered intermittently: 9-12 units Bayes networks are the modern representation of causal relations in the context of uncertain information. They have important applications in representation and in discovery in developmental psychology, cognitive psychology, cognitive neuropsychology and social psychology. This course will introduce the networks and discuss their use in theoretical representations and discovery procedures in each of these areas. Prerequisites: Permission of the Instructor

80-781 Formal Semantics
Spring: 9-12 units
This course is a high level introduction to the theory of linguistic meaning and interpretation. When we look at how language is used in communication, we see two interacting systems of knowledge. On the one hand is the purely linguistic or semantic, information: the meanings of words and morphemes, and the linguistic rules which govern these meanings are combined to give the literal meanings of larger expressions in which they occur. On the other hand is the knowledge of the context of utterance and of the rational principles which govern language use. Hearers use this pragmatic knowledge in conjunction with their semantic knowledge to determine the communicative intentions of speakers. This course will introduce students to explicit theoretical treatments of both the semantic and pragmatic components of the linguistic system. Prerequisites: 80-110 or 80-210 or 80-211 or 80-310

80-811 Thesis Seminar
Spring: 12 units
Spring: 9-12 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. Prerequisite: for students working on a philosophy thesis

80-812 Seminar on Philosophy and Methodology
Intermittent: 9-12 units
Intermittently: 9-12 units This course explores the foundations of causation. It explores how causal claims are connected 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

80-813 Seminar of Philosophy of Mathematics
Fall: 9-12 units
**Alternate Years (Fall): 9-12 units The seminar focuses on mathematical and logical work, important for foundational issues. That may range from the detailed presentations of 'constructive' consistency proofs through conceptual analyses of central mathematical concepts to the discussion of ontological and epistemological issues.

80-814 Seminar on Philosophy of Science
Intermittent: 9-18 units
Intermittently: 9-12 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.

80-815 Statistical Approaches to Learning and Discovery
Spring: 9-18 units
**Alternate Years (Spring): 9-12 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 Savages position is located within the current Bayesian program. Other seminal 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.

80-816 Seminar on Metaphysics
Intermittent: 9-18 units
Offered intermittently: 9-12 units We will use Hilary Putnam's essays (vol. 2 of his Philosophical Papers) and a related book (Reason, Truth and History) systematically to examine some contemporary views about broad, metaphysical questions concerning mind, language, and reality. We consider how and whether work in the philosophy of language can resolve traditional problems in the philosophy of mind. Since you can't do metaphysics without confronting reality, that's on the table too. Prerequisites: This is an advanced undergraduate/graduate level class.

80-817 Seminar on Social and Political Philosophy
Fall: 9-12 units
Fall: 9-12 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.

80-818 Seminar on Epistemology
Fall: 9-12 units
**Alternate Years (Fall): 9-12 units This seminar focusses on prominent issues in contemporary epistemology. Standard topics in the field will be considered in the light of recent research in artificial intelligence, cognitive science as well as social and decision sciences. Topics considered in recent years included '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.' The seminar discusses not only issues in 'classical' epistemology, but also more recent naturalistic and pragmatists approaches.

80-819 Seminar History of Philosophy's Aristotle's Ethics
Intermittent: 9-18 units
Offered intermittently: 9-12 units This seminar offers detailed investigations on particular philosophers or particular periods in the history of philosophy. Prerequisite: permission of instructor.

80-820 Categorical Logic
Fall: 6-12 units
Alternate Years (Fall): 9-12 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 topos. 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. Prerequisite: 80-413/713 or equivalent
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 Chinese. Prerequisite: 82-231 or approved equivalent. Prerequisites: 82-231

82-235 Intensive Intermediate Chinese
Intermittent: 12 units
This course is the continuation of Intermediate Chinese (82-135). Students will continue to learn the basic skills of listening, speaking, reading and writing for daily communication, while more focus 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 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.

82-331 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 generating students’ language process competency in all four language skills. This course will introduce students to the Chinese culture and 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. Prerequisites: 82-232 or 82-235

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. Prerequisites: 82-232 or 82-235

82-333 Introduction to Chinese Language and Culture
Fall: 9,12 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, videos 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. Prerequisite: 82-232 for students seeking credit toward the Chinese minor. No prerequisites for non-majors. Prerequisites: 82-232

82-334 Structure in 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 to 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 weakness on particular problematic elements and sentence structures that are common among non-native Chinese speakers. After this class, students are expected to have a more comprehensive understanding of the structure of the language, which will help develop a solid foundation for their language proficiency. Prerequisite: 82-232 or equivalent or permission by the instructor. Prerequisites: 82-232

82-335 Selected 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 develop the ability to read in Chinese with fluency and proficiency within a format of rich cultural content. Readings will include traditional fables, mini-stories, articles on the lifestyle and social changes in modern China. While 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. Prerequisites: 82-232

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: 82-232

82-337 Mandarin Chinese for Oral Communication I Fall: 9 units
This course is designed for students who have already reached intermediate level in reading and writing Chinese but have no or little knowledge of Mandarin Chinese. This course aims to promote students' oral communicative competence and self-expression. Emphasis will be given to helping students develop the accuracy and fluency which characterize the speech of native Mandarin speakers. Students will also be exposed to Chinese culture and traditions. Prerequisites: 82-232

82-338 Mandarin 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. Prerequisites: 82-232

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 articles, students will be required to participate in intensive speaking activities, such as interviewing native speakers, oral presentations in class, debates, and special projects. At the end of the course, students are expected to be able 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: Intermediate level in reading and writing Chinese. Permission of the Instructor. Prerequisites: 82-232

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 to the students Chinese culture and traditions through the study of different styles of Chinese used in authentic literary works, 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 history of Chinese traditions and civilization. With this knowledge, combined with their ability to use different styles of Chinese language, students will be prepared to function in various ways in the real situation of China in the future. Prerequisite: 82-332 or approved equivalent. Prerequisites: 82-332

82-435 Advanced Reading in Chinese Intermittent: 9 units Prerequisites: 82-324

French

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, students will be required to spend two hours per week in the Language Learning Resource Center (LLRC) 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 function upon and draw upon strategies used by good language learners in their second language study. This course is a 12 unit course. A special section for Music Majors is only intermittently offered at 9 units. 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 two hours per week in the Language Learning Resource Center (LLRC) 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 function 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: 82-101 or 82-103

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 http://mlonline.hss.cmu.edu for a more detailed description of the course. Prerequisites: Placement test for all students to be taken in Porter Hall 225C prior to the first class meeting.

82-104 Elementary French II Online Spring: 12 units Prerequisites: 82-101 or 82-103

82-106 Intensive French Language and Culture: Elementary Level All Semesters: 0-15 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.

82-107 Introduction to French Film Intermittent: 9 units
An introduction to the French cinema and to cultural criticism, this course centers on the viewing, analysis and discussion of selected French films from its inception to the present. This course fulfills one of the requirements for the General Education Requirements of the College of Humanities and Social Sciences. Taught in English. Prerequisite: None.

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 literary and cultural texts and analysis, coupled with an 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. It will use such classic French texts as Antoine de Saint-Exupéry's Le Petit Prince, as well as famous French fairy tales and films. Prerequisite: 82-102/104, placement score, or permission of the Instructor. Prerequisites: 82-102 or 82-104

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 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. French culture and an individualized grammar review sequence are highlights of this course. It is presented in the text and through homework assignments. Regular participation in class is mandatory (four in-class hours per week). In addition, students will be required to spend two hours per week in the Language Learning Resource Center (LLRC) 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 function 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: 82-102 or 82-103

82-203 Intermediate 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. French culture and an individualized grammar review sequence are highlights of this course. It is presented in the text and through homework assignments. Regular participation in class is mandatory (four in-class hours per week). In addition, students will be required to spend two hours per week in the Language Learning Resource Center (LLRC) 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 function 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: 82-102 or 82-103
This course introduces the student of French to the world of francophone cultures with the transfer credit advisor for French. Transfer credit for study abroad in France, a French-speaking country, or other requirements of continuing cultural study, thus assignments will include analyses of personal research. Prerequisite: Completion of the intermediate level or the critical judgment in both oral and written form, documented through readings and written forms of French. Great emphasis will be placed on the expression of examples may be drawn from television and films, songs, and complete literary study of aspects of French history, French institutions, regions, literature, etc. made at defining the French "identity", or what it means to be French, through the expression of judgment in both oral and written form, documented through readings and personal research. Prerequisite: Completion of the intermediate level or the equivalent. Prerequisites: 82-201 or 82-203

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.

82-301 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 class 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: 82-202 or 82-204

82-304 The Francophone World Fall and Spring: 9 units
This course introduces the student of French to the world of francophone cultures in its broadest and richest dimension, from France to Quebec, Louisiana, the Antilles and French Guyana, North and West Africa, Madagascar, and the Middle and Far East. Materials studied will include literary as well as non-literary texts, films, videos, and songs. 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. Prerequisite: Completion of the intermediate level or the equivalent. Prerequisites: 82-202 or 82-204

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: 82-303 or 82-304

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.

82-401 Quebec Society Intermittent: 9 units
This course involves the study and discussion of a broad range of both social and cultural documents related to the evolution of a modern francophone society in Quebec over the last half-century. The class will be paired with a class in Quebec for cross-cultural discussions. An optional spring-break excursion to Quebec City is planned. Prerequisite: Completion of third year courses, approved equivalent or permission from the Instructor. Prerequisites: 82-303 and 82-304

82-402 The French in Love Intermittent: 9 units
The purpose of this course is to offer, through a thematic and historically oriented perspective, a topic (Love) for more intense research. This, in turn, will enable us to reflect and discuss the chosen works. While the French are stereotypically described as ‘lovers’, we will attempt to study this theme and its presentation through various literary works from Marie de France’s poems to Robbe-Grillet’s novel on jealousy, through popular songs by Joséphine Baker, Maurice Chevalier or Edith Piaf, films such as L’année du paradis or Jules et Jim, operas and paintings. Prerequisite: Completion of third year courses, approved equivalent or permission from the Instructor.

82-403 The French at War Intermittent: 9 units
This course focuses on the French and the War, with particular respect to the last World War as seen through selected movies, plays, poetry and a novel. We will read La Peste by Camus, and plays by Sartre, Arabal and Annouilh. We will watch movies by Clair, Renoir, Carné, Clouzot and Truffaut. Prerequisite: Completion of third year courses, approved equivalent or permission from the Instructor.

82-404 Francophone Realities: Ousmane Sembene Spring: 9 units

82-405 Images of Modernity: Baudelaire and the Painting of Modern Life Intermittent: 9 units
This seminar in literary studies and cultural analysis will engage us in the study of Baudelaire’s innovations in literature and in art criticism, especially in the context of the connections that he develops between visual images and literary art. The course will have three major topics: 1) literature: an exploration of the major genres (poetry, fiction, essays, and comic theater) in the Second Empire period (Baudelaire, Nerval, and Labiche); 2) the visual arts: line and color, light and shadow; looking at Baudelaire’s images (Romanticism and Impressionism); and 3) historical, aesthetics, and art history. Prerequisite: Completion of third year courses, approved equivalent or permission from the Instructor. Prerequisites: 82-303 and 82-304

82-406 The European Union Spring: 9 units

82-407 The Arts in Society: French Modernism Intermittent: 9 units
This course will explore a variety of major works of art in order to appreciate and understand French modernity (beginning with the Second Empire) from an interdisciplinary perspective, focusing on its own arts in society. We will take Baude laire’s writings as our unifying focus, with particular attention to his innovations in poetry and art criticism. We will examine the connections that he develops between visual images and literary art. The course will take the form of a seminar, with emphasis on student participation. Each student will be responsible for leading the discussion of a number of readings; each student will be responsible for active, well-prepared participation in the discussions. Written work will focus on the work read for class and will take the form of critiques prepared to facilitate class discussion, two take-home midterms, and an in-class exam. Prerequisite: None.

82-408 Matisse, Chagall, Picasso & Their Contemporaries: Art & Museums on the Riviera Intermittent: 9-12 units
This seminar 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 credit to count toward the major or minor in French. Prerequisites are completion of third year, or approved equivalent, or permission 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 languages 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 order to achieve these goals, students do personal work on
Course Descriptions

improving their control of the French phonological system, and discuss current issues in France and francophone regions/countries by using multimedia tools available in the Modern Language Learning Resource Center (MLRC). For students in the advanced level of this 305 core curriculum, a research project showing the application and intellectual development of one or several of the concepts described above is required. The project involves a written work of a minimum of 15 pages plus bibliography and a 10-minute oral presentation to the class, both in French.

82-413 The Arts in Society: Theatres of Love
Intermittent: 9 units
In comedy and in tragedy, from literary and operatic figures like the seducers Carmen and Don Juan to clowns, masks, and puppets, Eros (or desire) inhabits the theater arts. Philosophy and literature find Eros at the crossroads of identity and alterity, where questions are raised about gender, race, class, religious beliefs, the law, and the powers of the occult. The course will explore the fascination and the effects of some major representations of love in baroque and romantic literature, art, and performance, and the plays and other works from the baroque, romantic literature, art, philosophy, and opera, and contemporary works, including European cinema and the Afro-American cinema of Melvin van Peebles. Prerequisite: None Prerequisites: 82-303 and 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; 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. Prerequisites: 82-303 or 82-304

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; Twentieth Century Travel Literature and Emerging Literature: Twentieth-Century Francophone Writing. Completion of third year or permission from the Instructor. Prerequisites: 82-303 and 82-304

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.

German

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 Bader Hall 160. Textbook Web Site: http://ow.prenhall.com/treffpunkt/ Web Exercises: http://ml.hss.cmu.edu/FacPages/amgreen/projects/webex.html Online Gradebook: http://mlonline.hss.cmu.edu:8000/

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 permission of the Instructor. Prerequisites: 82-121 or 82-123

82-123 Self-Paced German
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 (1) 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 and 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. Please note that 82-123 does not count as a DCR3 course in the H&SS curriculum. YOU MUST ATTEND THE FIRST MEETING. IF YOU CANNOT ATTEND, CONTACT THE INSTRUCTOR BEFORE THE MEETING. Prerequisite: None.

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.

82-221 Intermediate German I
Fall and Spring: 9 units
An integrated approach to the study of the German language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken German. This course explores definitions of realia 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 German. This course is intended for students with one year of college German (or equivalent). The primary emphasis is further development of reading, viewing, listening, speaking, and writing skills. The topics considered deal with aspects of contemporary German culture. Texts used will include several works of youth literature. Class discussions on the readings and short compositions in German will be supplemented by audio, video, and Internet material. Prerequisite: 82-122, placement score, equivalent coursework, or permission of the Instructor. Prerequisites: 82-122 or 82-123

82-222 Intermediate German II
Fall and Spring: 9 units
An integrated approach to the study of the German language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken German. 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 German. The second semester course sequence for intermediate level students deals with 20th century German history and culture. Class discussions on the readings and short compositions in German will be supplemented by audio, video, and Internet material. Prerequisite: 82-221, placement score, equivalent coursework, or permission of the Instructor. Prerequisites: 82-221

82-225 Intensive Intermediate German
Intermittent: 9 units
This course is offered in Spring 2002 in order to meet the needs of current students of German and to cover the material from both Intermediate I and Intermediate II in one semester. This course will explore the current culture of Germany and Austria, through the reading of a work of youth literature. Two additional works of youth literature will focus on two defining events in 20th century Germany: the third Reich and the unification. Discussion in class will focus on the readings. Grammar will be discussed when necessary, and always related to the text being read This course is taught entirely in German. Assignments include: regular written homework in the form of information and discussion questions on the texts, essays, and a final written and oral project. In addition, three unit tests will be given. Prerequisites: Completion of 82-122 or 82-221. No materials used in previous 221 courses will be repeated in this course. This course will prepare all students for 82-323, which is the next level. Prerequisites: 82-222 or 82-221

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.

82-323 Germany, Austria and Switzerland in the 20th Century
Fall and 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 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: 82-226, placement score, equivalent coursework, or permission of the Instructor. Prerequisites: 82-222
82-324 Contemporary Germany, Austria and Switzerland
Fall and 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 their ability to express critical judgments in both written and oral form, documented through readings and personal research. Prerequisite: 82-222, placement score, equivalent coursework, or permission of the Instructor. Prerequisites: 82-222 or 82-323 or 82-325

82-325 Introduction to German Studies
Fall and Spring: 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 intratability, 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 politics, economic policies, popular culture, and identity. Stud., as coming out of the course should have a broad understanding of the various tensions and problems that have characterized German culture and society for the last two centuries. In addition to broadening students' cultural knowledge about the German-speaking world, this course will continue to emphasize the improvement of students' ability to speak, read, write, and listen to German. Prerequisite: 82-222, placement score, equivalent coursework, or permission of the Instructor. Prerequisites: 82-222 or 82-323 or 82-324

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.

82-421 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, the 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 examines works by some of the major authors of this period (Marin, 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 major 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. Prerequisites: 82-325

82-424 The New Germany
Spring: 9 units
This course explores contemporary culture in German speaking Central Europe.

82-426 Studies in German Literature and Culture
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 Between the Wars. Prerequisite: Completion of 82-325 or approved equivalent. Prerequisites: 82-323 or 82-324 or 82-325

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: Variable units
From the beginning of the twentieth century and the classics of silent film to the 1970s masterpieces of Fassbinder and Syberberg, the history of German film is extraordinarily rich. It provides crucial insights into the development of the German nation in the modern era. This course offers a general introduction to German film studies. Prerequisite: Completion of 82-325 or approved equivalent. Prerequisites: 82-324

82-429 German Reading and Translation Workshop: Undergraduate
Intermittent: 9 units
This course will explore different models of translation. Individual and group work will focus on translation of literary pieces, journal articles, critical essays, materials from the internet and other sources. The workshop will also offer an advanced-level grammar and stylistics review, a vocabulary builder and increased exposure to German language and culture. Prerequisite: Completion of 82-323 or 82-324 or permission of the Instructor. Prerequisites: 82-324

Italian

82-161 Elementary Italian I
Fall: 9,12 units
A two-semester course sequence (82-161, 82-162) for beginning students focusing on developing communicative language proficiency: oral practice, aural comprehension, reading, writing, structural analysis, and language learning resource center work with audio and video tapes. Also a study of cultural aspects of Italy. 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: 82-161 or 82-163

82-163 Self-Paced Italian
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.

82-261 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 82-163 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-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 intensive review, readings and intensive practice in written and spoken Italian. Prerequisite: 82-261 or approved equivalent.

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.
Course Descriptions

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.

Japanese

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. Four hours in-class instruction per week, plus mandatory homework assignments. Prerequisite: 82-171 or approved equivalent. Prerequisites: 82-171.

82-271 Intermediate Japanese I
Fall: 12 units
An integrated approach to the study of the Japanese language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken Japanese. 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 Japanese. A two-semester course sequence (82-271, 82-272) for intermediate-level students. An integrated approach to the study of Japanese language and culture, consisting of grammar review, reading, and intensive practice in written and spoken Japanese. Course materials include authentic audiovisual and written texts on top of the assigned textbooks. Also integrated are cultural explorations through direct interactions with native speakers. Four hours of in-class instruction per week, plus mandatory homework assignments. Prerequisite: 82-171/82-172 or approved equivalent.

82-272 Intermediate Japanese II
Spring: 12 units
An integrated approach to the study of the Japanese language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken Japanese. 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 Japanese. A sequel to Intermediate Japanese I (82-271). An integrated approach to the study of Japanese language and culture, consisting of grammar review, reading, and intensive practice in written and spoken Japanese. Course materials include authentic audiovisual and written texts on top of the assigned textbooks. Also integrated are cultural explorations through direct interactions with native speakers. Four hours of in-class instruction per week, plus mandatory homework assignments. Prerequisite: 82-171/82-172 and 82-271 or approved equivalent.

82-273 Introduction to Japanese Language and Culture
Fall: 9 units
This course is an introduction to modern Japanese and the role the language plays in contemporary Japanese society. It provides an overview of the language from cultural, social psychological and linguistic perspectives, and is intended for individuals with interest in Japan or the Japanese language, as well as for students of the Japanese language. Topics covered include the distinctive features of Japanese as a linguistic system, spoken and written; gender-and-stereotypically based differences in language use; the role of the language in Japanese interpersonal communication; and its role in Japanese cultural identity. The course is taught in English with no previous knowledge of Japanese assumed. Prerequisite: None.

82-371 Advanced Japanese I
Fall: 9 units
A one-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.

82-372 Advanced Japanese II
Spring: 9 units
A sequel to Advanced Japanese I (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: 82-271/82-272 or approved equivalent.

82-475 Topics in Japanese Studies: Current Issues and Trends in Japan
Intermittent: 9 units
This course examines and discusses current issues and trends in present-day Japan. (a) To understand what is happening in Japan at the moment. (b) To examine how they are affecting Japanese people and society. (c) To interpret them from Japanese and international perspectives. Materials are taken from online Japanese newspapers, TV news and other relevant programs, magazines, best-selling books and comics, and films of box office attraction. Prerequisite: 82-372 or equivalent.

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.

82-571 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.

Russian

82-291 Intermediate Russian
Fall: 9 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 per week, plus mandatory homework assignments.

82-292 Intermediate Russian II
Spring: 9 units
An integrated approach to the study of the Russian language and culture by means of grammar review, literary and cultural readings and analysis, and intensive practice in written and spoken Russian. 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 Russian. A two-semester course sequence (82-291, 82-292). Prerequisite: 82-291 or approved equivalent. Prerequisites: 82-292.

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. Prerequisites: 82-291

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. Prerequisites: 82-292

82-392 Advanced Russian II
Spring: 9 units
The second part of a two-semester course sequence (82P)Prerequisite: 82-391 or approved equivalent. Prerequisites: 82-391

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 films of Great Britain, Germany, France, Hungary, the Czech Republic, Russia, and the United States. The 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 persistent appeal 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 works including the following 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, Ivan Turgenev’s Faust, Mikhail Bulgakov’s Master and Margarita, Busoni’s Doctor Faust, Vlachy Havel’s Temptation, F. W. Murnau’s Faust, Iván Szabó’s Mephisto, and Christa Wolf’s Accident. Lecture and discussion formats are combined at each class meeting. Written papers, oral presentations, and participation in class discussions are required, as are reading assignments of approximately 200 pages per week and viewing of films outside of class hours. The course is offered in English for 9 units. The course is offered for 12 units for work conducted in Russian with an additional hourly meeting per week. Prerequisite: The course in English no prerequisites.

82-397 Russia’s Demons
Intermittent: 9-12 units
Demons and devils, ghosts and goblins, witches and werewolves: Russian literature, art and music 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 prepared Russian writers for creating characters of this kind? 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 Zamyatin. 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: 82-397 or approved equivalent, or permission of the Instructor. Prerequisites: 82-391

Spanish
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, structural analysis, and language learning resource center. Also a study of cultural aspects of Spanish-speaking countries. 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.

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: 82-141 or 82-143

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 either CD-ROM or 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

Course Descriptions

the instructor for conversation and practice. See http://mlonline.hss.cmu.edu for a more detailed description of requirements and class structure before enrolling. Fulfills DCR3 requirement. Prerequisite: Spanish Placement test for all students to be taken in Porter Hall 225C prior to the first class meeting.

82-144 Elementary Spanish II Online
Spring: 12 units
A continuation of 82-143, Elementary Spanish 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 http://mlonline.hss.cmu.edu for a more detailed description of requirements and class structure before enrolling. Fulfills DCR3 requirement. Prerequisite: 82-141, 82-143 or permission of the Instructor. Spanish Placement test for all students to be taken in Porter Hall 225C prior to the first class meeting. Prerequisites: 82-141 or 82-143

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 82-144 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 82-243 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. The course is offered for 12 units for group activities, plus individual weekly meetings with a tutor or the Instructor for conversation and practice. See http://mlonline.hss.cmu.edu for a more detailed description of requirements and class structure before enrolling. Prerequisite: 82-142, 82-144, or permission of the Instructor. Spanish Placement test for all students to be taken in Porter Hall 225C prior to the first class meeting.

82-342 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 for 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 ethnicity’?s that have inhabited the peninsula since ancient times. 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
Course Descriptions

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 all the subjects of the period, and Spanish and English language and culture courses or Instructor approval.

82-441 Studies in Peninsular Literature and Culture: Poets and Playwrights of Exile
Intermediate: 9 units
A sociocritical approach to the study of Spanish literature. A survey of representa- tive 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
Intermediate: 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 apply them to the study of Spanish. Attention will be given to different levels of analysis in linguistics including phonetics, phonology, morphology, and syntax. Class times will be divided between exercises, lectures, and discussion. Students will have the opportunity to write and present a research paper in specific areas of Spanish linguistics according to their interests. Prerequisite: Advanced course work in Spanish, 80-280 or 82-383, or permission of Instructor.

82-443 Spanish Reading and Translation Workshop
Intermediate: 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 news services and bulletin boards, for students with advanced Spanish background (major & minors), the reading and translation workshop will offer an advanced-level grammar and style 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
Intermediate: 9 units
This course, taught in Spanish, introduces the curious student to the means to look at Spanish through the eyes of a scientist. We will study the Spanish phonetic system and discover the "legal" ways to construct a new word or syllable. We will explore the unconscious rules that a native speaker uses to construct and comprehend sentences that have never before been spoken. We will go back in history to find the origins of many words that "look" Spanish but come from languages with very different properties. Students will gain some understanding of the ways in which Spanish works as a complete language system and how, as a natural human language, it contains the principles common to all languages. By the end of the semester, the curious and the diligent will be able to defend themselves against teachers who insist that Spaniards lisp, make descriptive and theoretical commentary on the language they encounter, comprehend some of the technical linguistics literature, and be better prepared for study of second language acquisition (SLA), formal language or on teaching Spanish. Prerequisite: Students must have completed all 300-level coursework in Spanish and should have some coursework in a linguistics-related area.

82-445 U.S. Latino Literature: Necessity is the Mother of all 'Coyotes'
Intermediate: 9 units
This course proposes to problematize socio-political and historico-cultural issues concerning U.S. Latinos and Hispanic immigrants in the United States. This will involve the analysis and application of assimilation, transculturation and bilingualism theory, and rhetorical/translation problems of the material under examination. Also of interest will be an ongoing class discussion of Latinos/Hispanics in history, the media, entertainment, politics and education. We shall also discuss the "borders?, geographical, political and societal, that may or do exist between U.S. mainstream society, Latinos and Hispanic immigrants and strategies employed by hyphenated-Americans for overcoming, subverting or understanding this situation. Materials for the course will include literature, film, essays and music by and about Latinos and Hispanics in the United States. 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 Spanish Language and Culture, 82-543 Latin American 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 individual research of the course topics. Prerequisite: By permission of the Instructor only.

82-451 Studies in Latin American Literature and Culture
Intermediate: 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.

82-452 The Latin American Fin de Siglo: Modernity, Modernismo, and Underdevelopment
Intermediate: 9 units
In this course, we shall use print media, film, music, dance, fashion, diet, architecture to study the anthropological and cultural ramifications of politico- economic 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. Prerequi-site: Completion of 82-345 or permission of instructor.

82-454 The Hispanic Caribbean: Rhyme, Reason and Song
Intermediate: 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 historic events), 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.

82-456 Topics in Hispanic Studies
Spring: 3 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, Rodoredos, Caballeros, Picaro, Santos; Latin American Short Story and Essay; Literary Meditations; Portrayals of Family Life in Twentieth-Century Spain; The Other in Latin American Literature and Film), Prerequisites: 82-345

82-457 Contemporary Latin American Texts: Revision, Rewriting and Representation
Intermediate: 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 contempo- rary texts. We shall also examine the categories and implications of historized fiction and "literarized" 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. Prerequis- ite: Completion of 82-345 or permission of instructor.

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.

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.
Seminar Descriptions

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 improve 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, seminars, and film comprehension. 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 skill 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 about language learning and 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&S 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 the perspective of a cultural outsider, 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.

82-110 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.

82-180 Freshman Seminar: Bilingualism Around the World Intermittent: 9 units
This course will examine social and cognitive effects of knowing two languages, i.e., bilingualism. It will focus on the individual, the education system, and society. We will consider topics such as the measurement and description of bilingualism; the relationship between native language acquisition and second language learning; the affective and cognitive consequences of becoming bilingual; the organization and implementation of programs designed to develop second language proficiency; and the sociocultural role of bilingualism in encouraging or discouraging second language learning or teaching programs. Examples, readings, and assignments will be selected to permit consideration of a broad range of issues from both so-called monolingual and bilingual countries. 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 through language use. Illustrative examples include analysis of the relationship between language and thought (the Sapir-Whorf linguistic relativism hypothesis); standard versus vernacular languages; attitudes toward language acquisition as it differs from community to community; the development of English in the United States and worldwide and the profound effects of contact between these two languages; the impact of English language maintenance, violence, Wars; the status of English as a political and economic language; and the diverse roles of English in the world today. The course will also compare and contrast bilingual and monolingual societies, focusing on the concept of language policy. Emphasis will be placed on the importance of language policy in the development of cultural identity and the influence of language on national and international relations. 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 modernism. Students will be introduced to cultural history and development of modernity through art, music and film. 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 pressing questions in the development of Western culture: what is tragedy, how did it evolve, and what does it mean today? Starting with Aeschylus' 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 the classical age of nineteenth century thought sought to reevaluate and reclaim the tragic form, linking it to 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 four 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 Spring: 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 the cultural history. Class discussions will help students develop strategies for 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. The course will include secondary readings, primary documents, and films. Prerequisite: None.

82-187 Freshman Seminar: Introduction to French Cinema Fall: 9 units
This course will attempt to examine, primarily in and through films, representations of France and the French through traditional symbols of the Republic (Marianne) or historic figures (Napoleon), but will also extend to the "non-visible" and the simple people, and above all the actors and artists who, eventually served as representations of the French people and their aspirations, denials, etc., during those crucial years. In looking at examples ranging from early experiments to the "New Wave", students will acquire a number of critical tools that will enable them to better understand how a specific film, or a critical sensibility helped legitimize cinema as an art form. Films will be used as texts and will be supplemented with historical and cultural works in an interdisciplinary perspective. To facilitate discussion, students will write three weeks, and the in-class focus is on intensive discussion and analysis of the texts. Prerequisite: None.

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 list 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 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.

82-280 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 they learn languages as well as 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 the Pittsburgh Public Schools with either elementary school students of ESL, German, or Spanish or with high school students of French, German, Japanese, or Spanish. The elementary school experience involves regular visits, mentoring, and tutoring at Greenfield Elementary School, Linden School, or Liberty School. 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, Taylor High School, or Burrell High School. Activities in the high school 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 experience. 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. Prerequisite: 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: 6-12 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.

Study Abroad and Transfer Credits
Carnegie Mellon University students may participate in a variety of study abroad opportunities including University exchange programs, University affiliated programs, Department of Modern Languages sponsored programs and other approved programs. They may receive transfer credit at the appropriate level for their work. The Department of Modern Languages sponsors such programs in China, France, Germany and Spain. Fuller descriptions of these programs may be found on the internet at: http://ml.hss.cmu.edu/ml/study_abroad_programs.html.

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 student's ability to understand and apply many of the basic models of our behavior and thought that explain the wide areas of our functioning. 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 the nature of creativity. Finally, the course will examine the similarities 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 the 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 psychopathological development. Specific topics within these areas include brain function, motivational control systems, learning, memory, and thinking processes, and psychopathology. In addition to the lecture, the course includes a weekly laboratory 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. Co-requisites: 85-213

85-211 Cognitive Psychology
Fall and Spring: 9 units
This course will examine the cognitive processes underlying perception, mental imagery, memory, language, 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: 15-211

85-219 Biological Foundations of Behavior
Fall: 9 units
This course will provide students with a general introduction to the underlying biological and psychological processes involved in behavior. In this course, we will examine the neural, 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 biologists 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 peoples 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 research 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" and theories about the causes and treatment of abnormality. Students will also 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 signal 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. Prerequisites: (36-247) and (85-211 or 85-213)

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. Prerequisites: 36-247 and 85-221

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 will have an opportunity to design experiments 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. Prerequisites: (85-241 or 85-251) and (36-247)

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.

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 recording 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 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: 85-211 or 85-219

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 critical analysis of research by investigating 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 research for behavior for relationships and health. The course will also cover research on other types of pro-social behavior such as empathy, altruism, forgiveness, and cooperation. This is an advanced seminar in which you will be expected to read original research articles and chapters on assigned topics and present your findings. The course will closely follow the different approaches and attempts to define the field that have contested for dominance during the discipline. The final exam will focus 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.

85-360 Human Memory Fall: 9 units

This course will cover 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: 85-221

85-370 Perception Spring: 9 units
Perception, broadly defined, is the construction of a representation of the external world. Although we often think of perception as the processing of input to the sense organs, the world conveyed by the senses is ambiguous, and cognitive and sensory systems interact to interpret it. This course examines the mechanisms involved in visual perception, along with consideration of other perceptual systems such as auditory perception, haptic perception (touch) and pain. The course progresses through sensory coding interacts with top-down processes such as selective attention, the use of context, and application of prior knowledge. Additional topics may include perceptual learning and development, object recognition, reading, spatial processing, and developmental impairments. Prerequisites: 85-102 or 85-211

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 traditions of human expression and the themes that are common to all cultures. The major topics to be included will be the experience and functionality of consciousness, cultural approaches to consciousness, perception and cognitive processes, the cultural constructs of time, space, and causality, the relationship between culture and the mind, cross-cultural differences in the experience of consciousness, and the cultural differences in the meaning and practice of human memory and memory as a cultural construct. The emphasis will be on those topics that are relevant for cross-cultural psychology. Prerequisites: 85-100 or 85-102 or 85-108 or 85-150 or 85-198 or 85-211 or 85-219 or 85-241 or 85-251 or 85-261

85-380 The Historical Development of Experimental Psychology Fall: 9 units
This course will be divided between a detailed examination of the history of psychological experimentation and an exploration of the major theoretical issues in contemporary psychology. The course will consist of our reading and discussing primary research literature and asking students to critique research in child development. The purpose of the course is to develop 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, and ethical issues involved in doing research.

85-382 Consciousness and Cognition Interim: 9 units
This course will examine the relationship between consciousness and cognition. 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. We will be discussing the history of this field, as well as current issues and controversies. 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, neuropsychological approaches to consciousness, perceptual and attentional control, attentional strategies and control mechanisms, the role of attention and consciousness in the control of behavior, and the role of attention and consciousness in the control of behavior. The emphasis will be on those topics that are relevant for cross-cultural psychology. Prerequisites: 85-100 or 85-102 or 85-108 or 85-150 or 85-198 or 85-211 or 85-219 or 85-241 or 85-251 or 85-261

85-390 Human Memory Fall: 9 units

Prerequisites: (85-211 or 85-213)

86-382 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 research concerning the development of expertise. Questions addressed in the following: What does it take to become an expert? Are experts born or made? Is the process of acquiring expertise common across different domains from music to sports to science? Research studied in the course will employ a variety of methodologies, from case studies to protocol analysis to computational modeling. Prerequisites: 85-211 or 85-213

Course Descriptions

9 units

9 units

9 units

9 units

9 units

9 units
Course Descriptions

85-408 Visual Cognition
Intermittent: 9 units
Recognizing an object, face or word is a complex process which is mastered little by little during the first 2 years of life. This course adopts a three-pronged approach, drawing on psychological, neural and computational models to explore a range of topics including early vision, attention, face recognition, reading and object recognition, and visual imagery. The course will take a seminar format.

85-412 Cognitive Modeling
Spring: 9 units
This course will be concerned with modeling of cognition. We will use a high-level modeling language to simulate a range of cognitive tasks from the literature on attention, memory, problem solving and skill acquisition. Students will end the course developing a model for a phenomenon of their choosing. The course grade will be determined by a series of assignments involving developing cognitive models and by a written exam. Prerequisites: 85-213

85-414 Cognitive Neuropsychology
Spring: 9 units
This course will review what has been learned of the neural bases of cognition through studies of brain-damaged patients as well as newer techniques such as brain stimulation mapping, regional metabolic and blood flow imaging, and attempt to relate these clinical and physiological data to theories of the mind cast in information-processing terms. The course will be organized into units corresponding to the traditionally-defined subfields of cognitive psychology such as perception, memory and language. In each area, we will ask: To what extent do the neurological phenomena make contact with the available cognitive theories? When they do, what are their implications for these theories (i.e., Can we use our knowledge of particular cognitive processes using neurologically impaired individuals?)? When they do not, what does this tell us about the parsing of the mind imposed by the theories and methodologies of cognitive psychology and neuropsychology? Prerequisites: 85-211 or 85-219

85-417 Cognitive Modeling and Intelligent Tutoring Systems
Fall: 9 units
This course will focus on the combination of cognitive psychology and artificial intelligence required to develop intelligent computer-assisted instruction. A background in artificial intelligence (minimally LISP) and cognitive psychology is required. Half of the course will be project-oriented. We will learn the production system GRAPEAS and work up to producing an expert system and a tutor for a fragment of calculus. Prerequisites: 15-211 or 85-213 or 85-411

85-419 Introduction to Parallel Distributed Processing
Spring: 9 units
This course will provide an overview of parallel-distributed processing models of aspects of perception, memory, language, knowledge representation, and learning. The course will consist of lectures describing the theory behind the models as well as their implementation, and students will get hands-on experience running existing simulation models on workstations. Prerequisites: 85-211 or 85-213

85-421 Language and Thought
Intermittent: 9 units
This course will explore the language ability which the child learns to express in general or the specific language facility? Why is it so hard to learn a second language? Are there important links between language and culture?  Prerequisites: 85-150 or 80-180 or 80-181 or 82-382 or 85-108 or 85-211 or 85-213

85-422 Infancy
Intermittent: 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: 85-241 or 85-251

85-449 Emotion and Social Behavior
Spring: 9 units
This course explores a number of issues and questions involving human motivation. The course begins by considering how 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 the psychological 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 activities 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 methods 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 states of brain damage. Prerequisites: 85-211 or 85-251 or 85-411 or 85-414 or 85-419

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.

85-444 Interpersonal Relationships
Fall: 9 units
This course begins 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, misattributions 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: (85-241 and 85-340) or (85-251 and 85-340)

85-446 Psychology of Gender
Spring: 9 units
This course is devoted to the investigation of psychological gender rather than biological sex. 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: 85-241 or 85-251

85-451 Psychology of Purpose
Spring: 9 units
This course explores a number of issues and questions involving human motivation. The course begins by considering how 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 to people when they are having difficulty attaining the goals they value. Discussion surrounding motivational failure centers largely on how people adjust when they are having difficulty attaining the goals they have set. Prerequisites: 85-241 or 85-251 and (85-310 or 85-320 or 85-340)

85-455 The Discovery of Spoken Language
Spring: 9 units
This course will provide an overview of parallel-distributed processing models of aspects of perception, memory, language, knowledge representation, and learning. The course will consist of lectures describing the theory behind the models as well as their implementation, and students will get hands-on experience running existing simulation models on workstations. Prerequisites: 85-241 or 85-251 and (85-310 or 85-320 or 85-340)

85-465 The Discovery of Spoken Language
Spring: 9 units
This course will explore infants' acquisition of spoken language. We will focus on the very early perceptual and cognitive skills that infants develop in language and 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 prenatals and postnatal development of the skills that support the discovery of spoken language, we will survey common 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
Intermediate: 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.

85-480 Internship in Clinical Psychology
All Semesters: 6-12 units
This is a cooperative effort by Carnegie Mellon University and a number of community health facilities, and includes semester-long placements in psychology and psychiatry settings. Students will accrue a minimum of 800 hours. Supervision is provided by a registered psychologist. Course work will be divided into 3 components: lecture, practice, and evaluation. The student's progress will be evaluated in writing at the end of Fall Semester. Prerequisite: Grade of B or better in previous research course required to enter, grade of B or better in first semester of internship sequence required to complete, and permission of instructor. A formal proposal is required in the first semester. This course differs from the Honors Thesis sequence (85-508,507,506) 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.

85-508 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 at the end of Fall Semester. Prerequisite: Grade of B or better in 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 Problems in Psychology (85-508,507,506) 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.

Social & Decision Sciences
Undergraduate Courses

88-110 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 major 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.

88-111 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 in making deals with other traders in the market. In each experiment it is time to really put 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, external control, pollution, network externalities, information economics, and international trade.

40-111 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? Secondly, we will examine which rights/issues have been raised in 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.

**88-114 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 and heuristics (Tversky and Kahneman). 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’s 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.”

**88-120 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 emotional states affect judgments and choice? How do people come to take action? What cognitive heuristics are used 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.

**88-198 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&S 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&S Academic Advisor. Prerequisites/ restrictions: for H&S students only; only for second-semester freshman, or first- or second-semester sophomores. minimum cumulative CPA 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&S 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 and public goods, externalities, market failure, and government failures. The second part of the course consists of normative analysis of government policies. This begins with an examination of the conditions necessary for a policy to be economically efficient. This is followed by an examination of how factors shape market failure, when private markets are not efficient. The strengths and weaknesses of markets are then examined in a broader framework encompassing terms with information decentralization, transaction costs, and the development and use of computerized decision aids involving uncertainty; methods for quantifying preferences and expert opinion; and the development and use of computerized decision aids ranging from spread sheet programs to highly specialized decision support models. Prerequisites: 36-201 or 36-211 or 36-217 or 36-220 or 36-225 or 36-247 or 70-207 or 36-267.

**88-250 Regression Methods in Social Science**

Fall: 9 units

This is a class on empirical research design and analysis, emphasizing causal inference. Attention focuses on trying to identify the causes of significant social phenomena such as the growth of cities, international conflict, student performance in voucher systems, and smoking by youths. Empirical research involves a number of broad steps, including formulating the problem, developing specific hypotheses, collecting data relevant to the hypotheses, analyzing the data using statistical tools, constructing alternative explanations for the empirical findings, and collecting additional information with which to distinguish among the alternatives explanations. Empirical problems that can be analyzed using regression and related statistical techniques will be considered. First, empirical problems involving preexisting data will be considered, problems in which data are collected experimentally will be considered. Last, the challenges to statistical analyses of non-experimental data will be considered. Prerequisites: 36-202.

**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 analysis of experimental data. 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 research methods 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 organizations in organizations. We discuss such questions as how individuals make decisions and how these can influence organizational success or failure. In the third part, we examine various models of organizational behavior. Here, we examine 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 Macroeconomic Policy**

Spring: 9 units

The 1960s was the golden age for macroeconomists. There existed an almost universal consensus on the macroeconomic work of government. As 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 new consensus has emerged. To the contrary, different schools think very differently about the right way to conduct 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: 73-250 or 88-220

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 decision making: inference, 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.

88-305 Philosophy of Social Science
Spring: 9 units
This course asks whether we can use the scientific method to understand social phenomena like the behavior of individuals, how social institutions and norms come into being, to what extent social 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 types of explanation? The two cases? Do simple social "laws" exist which explain the behavior of individuals? Do social phenomena 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 theme 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
Electoral rules have far-reaching consequences for the representation of collective values and for policy outcomes. Some electoral systems are ostensibly meant to maximize minority representation, while others are designed to achieve alternative goals. Because of the importance of electoral rules in defining fairness or sensibility. This course broadly explores how the rules for collective decisions affect the electoral process, who wins and who loses, and the stability of the system. Examples will include elections in the U.S., Europe, and Asia, as well as contexts in non-governmental organizations, such as businesses and social clubs. Grading may be based mainly on five essay assignments, one exam, and one oral presentation.

88-326 Theories of International Relations
Fall and Spring: 9 units
This course provides an introduction to the study of U.S. foreign policy. The main focus will be on problems and possibilities confronting the world during the Cold War as well as on political changes in the Post-Cold War era. Among important foreign policy strategies which we will discuss are the strategy of containment, NSC-68, the Eisenhower-Dulles "New Look," the Kennedy-Johnson "flexible response," "déteint" and approaches to contemporary American foreign policy.

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. The course will study how political factors, historical legacies, and the economic interests of the rich variety of economic 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 affect the choices made concerning these issues and challenges. Prerequisites: (21-111 or 21-121 or 21-115 or 21-116) and (73-260 or 36-201 or 36-207 or 36-220 or 36-225 or 36-247 or 70-207)

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 evolutionary and economic 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: 73-250 or 88-220

88-341 Organizational Communication
Fall: 9 units
Much of the work in groups and organizations consists of communication. You can learn a great deal about the functioning of an organization by observing the ways in which people communicate. In this course, we will be the basis of this examination. We will 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: 73-250 or 88-220

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: 73-250 or 88-220

88-344 Organizational Intelligence in the Information Age
Spring: 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 within them) acquire this knowledge? In what ways do new technologies affect the norms, procedures, and culture of organizations? How do leaders successfully guide their organizations through the world where new information and new technologies are constantly being produced? This course is about information assessment and analysis in organizations, and the way organizations are transformed by technology.

88-345 The Rise of Industrial Research and Development
Intemittent: 9 units
This course provides an introduction to the study of U.S. foreign policy. The main focus will be on problems and possibilities confronting the world during the Cold War as well as on political changes in the Post-Cold War era. Among
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, technological innovation? Is the international 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? Has R&D been "marginalized"? 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 individual or 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

Intermediate: 9 units

The Internet is only the latest example of a complex technological system that.functions simultaneously using many technologies. These systems are a result of emerging, ranging from transportation systems such as the railroad and mass-produced automobiles running on paved roads and highways to networks of information systems including the telephone, 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 the corporate world simulations are playing a growing role as the tool for reasoning about change, adaptation, evolution, and learning. This course prepares you to interpret the results from and to design such models. This course teaches the student how to design and analyze computational models and how to evaluate the results of other computational models. Issues covered include: representation of groups, representation of organizational structure, representation of communication, representation of information and knowledge representations, and communication of technology, representation of tasks, evaluation of these topics, rather changes, optimization models, canonical tasks, performance measures, data capturing, virtual experiments, analysis, docking, levels and types of validation, and social turing tests. Illustrative models will be drawn from recent publications in the area of computational organization theory, computational sociology, computational economics, and other simulation areas in the domains of interest to the students. No prior knowledge of science or modeling is required. This course does not teach programming.

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 overpopulation, pollution, and water shortage are of global environmental problems, and the international treaties and agreements, institutions, mechanisms and policies are in place to address them. This course discusses these topics, including changes, optimization models, canonical tasks, performance measures, data capturing, virtual experiments, analysis, docking, levels and types of validation, and social turing tests. Illustrative models will be drawn from recent publications in the area of computational organization theory, computational sociology, computational economics, and other simulation areas in the domains of interest to the students. No prior knowledge of science or modeling is required. This course does not teach programming.

88-355 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 communication. 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 this course. Prerequisites: 73-250 or 88-220

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 possibility theories of Arrow and Gibbard and Satterthwaite, (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 issues of political science and current events are examined and discussed. The course has no formal prerequisites.

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.
88-366 Social Issues in Computing
Spring: Mini Session - 6 units
When people use electronic information systems to conduct social relationships, the relationships are constructed within and are strongly influenced by the medium in which they are conducted. Although there is some understanding of these influences, the social context of computing is a relatively new area of study. This course will consider relationships in which electronic media, principally the Internet, are the organizing principles of communication.
organizational theory from a macro perspective. Both classic historical treatments of organizations and modern approaches and concerns in the area are covered. Theoretical perspectives covered include: structuralism, information processing, resource dependency, population ecology, networks, open and closed systems, and institutionalism. In addition, a variety of substantive and methodological topical areas that are having a major impact on the field are addressed: Organizational Learning, Organizations and Technology, Communication in Organizations, Computational Organization Theory, Organizational Evolution & Change, and Social and Organizational Networks. Priority access to this course will be given to Ph.D. students, masters students, and undergraduate seniors. Grading may be based mainly on a term paper, attendance, and paper synopses. No prior knowledge of organizational theory is required.

88-467 Computers in Organizations
Spring: 12 units
Computers have been used in organizations since World War II. Their use has both intensified and changed in character in recent decades. For a typical firm, financial accounting is the largest single computing application, followed by personnel management and sales. The use of computers allows increased decision-making capability, increased accuracy, and increased speed of operation. The course is designed to provide computer-related knowledge to upper-level business students. Emphasis is on business computer applications and the management of computer systems. Prerequisites: 99-222 Creating Pittsburgh
Spring: 9 units
Focusing on the role of the artist as citizen, this course looks at the way that artists and humanists are entrusted with interpreting and altering cultural logic; therefore, the manner in which they react to their political and social environment. Additionally, students will also keep in regular contact with a faculty member in their major discipline. Students will have the opportunity to participate in a service/learning experience (http://dev.mac.cc.cmu.edu/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.

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: 88-501

88-505 Undergraduate Internship
All Semesters: 3,6,9 units
An internship is an approved and monitored work experience than can be related to an academic study through active reflection and specific learning goals. Students must work at least 10 hours per week for the semester at the internship. Additionally, students will also keep in regular contact with a faculty member in their major discipline. They will also complete an application in person or electronically (http://dev.mac.cc.cmu.edu/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.

University Studies

Undergraduate Courses

Fall: 1st & 2nd mini and Spring: 3rd mini
Computing Skills Workshop (CSW) is a 3-unit required class that ALL incoming undergraduate students are required to take during the fall semester. 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 for summer programs or advanced Placement Computing Courses cannot be credited/substituted for this requirement. During Orientation all incoming undergraduates will also attend an Email/Security Session. This session is meant to help you learn to access your Carnegie Mellon email account and understand how to keep your account secure.

99-200 Tutoring, Mentoring, and Role Modeling
Spring: 6 units Pass/Fail
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 tutor 2 hours per week, in a time slot of your choosing. 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 tutor’s 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. Tutoring is coordinated with the East End Youth Program (http://www.cmu.edu/outreach/eeyp). More information can be found at http://www.cmu.edu/outreach/99-200.

99-222 Creating Pittsburgh
Spring: 9 units
Focusing on the role of the artist as citizen, this course looks at the way that artists and humanists are entrusted with interpreting and altering cultural logic; therefore, the manner in which they react to their political and social environment. Additionally, students will also keep in regular contact with a faculty member in their major discipline. Students will have the opportunity to participate in a service/learning experience (http://dev.mac.cc.cmu.edu/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.

99-250 SEMINAR for Peer Tutors
Fall/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. Prerequisites: Freshmen, sophomores, or junior status. Students must complete an application in person or electronically (http://dev.mac.cc.cmu.edu/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 Leaders
Fall/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. Prerequisites: Freshmen, sophomores, or junior status. Students must complete an application in person or electronically (http://dev.mac.cc.cmu.edu/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 Counselors
Fall/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). 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 academic counselor. 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. Prerequisites: Freshmen, sophomores, or junior status. Students must complete an application in person or electronically (http://dev.mac.cc.cmu.edu/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.

99-260 Mentors in Math: A Community Service Course Department: Center for University Outreach
Fall: 9 units
Students will have the opportunity to participate in a service/learning experience by mentoring (tutoring) mathematically gifted children in the public schools. Students will attend training sessions during the semester, during which they will discuss assigned readings, examine topics to be taught, and learn instructional strategies. Students will travel to Pittsburgh Public Schools weekly to meet with groups of children. Students will provide high-level, challenging mathematical instruction for these gifted youngsters. Students will monitor children’s progress, maintain a journal, and submit a paper or seminar project summarizing the experience. Transportation to the public schools will be provided. Prerequisites: none

99-451 Fluency and Communication Skills for Nonnative Speakers of English
This course is designed to help graduate students who are nonnative speakers of English gain the skills needed to work at Teaching Assistants. The focus will be two-fold: 1) students will have the opportunity to develop robust teaching fluency, and 2) they will gain a better understanding of the culture of the American classroom, their role as “interactionists” and “learning to a specific place — Pittsburgh and its environs — the context of this course suggests that any analysis of the arts must be based in an understanding of the many overlapping ideologies and milieus in which creative work occurs.

Social & Decision Sciences

University Studies
will be required to be videotaped teaching two sample lessons to the class, and then meet individually with the instructor to review the tapes. Prerequisite: permission from the Intercultural Communication Center.

99-452 Language and Culture for Teaching
The goal of this course is to strengthen the oral communication skills of graduate non-native speakers of English so that they can communicate more successfully in academic, professional and multicultural environments. Classroom activities focus on developing robust fluency and help students develop an awareness of various communicative styles and cultural assumptions. The in-class learning activities include videotaped prepared speeches, discussions and pronunciation practice. We also examine language-learning techniques so that students can become more informed self-paced learners. Prerequisite: Permission from the Intercultural Communication Center.
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Key to Buildings and Services

ACADEMIC BUILDINGS

Location | Name
---|---
D-4 | 1. Alumni House
A-5 | 2. Baker Hall
A-1 | 3. Braner Hall
+ | 4. Carnegie Mellon Research Institute at Pittsburgh Technology Center
A-3 | 5. College of Fine Arts
C-4 | 6. Cremo Hall
B-7 | 7. Davis Hall
A-2 | 8. Facilities Management Services Building
B-6 | 9. Graduate School of Industrial Administration
A-2 | 10. Gymnasium
C-5 | 11. Hamberg Hall
A-4 | 12. Hunt Library
B-14 | 13. Margaret Worthington Carnegie Hall
C-8 | 14. Mellon Institute
B-8 | 15. Newman-Simon Hall
B-5 | 16. Planetary Robotics Building
A-18 | 17. Porter Hall
A-5 | 18. Publications and Printing Building
C-3 | 19. Purnell Center
A-6 | 20. Roberts Engineering Hall
C-21 | 22. Scaife Hall
C-10 | 23. South College
A-5 | 24. Software Engineering Institute
A-2 | 25. Studio Theatre
C-5 | 26. University Center
C-7 | 27. University Technology Development Center
C-4 | 28. Warner Hall
B-3 | 29. West Garages
B-11 | 30. Whitefield Hall
B-6 | 31. 407 South Craig Street
C-3 | 32. 4615 Forbes Ave.
C-3 | 33. 4902 Forbes Ave.
C-3 | 34. 5555 Penn Avenue

RESIDENCE BUILDINGS

Location | Name
---|---
B-1 | 35. Boss Hall
E-6 | 36. Cathedral Mansions
E-2 | 37. Doherty Apartments
B-1 | 38. Donner Hall
D-2 | 39. Dormitories
D-1 | 40. Freshman Apartments
D-2 | 41. Fraternity Quads
B-6 | 42. Housing Office
A-1 | 43. Henderson Hall
B-1 | 44. Margaret Worthington Houses
B-1 | 45. Margaret Worthington Sorority Houses
E-1 | 46. Marguerite Apartments
B-1 | 47. McGroar Hall
B-6 | 48. Morewood Gardens
B-3 | 49. Morewood Hall
E-5 | 50. Morewood Terraces
B-1 | 51. Mood Hall
B-1 | 52. Moorehead House
B-1 | 53. Moorehead House
D-1 | 54. Neil Arms
D-1 | 55. Showers Apartments
B-1 | 56. Spirit House
B-1 | 57. Tech House
D-8 | 58. Tech House
A-2 | 59. Welch Hall
B-7 | 60. West Wind
C-1 | 61. Westwind Apartments
B-1 | 62. 99 Gladstone Road
D-3 | 63. 1094 Devon Road

PARKING AREAS

Location | Name
---|---
B-3 | 64. Fine Arts
B-3 | 65. Firestone
B-3 | 66. Children's School
D-2 | 67. East Campus Garage
P-4 | 68. East Campus Garage
P-6 | 70. Forbes
P-7 | 71. Forbes
D-9 | 72. Morewood
P-8 | 73. Moorehead
C-9 | 74. Purnell Center
P-9 | 75. Purnell Center
P-10 | 76. Public Housing
P-11 | 77. Public Housing
D-3 | 78. Alumni House
E-14 | 79. Multfield Hall
E-6 | 80. North College
B-6 | 81. Purnell Center
P-18 | 82. 4902 Forbes
P-19 | 83. Pittsburgh Technology Center
B-6 | 84. Junction Hollow
B-6 | 85. Branner House
A-3-5 | 86. 4th St. Disabled Parking
W | 87. Visitor Parking
A-3-5 | 88. Accessible Parking

*Off Campus, See City Area Map.

City Area Map

ROBOTICS ENGINEERING CONSORTIUM

Colleges

Carnegie Institute of Technology

College of Humanities
College of Fine Arts
Graduate School of Arts and Sciences
School of Computer Science

approachable scale

approximate scale

1 mile
2 miles
3 miles

424 Campus Map
### 2002-2003 Academic Calendar

#### Fall 2002 Semester

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 19</td>
<td>M</td>
<td>Fall Payment Due</td>
</tr>
<tr>
<td>August 26</td>
<td>M</td>
<td>Semester &amp; Mini-1 Classes Begin</td>
</tr>
<tr>
<td>September 2</td>
<td>M</td>
<td>Labor Days; No Classes</td>
</tr>
<tr>
<td>August 30</td>
<td>F</td>
<td>Mini-1 Course Add Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>August 30</td>
<td>F</td>
<td>Mini-1 Course Audit Grade Option Deadline (except GSIA)</td>
</tr>
<tr>
<td>August 30</td>
<td>F</td>
<td>Mini-1 Course Drop Deadline to Receive Tuition (GSIA only)</td>
</tr>
<tr>
<td>September 9</td>
<td>M</td>
<td>Semester Course Add Deadline without Dean’s Permission</td>
</tr>
<tr>
<td>September 9</td>
<td>M</td>
<td>Semester Course Audit Grade Option Deadline</td>
</tr>
<tr>
<td>September 10</td>
<td>T</td>
<td>Mini-1 Course Add Deadline without Dean’s Permission (GSIA only)</td>
</tr>
<tr>
<td>September 10</td>
<td>T</td>
<td>Mini-1 Course Audit Grade Option Deadline (GSIA only)</td>
</tr>
<tr>
<td>September 10</td>
<td>T</td>
<td>Mini-1 Course Drop Deadline to Receive Tuition (GSIA only)</td>
</tr>
<tr>
<td>September 25</td>
<td>W</td>
<td>Mini-1 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>October 7-11</td>
<td>M-F</td>
<td>Mini-1 Faculty Course Evaluations</td>
</tr>
<tr>
<td>October 14</td>
<td>M</td>
<td>Mini-1 Last Day of Classes</td>
</tr>
<tr>
<td>October 14</td>
<td>M</td>
<td>Mini-1 Course Drop Deadline to Receive a Withdrawal Grade</td>
</tr>
<tr>
<td>October 15</td>
<td>T</td>
<td>No Graduate Mini-1 Course Meetings (Reading Day)</td>
</tr>
<tr>
<td>October 15-16-17</td>
<td>T-Th</td>
<td>No Undergraduate Mini-1 Course Meetings (Reading Period)</td>
</tr>
<tr>
<td>October 16-17-18-19</td>
<td>W-Sa</td>
<td>Graduate Mini-1 Exam Days</td>
</tr>
<tr>
<td>October 18</td>
<td>F</td>
<td>Undergraduate Mini-1 Exam Day</td>
</tr>
<tr>
<td>October 18</td>
<td>F</td>
<td>Mid-Semester Break; No Classes (Mini-1 exams will take place)</td>
</tr>
<tr>
<td>October 21</td>
<td>M</td>
<td>Semester Mid-Term &amp; Mini-1 Final Grades Due by 4 p.m.</td>
</tr>
<tr>
<td>October 21</td>
<td>M</td>
<td>Mini-2 Classes Begin (except GSIA)</td>
</tr>
<tr>
<td>October 23</td>
<td>W</td>
<td>Mini-2 Classes Begin (GSIA only)</td>
</tr>
<tr>
<td>October 25</td>
<td>F</td>
<td>Mini-2 Course Add Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>October 25</td>
<td>F</td>
<td>Mini-2 Course Audit Grade Option Deadline (except GSIA)</td>
</tr>
<tr>
<td>October 25</td>
<td>F</td>
<td>Mini-2 Course Drop Deadline to Receive Tuition (adjustment except GSIA) 1</td>
</tr>
<tr>
<td>November 4</td>
<td>M</td>
<td>Semester Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>November 5</td>
<td>T</td>
<td>Mini-2 Course Add Deadline without Dean’s Permission (GSIA only)</td>
</tr>
<tr>
<td>November 5</td>
<td>T</td>
<td>Mini-2 Course Audit Grade Option Deadline (GSIA only)</td>
</tr>
<tr>
<td>November 5</td>
<td>T</td>
<td>Mini-2 Course Drop Deadline to Receive Tuition (GSIA only)</td>
</tr>
<tr>
<td>November 18-22</td>
<td>M-F</td>
<td>Spring 2003 Registration Week</td>
</tr>
<tr>
<td>November 27-29</td>
<td>W-F</td>
<td>Thanksgiving Holiday; No Classes</td>
</tr>
<tr>
<td>November 25</td>
<td>M</td>
<td>Mini-2 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>December 2-6</td>
<td>M-F</td>
<td>Semester &amp; Mini-2 Faculty Course Evaluations</td>
</tr>
<tr>
<td>December 6</td>
<td>F</td>
<td>Semester &amp; Mini-2 Last Day of Classes (except GSIA)</td>
</tr>
<tr>
<td>December 6</td>
<td>F</td>
<td>Semester &amp; Mini-2 Course Drop Deadline to Receive a Withdrawal Grade (except GSIA) 2</td>
</tr>
<tr>
<td>December 9-10</td>
<td>M-T</td>
<td>Final Examinations (except GSIA)</td>
</tr>
<tr>
<td>December 11</td>
<td>W</td>
<td>Reading Day</td>
</tr>
<tr>
<td>December 12-13</td>
<td>R-F</td>
<td>Final Examinations (except GSIA)</td>
</tr>
<tr>
<td>December 12</td>
<td>T</td>
<td>Mini-2: GSIA Semester &amp; Mini-2 Last Day of Classes</td>
</tr>
<tr>
<td>December 12</td>
<td>T</td>
<td>GSIA Semester &amp; Mini-2 Course Drop Deadline to Receive a Grade</td>
</tr>
<tr>
<td>December 14</td>
<td>Sa</td>
<td>Final Examinations (GSIA only)</td>
</tr>
<tr>
<td>December 15</td>
<td>Su</td>
<td>Reading Day</td>
</tr>
<tr>
<td>December 16-17</td>
<td>M-T</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>December 19</td>
<td>Th</td>
<td>Final Grades Due by 4 p.m.</td>
</tr>
</tbody>
</table>

**Notes:**
- *Exceptions for GSIA 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 withdrawing from the University should consult the official Tuition Adjustment Policy.*
- 2. Not Applicable for Graduate Students except graduate students in MCS & GSIA.*

#### Spring 2003 Semester

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 4</td>
<td>M</td>
<td>Spring Payment Due</td>
</tr>
<tr>
<td>January 13</td>
<td>M</td>
<td>Semester &amp; Mini-3 Classes Begin</td>
</tr>
<tr>
<td>January 17</td>
<td>F</td>
<td>Mini-3 Course Add Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>January 17</td>
<td>F</td>
<td>Mini-3 Course Audit Option Deadline (except GSIA)</td>
</tr>
<tr>
<td>January 17</td>
<td>F</td>
<td>Mini-3 Course Drop Deadline to Receive Tuition (except GSIA)</td>
</tr>
<tr>
<td>January 20</td>
<td>M</td>
<td>Martin Luther King Day; No Afternoon Classes Noon-4:30 p.m.</td>
</tr>
<tr>
<td>January 24</td>
<td>F</td>
<td>Semester Course Drop Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>January 24</td>
<td>F</td>
<td>Semester Course Audit Option Deadline (except GSIA)</td>
</tr>
<tr>
<td>January 24</td>
<td>F</td>
<td>Semester Course Drop Deadline to Receive Tuition (adjustment)</td>
</tr>
<tr>
<td>January 24</td>
<td>F</td>
<td>Mini-3 Course Add Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>January 24</td>
<td>F</td>
<td>Mini-3 Course Audit Option Deadline (GSIA only)</td>
</tr>
<tr>
<td>January 24</td>
<td>F</td>
<td>Mini-3 Course Drop Deadline to Receive Tuition (GSIA only)</td>
</tr>
<tr>
<td>February 11</td>
<td>T</td>
<td>Mini-3 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>Feb. 24-28</td>
<td>M-F</td>
<td>Mini-3 Faculty Course Evaluations</td>
</tr>
<tr>
<td>February 28</td>
<td>F</td>
<td>Mini-3 Last Day of Classes</td>
</tr>
<tr>
<td>February 28</td>
<td>F</td>
<td>Mini-3 Course Drop Deadline to Receive a Withdrawal Grade</td>
</tr>
<tr>
<td>March 1</td>
<td>Sa</td>
<td>Graduate Mini-3 Exam Days</td>
</tr>
<tr>
<td>March 3-4-5</td>
<td>M-W</td>
<td>Graduate Mini-3 Exam Days</td>
</tr>
<tr>
<td>March 6</td>
<td>Th</td>
<td>Undergraduate Mini-3 Exam Day</td>
</tr>
<tr>
<td>March 6</td>
<td>Th</td>
<td>Mid-Semester Break; No Classes (Mini-3 exams will take place)</td>
</tr>
<tr>
<td>March 7</td>
<td>F</td>
<td>Mid-Semester Break; No Classes</td>
</tr>
<tr>
<td>March 10</td>
<td>M</td>
<td>Mini-4 Classes Begin</td>
</tr>
<tr>
<td>March 10</td>
<td>M</td>
<td>Semester Mid-Term &amp; Mini-3 Final Grades Due by 4 p.m.</td>
</tr>
<tr>
<td>March 14</td>
<td>F</td>
<td>Mini-4 Course Add Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>March 14</td>
<td>F</td>
<td>Mini-4 Audit Grade Option Deadline (except GSIA)</td>
</tr>
<tr>
<td>March 14</td>
<td>F</td>
<td>Mini-4 Course Drop Deadline to Receive Tuition (except GSIA)</td>
</tr>
<tr>
<td>March 21</td>
<td>F</td>
<td>Mini-4 Course Add Deadline without Dean’s Permission (GSIA only)</td>
</tr>
<tr>
<td>March 21</td>
<td>F</td>
<td>Mini-4 Audit Grade Option Deadline (GSIA only)</td>
</tr>
<tr>
<td>March 21</td>
<td>F</td>
<td>Mini-4 Course Drop Deadline to Receive Tuition (GSIA only)</td>
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<td>F</td>
<td>Mini-4 Course Add Deadline without Dean’s Permission (GSIA only)</td>
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<td>F</td>
<td>Mini-4 Audit Grade Option Deadline (GSIA only)</td>
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<tr>
<td>March 21</td>
<td>F</td>
<td>Mini-4 Course Drop Deadline to Receive Tuition (GSIA only)</td>
</tr>
<tr>
<td>March 21</td>
<td>F</td>
<td>Mini-4 Course Drop Deadline to Receive Tuition (GSIA only)</td>
</tr>
<tr>
<td>Mar. 24-28</td>
<td>M-F</td>
<td>Spring Break; No Classes</td>
</tr>
<tr>
<td>March 31</td>
<td>M</td>
<td>Semester Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>April 11-12</td>
<td>F-Sa</td>
<td>Spring Carnival; No Classes (except GSIA)</td>
</tr>
<tr>
<td>April 14</td>
<td>M</td>
<td>Summer 2003 Registration Begins</td>
</tr>
<tr>
<td>April 15</td>
<td>T</td>
<td>Mini-4 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>April 21-25</td>
<td>M-F</td>
<td>Fall 2003 Registration Week</td>
</tr>
<tr>
<td>April 21-25</td>
<td>M-F</td>
<td>Semester &amp; Mini-4 Faculty Course Evaluations</td>
</tr>
<tr>
<td>May 2</td>
<td>F</td>
<td>Semester &amp; Mini-4 Last Day of Classes (except GSIA)</td>
</tr>
<tr>
<td>May 2</td>
<td>F</td>
<td>Semester &amp; Mini-4 Course Drop Deadline to Receive a Withdrawal Grade (except GSIA) 2</td>
</tr>
<tr>
<td>May 3</td>
<td>Sa</td>
<td>GSIA Semester &amp; Mini-4 Final Examinations</td>
</tr>
<tr>
<td>May 4</td>
<td>Su</td>
<td>Reading Day</td>
</tr>
<tr>
<td>May 5-6-7</td>
<td>M-T-W</td>
<td>GSIA &amp; Mini-4 Final Examinations</td>
</tr>
<tr>
<td>May 7</td>
<td>W</td>
<td>Reading Day</td>
</tr>
<tr>
<td>May 8-9</td>
<td>Th-F</td>
<td>Final Examinations (except GSIA)</td>
</tr>
<tr>
<td>May 13</td>
<td>M-T</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>May 15</td>
<td>Th</td>
<td>Final Grades for Graduating Students due by 4 p.m.</td>
</tr>
<tr>
<td>May 18</td>
<td>Su</td>
<td>Commencement</td>
</tr>
<tr>
<td>May 18-19</td>
<td>M-W</td>
<td>Final Grades for Non-grading Students due by 4 p.m.</td>
</tr>
<tr>
<td>May 20</td>
<td>T</td>
<td>Final Grades Mailed to Students</td>
</tr>
</tbody>
</table>
### 2003-2004 Academic Calendar

#### Fall 2003 Semester

Semester: (M-14.5, T-15, W-15.5, Th-14, F-13) Total=71.5

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 18</td>
<td>M</td>
<td>Fall Payment Due</td>
</tr>
<tr>
<td>August 25</td>
<td>M</td>
<td>Semester &amp; Mini-1 Classes Begin</td>
</tr>
<tr>
<td>September 1</td>
<td>M</td>
<td>Labor Day; No Classes</td>
</tr>
<tr>
<td>August 29</td>
<td>F</td>
<td>Mini-1 Course Add Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>August 29</td>
<td>F</td>
<td>Mini-1 Course Audit Grade Option Deadline (except GSIA)</td>
</tr>
<tr>
<td>September 8</td>
<td>M</td>
<td>Semester Course Add Deadline without Dean’s Permission</td>
</tr>
<tr>
<td>September 8</td>
<td>M</td>
<td>Semester Course Audit Grade Option Deadline</td>
</tr>
<tr>
<td>September 8</td>
<td>M</td>
<td>Semester Course Drop Deadline to Receive Tuition Adjustment (except GSIA)</td>
</tr>
<tr>
<td>September 8</td>
<td>M</td>
<td>Mini-1 Course Add Deadline without Dean’s Permission</td>
</tr>
<tr>
<td>September 8</td>
<td>M</td>
<td>Mini-1 Course Audit and/or Pass/Fail Grade Option Deadline (GSIA only)</td>
</tr>
<tr>
<td>September 8</td>
<td>M</td>
<td>Mini-1 Course Drop Deadline to Receive Tuition Adjustment (GSIA only)</td>
</tr>
<tr>
<td>September 24</td>
<td>W</td>
<td>Mini-1 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>October 6-10</td>
<td>M-F</td>
<td>Mini-1 Faculty Course Evaluations</td>
</tr>
<tr>
<td>October 13</td>
<td>M</td>
<td>Mini-1 Last Day of Classes</td>
</tr>
<tr>
<td>October 13</td>
<td>M</td>
<td>Mini-1 Drop Course Deadline to Receive a Withdrawal Grade 2</td>
</tr>
<tr>
<td>October 14</td>
<td>T</td>
<td>No Graduate Mini-1 Course Meetings (Reading Day)</td>
</tr>
<tr>
<td>October 14-15-16</td>
<td>T-Th</td>
<td>No Undergraduate Mini-1 Course Meetings (Reading Period)</td>
</tr>
<tr>
<td>October 15-16-17-18</td>
<td>W-Sa</td>
<td>Graduate Mini-1 Exam Days</td>
</tr>
<tr>
<td>October 17</td>
<td>F</td>
<td>Undergraduate Mini-1 Exam Day</td>
</tr>
<tr>
<td>October 17</td>
<td>F</td>
<td>Mid-Semester Break; No Classes (Mini-1 exams will take place)</td>
</tr>
<tr>
<td>October 20</td>
<td>M</td>
<td>Mid-Semester Break; No Classes</td>
</tr>
<tr>
<td>October 21</td>
<td>T</td>
<td>Semester Mid-Term &amp; Mini-1 Final Grades Due by 4 p.m.</td>
</tr>
<tr>
<td>October 21</td>
<td>T</td>
<td>Mini-2 Classes Begin</td>
</tr>
<tr>
<td>October 27</td>
<td>M</td>
<td>Mini-2 Course Add Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>October 27</td>
<td>M</td>
<td>Mini-2 Course Audit Grade Option Deadline (except GSIA)</td>
</tr>
<tr>
<td>October 27</td>
<td>M</td>
<td>Mini-2 Course Drop Deadline to Receive a Withdrawal Grade (except GSIA)</td>
</tr>
<tr>
<td>November 3</td>
<td>M</td>
<td>Mini-2 Course Add Deadline without Dean’s Permission (GSIA only)</td>
</tr>
<tr>
<td>November 3</td>
<td>M</td>
<td>Mini-2 Course Audit and/or Pass/Fail Grade Option Deadline (GSIA only)</td>
</tr>
<tr>
<td>November 3</td>
<td>M</td>
<td>Mini-2 Course Drop Deadline to Receive Tuition Adjustment (GSIA only)</td>
</tr>
<tr>
<td>November 4</td>
<td>T</td>
<td>Semester Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>November 17-21</td>
<td>M-F</td>
<td>Spring 2001 Registration Week</td>
</tr>
<tr>
<td>November 26-28</td>
<td>W-F</td>
<td>Thanksgiving Holiday; No Classes</td>
</tr>
<tr>
<td>November 24</td>
<td>M</td>
<td>Mini-2 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>December 1-5</td>
<td>M-F</td>
<td>Semester &amp; Mini-2 Faculty Course Evaluations</td>
</tr>
<tr>
<td>December 9</td>
<td>T</td>
<td>Semester &amp; Mini-2 Last Day of Classes (except GSIA)</td>
</tr>
<tr>
<td>December 9</td>
<td>T</td>
<td>Semester &amp; Mini-2 Course Drop Deadline to Receive a Withdrawal Grade (except GSIA) 2</td>
</tr>
<tr>
<td>December 10-11</td>
<td>W-Th</td>
<td>Reading Day (except GSIA)</td>
</tr>
<tr>
<td>December 12</td>
<td>F</td>
<td>Final Examinations (except GSIA)</td>
</tr>
<tr>
<td>December 12</td>
<td>F</td>
<td>GSIA Semester &amp; Mini-2 Last Day of Classes</td>
</tr>
<tr>
<td>December 12</td>
<td>F</td>
<td>GSIA Semester &amp; Mini-2 Course Drop Deadline to Receive a Withdrawal Grade 2</td>
</tr>
<tr>
<td>December 13</td>
<td>Sa</td>
<td>Reading Day</td>
</tr>
<tr>
<td>December 14</td>
<td>Su</td>
<td>Reading Day</td>
</tr>
<tr>
<td>December 15-19</td>
<td>M-F</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>December 22</td>
<td>M</td>
<td>Final Grades Due by 4 p.m.</td>
</tr>
</tbody>
</table>

**Notes:**
- Exceptions for GSIA refer only to graduate programs.
- 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 Withdrawing from the University should consult the official Tuition Adjustment Policy.
- Not Applicable for Graduate Students except graduate students in MCS & GSIA.

#### Spring 2004 Semester

"Semester: (M-14.5, T-15, W-15.5, Th-14, F-13) Total=71.5"

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 5</td>
<td>M</td>
<td>Spring Payment Due</td>
</tr>
<tr>
<td>January 12</td>
<td>M</td>
<td>Semester &amp; Mini-3 Classes Begin</td>
</tr>
<tr>
<td>January 16</td>
<td>F</td>
<td>Mini-3 Course Add Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>January 16</td>
<td>F</td>
<td>Mini-3 Course Audit Grade Option Deadline (except GSIA)</td>
</tr>
<tr>
<td>January 16</td>
<td>F</td>
<td>Mini-3 Course Drop Deadline to Receive Tuition (except GSIA)</td>
</tr>
<tr>
<td>January 19</td>
<td>M</td>
<td>Martin Luther King Day; No Afternoon Classes Noon-4:30</td>
</tr>
<tr>
<td>January 23</td>
<td>F</td>
<td>Semester Course Add Deadline without Dean’s Permission</td>
</tr>
<tr>
<td>January 23</td>
<td>F</td>
<td>Semester Course Audit Grade Option Deadline</td>
</tr>
<tr>
<td>January 23</td>
<td>F</td>
<td>Semester Course Drop Deadline to Receive Tuition</td>
</tr>
<tr>
<td>January 23</td>
<td>F</td>
<td>Mini-3 Course Add Deadline without Dean’s Permission (GSIA only)</td>
</tr>
<tr>
<td>January 23</td>
<td>F</td>
<td>Mini-3 Course Audit or Pass/Fail Grade Option Deadline (GSIA only)</td>
</tr>
<tr>
<td>January 23</td>
<td>F</td>
<td>Mini-3 Course Drop Deadline to Receive Tuition (GSIA only)</td>
</tr>
<tr>
<td>February 11</td>
<td>T</td>
<td>Mini-3 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>Feb. 23-27</td>
<td>M-F</td>
<td>Mini-3 Faculty Course Evaluations</td>
</tr>
<tr>
<td>February 27</td>
<td>F</td>
<td>Mini-3 Last Day of Classes</td>
</tr>
<tr>
<td>February 27</td>
<td>F</td>
<td>Mini-3 Course Drop Deadline to Receive a Withdrawal Grade 2</td>
</tr>
<tr>
<td>March 2-3-4</td>
<td>T-Th</td>
<td>No Undergraduate Mini-3 Course Meetings (Reading Period)</td>
</tr>
<tr>
<td>March 1-2-3-4-5</td>
<td>M-F</td>
<td>Graduate Mini-3 Exam Days</td>
</tr>
<tr>
<td>March 5</td>
<td>F</td>
<td>Undergraduate Mini-3 Exam Day</td>
</tr>
<tr>
<td>March 5</td>
<td>F</td>
<td>Mid-Semester Break; No Classes (Mini-3 undergraduate exams will take place)</td>
</tr>
<tr>
<td>March 8</td>
<td>M</td>
<td>Semester Mid-Term &amp; Mini-3 Final Grades Due by 4 p.m.</td>
</tr>
<tr>
<td>August 12</td>
<td>M-F</td>
<td>Spring Break; No Classes</td>
</tr>
<tr>
<td>March 15</td>
<td>M</td>
<td>Mini-4 Classes Begin</td>
</tr>
<tr>
<td>March 19</td>
<td>F</td>
<td>Mini-4 Course Add Deadline without Dean’s Permission (except GSIA)</td>
</tr>
<tr>
<td>March 19</td>
<td>F</td>
<td>Mini-4 Audit Grade Option Deadline (except GSIA)</td>
</tr>
<tr>
<td>March 19</td>
<td>F</td>
<td>Mini-4 Course Drop Deadline to Receive Tuition (except GSIA)</td>
</tr>
<tr>
<td>March 22</td>
<td>M</td>
<td>Semester Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>March 26</td>
<td>F</td>
<td>Mini-4 Course Add Deadline without Dean’s Permission (GSIA only)</td>
</tr>
<tr>
<td>March 26</td>
<td>F</td>
<td>Mini-4 Audit or Pass/Fail Grade Option Deadline (GSIA only)</td>
</tr>
<tr>
<td>March 26</td>
<td>F</td>
<td>Mini-4 Course Drop Deadline to Receive Tuition (GSIA only)</td>
</tr>
<tr>
<td>April 12</td>
<td>M</td>
<td>Summer 2000 Registration Begins</td>
</tr>
<tr>
<td>April 13</td>
<td>T</td>
<td>Mini-4 Course Drop and Pass/Fail Grade Option Deadline; Assign Withdrawal Grade for Course Dropping After This Date 2</td>
</tr>
<tr>
<td>April 15</td>
<td>T</td>
<td>No Classes</td>
</tr>
<tr>
<td>April 16-17</td>
<td>F-Sa</td>
<td>Spring Carnival; No Classes (except GSIA)</td>
</tr>
<tr>
<td>April 19-23</td>
<td>M-F</td>
<td>Fall 2001 Registration Week</td>
</tr>
<tr>
<td>April 19-23</td>
<td>M-F</td>
<td>Semester &amp; Mini-4 Faculty Course Evaluations</td>
</tr>
<tr>
<td>April 30</td>
<td>F</td>
<td>Semester &amp; Mini-4 Last Day of Classes</td>
</tr>
<tr>
<td>April 30</td>
<td>F</td>
<td>Semester &amp; Mini-4 Course Drop Deadline to Receive a Withdrawal Grade 2</td>
</tr>
<tr>
<td>May 1</td>
<td>Sa</td>
<td>GSIA Semester &amp; Mini-4 Final Examinations</td>
</tr>
<tr>
<td>May 1</td>
<td>Sa</td>
<td>Reading Day (except GSIA)</td>
</tr>
<tr>
<td>May 2</td>
<td>Su</td>
<td>Reading Day</td>
</tr>
<tr>
<td>May 3-4</td>
<td>M-T</td>
<td>Final Examinations (except GSIA)</td>
</tr>
<tr>
<td>May 3-4-5</td>
<td>M-T-W</td>
<td>GSIA Semester &amp; Mini-4 Final Examinations</td>
</tr>
<tr>
<td>May 5</td>
<td>M</td>
<td>Reading Day (except GSIA)</td>
</tr>
<tr>
<td>May 6-7</td>
<td>Th-F</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>May 10-11</td>
<td>M-T</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>May 13</td>
<td>Th</td>
<td>Final Grades for Graduating Students due by 4 p.m.</td>
</tr>
<tr>
<td>May 16</td>
<td>W</td>
<td>Commencement</td>
</tr>
<tr>
<td>May 17</td>
<td>M</td>
<td>Final Grades for Non-graduating Students due by 4 p.m.</td>
</tr>
</tbody>
</table>

**Notes:**
- Exceptions for GSIA refer only to graduate programs.
The addendum to this catalog will be published in the summer of 2003 and bound in 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 administrators during the fall by way of campus mail. Additional copies of the catalog may be purchased at the bookstore.