2004-2006 Addendum

This addendum to the 2004-2006 Carnegie Mellon Undergraduate Catalog presents new academic programs as well as changes in existing programs and policies for the 2005-2006 academic year. The editorial staff apologizes that due to space limitations, certain material such as the addition of new faculty could not be included.

New programs are approved and existing programs are changed at various times throughout the year. The complete Undergraduate Catalog can be accessed via www.cmu.edu/esg-cat. The 2006-2008 catalog will be published during the summer of 2006. All changes and suggestions for improvement will be considered. Please direct your comments to:

William F. Elliott
Vice President for Enrollment

Cost of Attendance for 2005-2006

	Freshmen Fall 2005	Undergrads who Entered Fall 2003-2004	Undergrads who entered prior to Fall 2003
Resident			
Tuition	$31,650	$31,650	$31,186
Activity Fee	164	164	164
PAT Fee	70	70	70
Technology Fee	150	150	150
Media Fee	10	10	10
Orientation Fee - *freshmen*	190	0	0
Room [1]	5182	5182	5182
Dining	3724	3424	3424
Books & Supplies [3,4]	925	925	925
Personal & Misc.[4]	1295	1295	1295
Transportation [4]	0	0	0
TOTAL	$43,370	$42,870	$42,406
Commuter			
Tuition	$31,650	$31,650	$31,186
Activity Fee	164	164	164
PAT Fee	70	70	70
Technology Fee	150	150	150
Media Fee	10	10	10
Orientation Fee - *freshmen*	190	0	0
Dining [2]	1260	1260	1260
Books & Supplies [5]	925	925	925
Personal & Misc.[4]	1295	1295	1295
Transportation[4]	580	580	580
TOTAL	$36,294	$36,104	$35,640
Off-Campus			
Tuition		$31,650	$31,186
Activity Fee		164	164
PAT Fee		70	70
Technology Fee		150	150
Media Fee		10	10
Orientation - *freshmen*		0	0
Room		4682	4682
Dining		3424	3424
Books & Supplies [3,4]		925	925
Personal & Misc.[4]		1295	1295
Transportation [4]		0	0
TOTAL		$42,370	$41,906

[1] Based upon cost of a standard double room. Your actual cost may differ.

[2] The commuter dining amount is based upon a 9-meal/week plan + $10 in DineXtra.

[3] Design and Architecture students add an additional $470 for books/ supplies.

[4] These expenses will not appear on your Student Account Invoice. Transportation for resident and off-campus students varies based on home state.

NOTE: In addition, minimal health insurance coverage is required at an estimated cost of $921 per year, unless a waiver is granted because you are covered under your family's health plan. Premium health insurance coverage is suggested for international students at an estimated cost of $2,566 per year.

Campus Directory Additions/Changes

B.H.A. Intercollege Degree Program 268-8326/1745
B.S.A. Intercollege Degree Program 268-8326/1745

Student Affairs

Michael Murphy is no longer the Dean of Student Affairs. Jennifer Church will serve as the Interim Dean of Student Affairs.

University Policies

University Student-Defined Major Policy

The mission that a Carnegie Mellon degree will prepare a student to enter a professional track immediately upon graduation has been the historic reason that students are admitted directly into specified majors. This leads to intense and outstanding disciplinary education, including the skills for working with people in other disciplines and solving real-world, ill-defined problems. This "liberal, professional" education is interdisciplinary at the same time because real-world problems necessarily involve interaction between different disciplines. Research done at Carnegie Mellon also tends to be interdisciplinary for the same reason.

Carnegie Mellon also has numerous avenues by which a student can pursue study in more than one discipline. Degree programs such as BHA, BSA and SHS were designed to meet the interests of students who wish to combine studies in humanities *and* arts, sciences *and* arts, or in humanities *and* sciences. Several themes of study are available as minors. It is important to recognize that an additional major or a minor involves rigor in two fields and places more constraints on a student's program of study than a single major. So a Carnegie Mellon student wishing for a "broad" curriculum is advised to pursue a single major and exercise freedom in the choice of electives rather than opting for an additional major or minor.

In a few situations, however, the student may want to combine several areas of study, to study towards a coherent theme, or to combine subject areas that are not normally available in combination and span study in more than one college. In cases such as these, rare though they should be, the student may consider proposing a student-defined major. A student-defined major may be designed within one college (College student-defined major) or across colleges (University student-defined major). A student should resort to seeking a student-defined major **only** when no available combinations of current curricula match the student's aspirations exactly and the desired program of study is one that builds in-depth knowledge in at least one theme or area. The Associate Dean(s) of the respective involved college(s) is (are) responsible for approving a student-defined major and designating one college as the student's home college in the case of a University student-defined major. The Associate Dean(s) will also appoint an academic advisor for the student.

A University student-defined major is required to have the following characteristics in keeping with the philosophy of a Carnegie Mellon education:

(1) Satisfactory completion of the total number of units determined by the Associate Dean of the appropriate college on a case-by-case basis;

(2) Completion of a general education program approved by the student's advisor(s);

(3) Completion of an in-depth study in the area defined by the major.

A student interested in a student-defined major should initially seek advice from the Associate Dean of their current home college, and prepare a proposal for a program of study with their guidance. Courses that are reserved for students majoring in a department may not be available to a student-defined major. Thus, it is extremely important that the student outline a complete course of study for the entire student-defined major and, in addition, that the student consult with his/her advisor every semester to revise or reaffirm the major. It is also imperative that the student and advisor confirm the availability of courses with relevant departments.

It is important that the major area of study have a title that reflects the coherence in the combination of interest areas. With particular combinations of courses, the student may not be able to get a degree that connotes professional preparation such as a Bachelor of Fine Arts or a Bachelor of Science unless approved by the Associate Dean of that college. This is because the BFA and BS degree titles signify that the student has completed a certain number of studio or laboratory credits. Thus, the Bachelor of Arts (connoting a general degree) may be the only degree title that is possible to be awarded. The degree will be listed in the Commencement Program under the category of university interdisciplinary degrees. Students and their advisors will identify the most appropriate diploma ceremony for the student to attend and notify that department.

Degrees Offered Additions/Changes

College of Fine Arts
B.H.A. (jointly with the College of Humanities and Social Sciences)
B.S.A. (jointly with the Mellon College of Science)

College of Humanities and Social Sciences
B.H.A. (jointly with the College of Fine Arts)
B.S. in Economics and Statistics

Modern Languages
B.A. in Chinese

Psychology
B.S. in Cognitive Science
B.A. in Psychology
B.S. in Psychology
B.S. in Psychology and Biological Sciences*
* jointly sponsored with the Biological Sciences department
Ph.D. in Psychology
Ph.D. in Psychology and Behavioral Decision Research**
** jointly sponsored with the Social & Decision Sciences department

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

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

Addition
B.S.A. (jointly with the College of Fine Arts)

Undergraduate Admission

SAT I, ACT and SAT II Subject Tests have been replaced with SAT Reasoning, ACT with Writing and SAT Subject Tests.

Page 18: If you are selected for the BHA/BSA Program, you will be notified in the admission decision letter (as opposed to a separate letter).

Study Abroad
New Sponsored Study Abroad Programs: Dominican Republic and New Zealand

Mellon College of Science
Changed From
Enrollment in these unique programs is by invitation only for incoming first-year students, and by application for current students.
Changed To
Enrollment for the Science and Humanities program is by invitation only for incoming first-year students, and by application for current students.

Athletics and Physical Education
New Director: Susan Bassett

Intercollege
Removed
Page 86: Bachelor of Humanities and Arts Degree Program: Master of Information Systems Management (MISM) Accelerated Master's Program paragraph.

Carnegie Mellon Advising Resource Center
Formerly Carnegie Mellon Action Project (CMAP) Page 64

Background
The Carnegie Mellon Advising Resource Center (CMARC) was founded as Carnegie Mellon Action Project (CMAP) in 1968. Its original purpose was 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. In the spring of 2005 CMAP transitioned to the Carnegie Mellon Advising Resource Center (CMARC). After evaluating Carnegie Mellon's advising needs and adhering to new educational mandates, CMARC was established. It has refocused its advising efforts and broadened its audience, without losing sight of the university's commitment to diversity. CMARC is an advising and information center that assists students and connects them to appropriate communities, services and opportunities by providing academic planning and one-on-one counsel.

Identification and Recruitment
CMARC supports the university's commitment to attract and enroll a diverse student population. The office works in cooperation with the Office of Admission to identify talented students who wish to pursue degrees in any of the University's disciplines. CMARC assists in the recruiting process by coordinating the Summer Academy for Math and Science (SAMS), meeting with prospective students and parents, conducting information sessions and participating in campus visitation events.

Summer Academy for Mathematics and Science (SAMS)
One of seven pre-college programs at Carnegie Mellon, SAMS is designed to "make good students excellent." This six-week residential summer experience for juniors and seniors focuses on creating interest in technical disciplines, enhancing academic profiles and building personal competencies required for admission to competitive colleges and universities. It is for students considering careers in engineering, science or other math-based disciplines. Traditional classroom instruction along with creative "hands-on" projects, allow students to apply scientific concepts and principles.

Academic Advising
CMARC advisors, working in cooperation with faculty and departmental advisors, promote academic success. Their primary objective is to assist students in developing and achieving meaningful educational plans that are compatible with their life goals. They monitor students' performance throughout the school year, assist with course selection, and assure that students are making consistent progress towards graduation. CMARC supports the university's academic advising mission.

Leadership Development
CMARC seeks to prepare students to make a long term positive impact in their communities and workplace. We provide a variety of experiences that educate and train students in effective leadership principles. Emphasis is placed on ethical decision making and collaboration which are skills that can distinguish students in today's global competitive job market. Service learning opportunities are also made available.

Community Building
Establishing social and academic networks amongst peers is a major tenet of student retention. Research suggests that students who become an integral part of the campus community usually persist and graduate. CMARC assists students in establishing these connections by sponsoring a variety of activities. These informal interactions often help students understand the culture and unwritten rules of the institution.

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

Summary
CMARC's primary purpose is to build a supportive, intellectual and social community across diverse cultures. It exists as a place where student differences and talents are guided, appreciated and reinforced. Services are student centered and advisors seek to empower students to excel on their path to academic and personal success at Carnegie Mellon.

Carnegie Mellon Advising and Resource Center Staff
Mrs. Ty Walton, Director, tw0y@andrew.cmu.edu
Mr. Damian Dourado, Sr. Program Associate,
ddourado@andrew.cmu.edu
Mr. Demetreus Darden, Program Associate, dhd@andrew.cmu.edu
Office Hours: M – F, 9:00 a.m. – 5 p.m.
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Carnegie Institute of Technology

Educational Objectives
The overarching objective of our engineering curriculum is to provide our students an education that enables them to be productive and fulfilled professionals throughout their careers. Our more specific, measurable objectives for graduates of our engineering curriculum are the following:

- Graduates recognize that they acquired a high quality, rigorous technical education from the College of Engineering at Carnegie Mellon.
- Graduates, in addition to their technical knowledge, recognize that they have acquired a broader body of knowledge that allows them to understand the larger context of the problems that they must address during their career.
- Graduates use their technical foundation and their broader base of knowledge to be successful in a diverse collection of individual careers inside and outside of the engineering profession.

Page 102 "Notes"
The following course was added:
03-121 Modern Biology 9

"Introductory Engineering Course"
Biomedical Engineering 09-105 or 33-106
has been changed to:
Biomedical Engineering 03-121

Biomedical Engineering

The Biomedical Engineering curriculum has undergone significant modifications. Please see pages 524-533 for additional information.

Civil and Environmental Engineering

Educational Objectives
The objectives of the Bachelor of Science in Civil Engineering:

- Graduates meet both routine and unique professional challenges in Civil Engineering or other chosen career paths.
- Graduates work independently or as a productive member of a team.
- Graduates communicate effectively with other professionals and with society at large both in writing and in speech.
- Graduates are leaders, face a breadth of career challenges and practice life long learning.

Engineering and Public Policy

The comparitive curriculum charts on pages 144-149 have been modified substantially. See pages 534-539 for the new charts.

Materials Science and Engineering
New Department Head: Gregory Rohrer

Standard Program, Sophomore Year (Spring) - 27-205 has been added to this list as a 3 unit course. The number of units for 27-216 has been reduced to 9.
The number of MSE restricted electives has decreased from 48 to 45.
The number of units required for a degree has been decreased from 382 to 379.

Department of Biomedical Engineering

Dr. Todd Przybycien, Head
www.cmu.edu/cit/bme

Biomedical engineers apply engineering principles to advance our understanding of living systems and to improve human health. 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. To underscore this, we use a double major B.S. degree format for our undergraduate education program. Carnegie Institute of Technology (CIT) undergraduates will elect any one of these following majors jointly with Biomedical Engineering: Chemical Engineering, Civil & Environmental Engineering, Electrical & Computer Engineering, Materials Science & Engineering, or Mechanical Engineering. Each of the double major degree programs is designed to be completed in four, very full and rich, years.

The department has undertaken a significant undergraduate curriculum revision to better prepare our graduates to practice their chosen profession. These changes will apply to the entering Class of 2009 and beyond. The new curriculum is structured to provide both breadth and depth within biomedical engineering. Our graduates will have: a firm understanding of biology and physiology; the ability to apply advanced mathematics, science and engineering to solve problems at the interface between engineering and the life sciences; and the ability to make measurements on and interpret data from living systems addressing the problems associated with the interaction between living and non-living materials and systems.

Our new curriculum comprises three parts: the BME core, the BME track elective system and the BME capstone design course. All biomedical engineering double majors will share a common exposure to the many facets of biomedical engineering in the BME Intro, Professional Issues and Laboratory courses and will build a common life sciences background in the Modern Biology and Physiology courses that comprise the new BME core requirement.

Following the core is our track system. Each student will select a track to build depth within biomedical engineering in the bioimaging, biomaterials and tissue engineering, biomechanics, or cellular and molecular biotechnology areas. Bioimaging is the study of bio/medical phenomena based on the information provided in digital images. It draws upon advances in signal processing, optics, probe chemistry, molecular biology, and machine learning to provide answers to biological and medical questions from the growing numbers of biological and medical images acquired in digital form. This track aligns most naturally with BME/ECE double majors. A bioimaging specialist will have a broad background and can expect to find work in biomedical industrial labs, pursue further education by going to either graduate or medical school, or be employed by one of the numerous biomedical tech companies developing new instrumentation and/or algorithms for digital imaging.

The Biomaterials and Tissue Engineering track addresses fundamental issues at the interface of materials science, biology and engineering. The course work includes the design and development of materials for biological applications. Students will understand how materials, cells, tissues and organ systems interact and direct rational, practical therapeutic solutions for clinical issues. Characterization techniques for measuring the outcome of biomaterials and biological interactions will be included in the track. BME/ChE and BME/MSE are the most seamless double major matches. Job opportunities for the students trained in materials and tissue engineering include work in biotechnology industries or further studies in graduate or medical school. Significant opportunities are expected for engineers trained in the development and production of biological materials, medical devices, and combination drug-cell-material devices.

Biomechanics refers to the application of principles of solid, fluid, and continuum mechanics to the study of the structure, function, and behavior of biological and medical systems under the influence of mechanical forces. Biomechanics draws on advances in biology, continuum mechanics, experimentation, imaging, applied mathematics, and scientific computing. Biomechanics models provide quantitative descriptions of molecule, cell, tissue, organ, and whole organism behavior under mechanical stimuli, and are employed to characterize human health, disease, and injury. Biomechanics models are also used in the design of rehabilitative devices and strategies. BME/CEE and BME/ME double majors are strong matches with this track. A biomechanicist's broad background enables him or her to work in the medical device industry or as a rehabilitation engineer, or to conduct fundamental biomechanics modeling and experimental research, or to pursue medical or graduate school.

The Cellular and Molecular Biotechnology track emphasizes fundamentals and applications of biochemistry, biophysics, and cell biology. It is ideally suited to the BME/CHE double major, which provides a strong core of chemistry and molecular processing principles, and is also appropriate for BME/CEE and BME/ME double majors who have interests in molecular and cellular level detail. This track can also suit molecularly-oriented BME/ECE double majors with interests in biosensing. This track prepares students for careers or advanced education involving bio/pharmaceutical manufacture, pharmacology, medical diagnostics, biosensors, drug delivery devices, and biological aspects of environmental engineering. Students pursuing the Cellular and Molecular Biotechnology track will acquire a deeper understanding of the molecular and cellular bases for the life processes. One of the unique characteristics of this track is an emphasis on processes and structures occurring on the nanometer to micrometer size scale range. Students following this track will acquire insights and quantitative modeling skills needed to develop biotechnologies based on live cell cultures, as well as technologies that exploit the unique properties of biomolecules in non-biological settings.

Each track requires a track gateway course which provides a common foundation for all who choose that track. The gateway course is typically followed by three electives chosen from a longer list of track electives. A dynamic listing of available track electives is maintained on the departmental web site. The areas of biomedical engineering represented by these tracks correspond to those areas in which Carnegie Mellon has coordinated research strengths. As a result, the courses are taught by experts who have direct, current experience and active research in that specialty. While there are natural alignments between each track and the second major paired with biomedical engineering, there are no restrictions; all tracks are open to all double majors. A general biomedical engineering track is also available for those students intending on pursuing graduate studies or medical school.

The double major degree program culminates in the BME Design course. This course pulls together biomedical engineering students from all engineering backgrounds into design teams. The design teams tackle industry- and clinic-sponsored projects to develop products and product concepts relevant to human healthcare and the life sciences. These projects typically result in the production of a prototype and have resulted in patent applications and the pursuit of licensing opportunities.

Several questions naturally arise. Why the double major? Why not a stand-alone BME degree? Where's the medical school? Again, 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 polydisciplinary 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 the in-depth training in engineering fundamentals that the double major format affords. 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 and instructors from the University of Pittsburgh Medical Center, the Western Pennsylvania/Allegheny Hospital System and the Children's Hospital system. These collaborations reinforce the clinical relevance of our education and research activities. Our approach to education is very different from that of the biomedical engineering community at large. And as the number of biomedical engineering degree programs continues to grow, we expect that this difference, in particular the double major 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 applications. Participants in the minor program can choose from course offerings within the elective track system to build marketable skills in a particular area of biomedical engineering.

The dynamism of the biomedical engineering field has created an incredibly exciting environment for students, faculty and staff alike at Carnegie Mellon. We invite you to share your educational experience and this excitement with us.

Course Requirements for the Double Major Degree

The requirements include **five BME core courses, participation in a BME elective track consisting of a coherent program of four courses, and the BME Design course.** Core courses will be taken by all students to insure that a basic foundation is acquired in the life sciences and its vocabulary. The BME Intro and Laboratory courses are designed to provide broad exposure to the elective track areas and to help students choose an elective track in which to participate. The elective track sequence will allow students to explore in more depth an area of biomedical engineering that complements their second major; these courses are explicitly focused on technical aspects of biomedical engineering or the underpinning life sciences. The design course is a project course where students with some common background, yet different expertise, work on a substantial problem in biomedical engineering. Courses that can fulfill these requirements are listed below; sample curricula for several of the most common double majors are also provided.

Core Courses (all required)

42-101 Introduction to Biomedical Engineering
Fall and Spring
(coreq. or prereq.: 03-121)

42-201 Professional Issues in Biomedical Engineering
Fall and Spring

42-202 Physiology
Fall and Spring
(prereq.: 03-121 or permission of instructor)

42-203 Biomedical Engineering Laboratory
Fall and Spring
(prereqs.: 42-101 and 42-202; students may substitute 03-124 Modern Biology Laboratory to fulfill pre-medical requirements).

03-121 Modern Biology
Fall and Spring

Elective Tracks (participation in one track required)

The tracks areas are: Bioimaging (BIMG), Biomaterials and Tissue Engineering (BMTE), Biomechanics (BMEC), Cellular and Molecular Biotechnology (CMBT), and General Biomedical Engineering (GBME). Tracks courses include a "gateway" required track course taken typically during the junior year, in addition to three electives at the junior or senior level chosen from a set of track electives. A student may replace one track elective with a research project, either 42-200 Sophomore BME Research Project, 42-300 Junior BME Research Project, 42-400 Senior BME Research Project or 39-500 CIT Honors Thesis, as long as the research project is supervised by a regular or courtesy BME faculty member and the project is conducted for 9 or more units of credit.

BIMG Track

BIMG Gateway Course (required)

18-396 Signals and Systems- Spring

BIMG Electives (choose 3)

42-334 Introduction to Computational Biology-Spring
OR
42-434 Computational Biology- Spring
42-431/18-496 Bioimaging- Spring
42-731/18-799 Advanced Bioimaging- Fall
18-791 Digital Signal Processing 1- Fall
18-798 Image and Video Processing- Spring
42-735/16-725 Medical Image Analysis- Spring

BMTE Track

BMTE Gateway Course (required)

03-232 Biochemistry
Spring (MSE double majors may substitute 03-231)

BMTE Electives (choose 2)

03-240 Cell Biology
Spring

09-217 Organic Chemistry
Fall

09-218 Organic Chemistry II
Spring

42-311/
27-510 Polymeric Biomaterials
Spring

42-312/
27-511 Metallic and Ceramic Biomaterials
Fall

42-413 Biomaterial Interfaces
Spring

42-424 Biological Transport
Spring

BMTE Capstone Course (required)

42-419 Biomaterial/Host Interactions
Fall

BMEC Track

BMEC Gateway Course (required)

42-341 Introduction to Biomechanics
Spring

BMEC Electives (choose 3)

42-312/
27-511 Metallic and Ceramic Biomaterials
Spring

42-424 Biological Transport
Spring

42-441 Cardiovascular Biomechanics
Fall

42-444 Medical Devices
Spring

42-347 Rehabilitation Engineering
Fall

42-502 Cellular Biomechanics
Spring

BIOE 1720 Biomechanics II: Biodynamics of Movement
[University of Pittsburgh Bioengineering course]

BIOE 1064 Biomechanics III: Tissues and Organs
[University of Pittsburgh Bioengineering course]

CMBT Track

CMBT Gateway Course (required)

42-321 Cellular and Molecular Biotechnology
Spring

CMBT Electives (choose 3)

03-232 Biochemistry
Spring

03-240 Cell Biology
Spring

42-422 Bioprocess Design
Spring

42-424 Biological Transport
Spring

42-426 Biosensors and BioMEMS
Spring

42-502 Cellular Biomechanics
Spring

42-723/
12-723 Biological Processes in Environmental Systems
Spring

GBME Track

Four courses selected from any of those listed with the BIMG, BMTE, BMEC or CMBT tracks above. At least one of the selected courses must be a track gateway course.

Capstone Design Course (required)

42-401 BME Design
Spring
Prereq.: Senior BME double-major status

Undergraduate Course Requirements for the Minor

For CIT students

General Requirements:
(five courses, minimum of 48 units)

42-101 Introduction to Biomedical Engineering
(coreq. or prereq.: 03-121)
42-202 Physiology
(prereq.: 03-121 or permission of instructor)
03-121 Modern Biology
BME track course
BME track course

For non-CIT students

General Requirements: (six courses, minimum of 60 units).

42-101 Introduction to Biomedical Engineering
(coreq. or prereq.: 03-121)

A second Introductory Engineering Course

42-202 Physiology
(prereq.: 03-121 or permission of instructor)
03-121 Modern Biology

*BME track course
**BME track course

***** This course **cannot** be a required course in your home department
****** This course must be offered by one of the CIT Departments (06-xxx, 12-xxx, 18-xxx,19-xxx, 24-xxx, 27-xxx or 42-xxx)

Both CIT and non-CIT students may replace one BME track course in the minor program with a research project, either 42-200 Sophomore BME Research Project, 42-300 Junior BME Research Project, 42-400 Senior BME Research Project or 39-500 CIT Honors Thesis, as long as the research project is supervised by a regular or courtesy BME faculty member and the project is conducted for 9 or more units of credit.

Advising

Each student who declares a BME double major or minor will be assigned a BME faculty member as an academic advisor; for double majors, this may be in addition to an advisor assigned in the second CIT department. Faculty members associated with other departments may also serve as information resources for those students contemplating participation in the double major or minor program. By department, these faculty members include:

Biological Sciences: Profs. Amy Burkert; Robert Murphy
Chemical Engineering: Profs. Michael Domach, Steinar Hauan, Todd Przybycien, James Schneider, and Robert Tilton
Chemistry: Prof. Newell Washburn
Civil & Environmental Engineering: Prof. Jeanne VanBriesen
Electrical & Computer Engineering: Profs. Jelena Kovacevic, José Moura and Richard Stern
Materials Science & Engineering: Profs. Prashant Kumta and Lisa Porter
Mechanical Engineering: Profs. Cristina Amon, Jim Antaki, Jonathan Cagan and Phil LeDuc

Mrs. Hilda Diamond, located in Doherty Hall 2100, will also help with aspects of advising and attention to details, including student course requirements, scheduling of BME courses and working with departments to avoid conflicts. Coordination of advising with a double major's second engineering department is essential. Note that for double majors, the second engineering department advisor must approve final schedules. Prof. Przybycien and Mrs. Diamond will serve as advisors to BME Minor program students from the SCS and H&SS colleges.

If you are a double major in Biomedical Engineering:

1. Always select your Engineering Core Courses First!
Many times it becomes very difficult to make up these courses, as they will inevitably conflict with required courses expected to be taken in subsequent years. In a few majors, BME substitutions occur for a few core courses. If you are ahead of schedule, consult with your advisor about possible options.

2. Make sure you take the BME required (core) courses as soon as possible.

Again, the likelihood of a major conflict increases if you wait, as these courses are scheduled so as to minimize conflicts in the year and semester they are most likely to be taken.

3. 42-101 Introduction to Biomedical Engineering should be taken, ideally, in the freshman year. If this is not possible, the fall of the sophomore year is the next best choice.

4. Minimum units to graduate.
Double majors must satisfy the minimum course requirements established by the second major department to graduate.

5. QPA requirements:
The QPA for BME core, track and design courses must be 2.00 or better to graduate with the BME double major. In addition, CIT has the following requirement for graduation: "A student must also achieve a cumulative quality point average of 2.00 in a series of core courses, up to a maximum of 184 units, specified by the department. When more than one possibility exists for meeting a specific requirement (e.g., Breadth), the courses will be chosen as to maximize the QPA. Similarly, when a course is retaken, the better grade will be used in the computation of the minimum QPA in the above courses."

Sample Schedule for BME-ECE Double Majors in the BIMG Track

Electrical & Computer Engineering

First Year

	Fall	Units
18-100	Intro to ECE	12
15-100	Introductory/Intermediate Programming	10
21-115	Differential Calculus	5
21-116	Integral Calculus	5
xx-xxx	General Education Course	9
99-101	Computing Skills Workshop	3
		44
	Spring	
xx-xxx	Intro. to Engineering Course	12
33-106	Physics I for Engineers	12
21-117	Integration & Differential Equations	5
21-118	Calculus of Approximation	5
76-xxx	Designated Writing Course	9
		43

Second Year

	Fall	Units
18-220	Fundamentals of Electrical Engineering	12
18-202	Mathematical Foundations of EE	12
33-107	Physics II for Engineers	12
xx-xxx	General Education Course	9
		45
	Spring	
18-240	Fundamentals of Computer Engineering	12
21-127	Concepts of Mathematics	9
xx-xxx	ECE Breadth Course I	12
xx-xxx	General Education Course	9
		42

Third Year

	Fall	Units
xx-xxx	ECE Breadth Course 2	12
xx-xxx	ECE Breadth Course 3	12
36-xxx	Probability and Statistics	9
xx-xxx	Math/Science Elective 1	9
xx-xxx	General Education Course	9
		51
	Spring	
18-380	Junior Seminar	0
xx-xxx	ECE Depth Course	12
xx-xxx	ECE Coverage Course 1	12
xx-xxx	Engineering Elective	12
xx-xxx	General Education Course	9
		45

Fourth Year

	Fall	Units
xx-xxx	Capstone Design	12
xx-xxx	Math/Science Elective 2	9
xx-xxx	Free Elective	6
xx-xxx	Free Elective	9
xx-xxx	General Education Course	9
		45
	Spring	
xx-xxx	Free Elective	12
xx-xxx	Free Elective	12
xx-xxx	Free Elective	12
xx-xxx	General Education Course	9
		45

Electrical & Computer Engineering and BME

First Year

	Fall	Units
18-100	Intro. to ECE	12
15-100	Introductory/Intermediate Programming	10
21-115	Differential Calculus	5
21-116	Integral Calculus	5
xx-xxx	General Education Course	9
99-101	Computing Skills Workshop	3
		44
	Spring	
42-101	**Intro. to BME**	**12**
33-106	Physics I for Engineers	12
21-117	Integration & Differential Equations	5
21-118	Calculus of Approximation	5
03-121	**Modern Biology**	**9**
		43

Second Year

	Fall	Units
18-220	Fundamentals of Electrical Engineering	12
18-202	Mathematical Foundations of EE	12
33-107	Physics II for Engineers	12
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
18-200	Emerging Trends in ECE	1
		46
	Spring	
18-240	Fundamentals of Computer Engineering	12
21-127	Concepts of Mathematics	9
xx-xxx	ECE Breadth Course I	12
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
42-201	**Professional Issues in BME**	**3**
		45

Third Year

	Fall	Units
18-396	**Signals and Systems**	**12**
xx-xxx	ECE Breadth Course 3	12
36-xxx	Probability and Statistics	9
76-xxx	Designated Writing Couse	9
xx-xxx	General Education Course	9
		51
	Spring	
xx-xxx	ECE Depth Course	12
xx-xxx	ECE Coverage Course 1	12
42-xxx	**BIMG Track Elective**	**12**
xx-xxx	General Education Course	9
		45

Fourth Year

	Fall	Units
42-xxx	**BIMG Track Elective**	**12**
42-xxx	**BIMG Track Elective**	**9**
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
		48
	Spring	
42-401	**BME Design**	**12**
18-5xx	Capstone Design	12
xx-xxx	General Education Course	12
xx-xxx	General Education Course	9
		45

- The bolded courses are BME courses for the double major.
- The track requirement course is 18-396 and must be taken for the Bioimaging track.
- You must take 3 courses designated as Bioimaging Electives to satisfy track requirements. Four are noted in the schedule to give you flexibility, you have to take three. These courses must be taken from the following list:
  1. 42-334 Introduction to Computational Biology (S,9) OR 42-434 Computational Biology (S,9)
  2. 42-431 Bioimaging (S,9)
  3. 42-731 Advanced Bioimaging (F,12)
  4. 42-735 Medical Image Analysis (S,12) (16-725)
  5. 18-791 DSP 1 (F,12)
  6. 18-798 Image and Video Processing (S,12)

Minimum number of units for degree: 367

Sample Schedule for BME-MSE Double Majors in the BMTE Track

Materials Science & Engineering

First Year

	Fall	Units
21-120	Differential & Integral Calculus	10
33-106	Physics I for Engineers	12
27-100	Materials in Engineering	12
xx-xxx	General Education Elective	9
		43
	Spring	
21-122	Integration, Differential Equations, and Approximations	10
15-100	Intro/Intermediate Programming	10
99-101	Computer Skills Workshop	3
xx-xxx	Introductory Engineering Elective	12
xx-xxx	General Education Elective	9
		44

Second Year

	Fall	Units
21-259	Calculus in Three Dimensions	9
27-201	Structure of Materials	9
27-202	Defects in Materials	9
27-215	Thermodynamics of Materials	12
27-299	Professional Development I	1
33-107	Physics II for Engineers	12
21-126	Intro to Mathematical Software	3
		55
	Spring	
09-101	Introduction to Experimental Chemistry	3
09-105	Modern Chemistry I	10
21-260	Differential Equations	9
27-205	Materials Characterization Lab	3
27-216	Transport in Materials	9
27-217	Phase Relations and Diagrams	12
xx-xxx	General Education Course	9
		55

Third Year

	Fall	Units
27-399	Professional Development II	1
27-301	Microstructure and Properties I	9
27-367	Selection and Performance	6
33-225	Quantum Physics & Structure of Matter	9
-or-		
09-217	Organic Chemistry	9
-or-		
03-121	Modern Biology	9
xx-xxx	Free Elective	9
27-xxx	MSE Restricted Elective	6
xx-xxx	General Education Elective	9
		49
	Spring	
36-220	Engineering Statistics & Quality Control	9
xx-xxx	General Education Elective	9
xx-xxx	Free Elective	9
xx-xxx	Free Elective	9
27-xxx	MSE Restricted Elective	6
27-xxx	MSE Restricted Elective	6
		48

Fourth Year

	Fall	Units
27-401	MSE Capstone I	12
27-499	Professional Development III	1
xx-xxx	Free Elective	9
xx-xxx	General Education Elective	9
xx-xxx	General Education Elective	9
27-xxx	MSE Restricted Elective	6
27-xxx	MSE Restricted Elective	6
		52
	Spring	
xx-xxx	Free Elective	9
27-xxx	MSE Restricted Elective	6
27-xxx	MSE Restricted Elective	6
27-xxx	MSE Restricted Elective	6
xx-xxx	General Education Elective	9
		36

Materials Science and Engineering and BME

First Year

	Fall	Units
21-120	Differential and Integral Calculus	10
33-106	Physics I for Engineers	12
27-100	Materials in Engineering	12
03-121	**Modern Biology**	**9**
		43
	Spring	
21-122	Integration, Differential Equations and Approximations	10
15-100	Intro/Intermediate Programming	10
99-101	Computer Skills Workshop	3
42-101	**Intro to Biomedical Engineering**	**12**
33-107	Physics II for Engineers	12
		47

Second Year

	Fall	Units
21-259	Calculus in Three Dimensions	9
27-201	Structure of Materials	9
27-202	Defects in Materials	9
27-215	Thermodynamics of Materials	12
27-299	Professional Development I	1
21-126	Intro to Mathematical Software	3
42-201	**Professional Issues in BME**	**3**
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		55
	Spring	
09-101	Introduction to Experimental Chemistry	3
09-105	Modern Chemistry I	10
21-260	Differental Equations	9
27-205	Materials Characterization Lab	3
27-216	Transport in Materials	9
27-217	Phase Relations and Diagrams	12
42-202	**Physiology**	**9**
-or-		
42-203	**BME Lab**	**9**
		55

Third Year

	Fall	Units
27-399	Professional Development II	1
27-301	Microstructure and Properties I	9
27-367	Selection and Performance	6
09-217	Organic Chemistry	9
xx-xxx	General Education Elective	9
03-231	**Biochemistry**	**9**
xx-xxx	General Education Course	9
		52
	Spring	
36-220	Engineering Statistics and Quality Control	9
42-xxx	BMTE Track Elective	9
xx-xxx	General Education Elective	9
xx-xxx	General Education Elective	9
27-xxx	MSE Restricted Elective	9
27-xxx	MSE Restricted Elective	9
		54

Fourth Year

	Fall	Units
27-401	MSE Capstone I	12
27-499	Professional Development III	1
42-419	**Host/Biomaterial Interactions**	**9**
xx-xxx	General Education Elective	9
xx-xxx	General Education Elective	9
27-xxx	MSE Restricted Elective	9
		49
	Spring	
27-xxx	MSE Restricted Elective	9
42-401	**BME Design**	**12**
42-xxx	**BMTE Track Elective**	**9**
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
		48

This Biomaterials and Tissue Engineering track requires Biochemistry (03-232) and two track electives chosen from: Polymeric Biomaterials (42-311); Metallic and Ceramic Biomaterials (42-312); Biomaterial Interfaces (42-413); Biological Transport (42-424); Cell Biology (03-240); Organic Chemistry II (09-218). Also, Organic Chemistry (09-217) should be chosen from the three science course options in the Fall of the Junior Year.

Minimum number of units for degree: 403

Sample Schedule for BME-CEE Double Majors in the BMEC Track

Civil & Environmental Engineering

First Year

	Fall	Units
12-100	Intro. to Civil & Environmental Engineering	12
21-120	Differential & Integral Calculus	10
33-106	Physics I for Engineers	12
99-101	Computing Skills Workshop	3
xx-xxx	H&SS Elective	9
		46
	Spring	
xx-xxx	Introduction to Engineering	12
21-122	Integration, Differential Equations and Approximations	10
33-107	Physics II for Engineers	12
xx-xxx	H&SS Elective	9
		43

Second Year

	Fall	Units
12-251	Intro. to Environmental Engineering	9
12-252	Environmental Engineering Lab	3
12-271	Intro. to Computer Apps in Civil & Environmental Engineering	9
09-101	Intro to Experimental Chemistry	3
09-105	Modern Chemistry I	10
xx-xxx	H&SS Elective	9
		43
	Spring	
12-235	Statics	9
21-260	Differential Equations	9
15-100	Intro/Intermediate Programming	10
xx-xxx	H&SS or CFA Elective	9
xx-xxx	Elective	9
		46

Third Year

	Fall	Units
12-301	Civil & Environmental Engineering Projects	12
12-331	Solid Mechanics	9
12-332	Solid Mechanics Lab	3
27-357	Materials Selection	9
xx-xxx	H&SS or CFA Elective	9
21-259	Calculus in 3-D	9
		51
	Spring	
12-355	Fluid Mechanics	9
12-356	Fluid Mechanics Lab	3
12-335	Soil Mechanics	9
12-336	Soil Mechanics & Materials Lab	3
xx-xxx	H&SS or CFA Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
		51

Fourth Year

	Fall	Units
12-401	Civil & Environmental Engineering Design	12
12-411	Engineering Economics	9
36-220	Eng Statistics & Quality Control	9
xx-xxx	H&SS or CFA Elective	9
xx-xxx	Elective	9
		48
	Spring	
xx-xxx	H&SS or CFA Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
		45

Civil & Environmental Engineering and BME

First Year

	Fall	Units
12-100	Intro to Civil & Environmental Engineering	12
21-120	Differential & Integral Calculus	10
33-106	Physics I for Engineers	12
99-101	Computing Skills Workshop	3
xx-xxx	General Education Course	9
		46
	Spring	
42-101	**Intro to Biomedical Engineering**	**12**
21-122	Integration, Differential Equations & Approximations	10
33-107	Physics II for Engineers	12
03-121	**Modern Biology**	**9**
xx-xxx	General Education Course	9
		52

Second Year

	Fall	Units
12-251	Intro to Environmental Engineering	9
12-252	Environmental Engineering Lab	3
12-271	Intro to Computer Apps in Civil & Environmental Engineering	9
09-101	Intro to Experimental Chemistry	3
09-105	Modern Chemistry I	10
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
42-201	**Professional Issues in BME**	**3**
		46
	Spring	
12-235	Statics	9
21-260	Differential Equations	9
15-100	Intro/Intermediate Programming	10
xx-xxx	General Education Course	9
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		46

Third Year

	Fall	Units
12-301	Civil & Environmental Engineering Projects	12
12-331	Solid Mechanics	9
12-332	Solid Mechanics Lab	3
27-357	Materials Selection	6
12-358	Materials Lab	3
xx-xxx	General Education Course	9
21-259	Calculus in 3-D	9
		51
	Spring	
12-355	Fluid Mechanics	9
12-356	Fluid Mechanics Lab	3
12-335	Soil Mechanics	9
12-336	Soil Mechanics & Materials Lab	3
42-341	**Introduction to Biomechanics**	**9**
42-xxx	General Education Course	9
xx-xxx	General Education Course	9
		51

Fourth Year

	Fall	Units
12-401	Civil & Environmental Engineering Design	12
12-411	Engineering Economics	9
36-220	Engineering Statistics & Quality Control	9
xx-xxx	General Education Course	9
42-4xx	**BMEC Track Elective**	**9**
		48
	Spring	
xx-xxx	General Education Course	9
12-xxx	CEE Upper Level Elective	9
42-xxx	**BMEC Track Elective**	**9**
42-xxx	**BMEC Track Elective**	**9**
42-401	**BME Design**	**12**
		48

Three Biomechanics electives must be chosen from: 42-312 Metallic and Ceramic Biomaterials; 42-424 Biological Transport; 42-441 Cardiovascular Biomechanics; 42-444 Medical Devices; 42-453 Rehabilitation Engineering; 42-502 Cellular Biomechanics; BIOE 1720 Biomechanics II: Biodynamics of Movement (Univ of Pittsburgh Dept of Bioengineering); and BIOE 1064 Biomechanics III: Tissues and Organs (University of Pittsburgh Dept of Bioengineering).

Minimum number of units required for degree: 388.

Sample Schedule for BME-ME Double Majors in the BMEC Track

Mechanical Engineering

First Year

	Fall	Units
21-120	Differential & Integral Calculus	10
24-101	Fundamentals of Mechanical Engineering	12
33-106	Physics for Engineering Students	12
99-101	Computing Skills Workshop	3
xx-xxx	Writing/Expression Course	9
		46
	Spring	
21-122	Integration, Differential Equations & Approximations	10
xx-xxx	Introductory Engineering Electives	12
xx-xxx	Restricted Technical Elective	10-13
xx-xxx	General Education Course	9
		41-44

Second Year

	Fall	Units
21-259	Calculus in Three Dimensions	9
24-221	Thermodynamics I	10
24-261	Statics	10
xx-xxx	Restricted Technical Elective	10-13
xx-xxx	General Education Course	9
		48-51
	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

Third Year

	Fall	Units
24-302	Mechanical Engineering Seminar I	1
24-311	Numerical Methods	9
24-322	Heat Transfer	10
24-351	Dynamics	12
24-xxx	ME Technical Elective	9-12
xx-xxx	General Education Course	9
		50-53
	Spring	
24-371	Electromechanical Systems	10
24-303	Mechnical Engineering Seminar II	1
24-321	Thermal-Fluids Engineering	12
24-352	Dynamic Systems Course	12
xx-xxx	General Education Course	9
		44

Fourth Year

	Fall	Units
24-441	Mechanical Eng. Design	12
xx-xxx	Free Elective	9
xx-xxx	Free Elective	9
xx-xxx	Free Elective	9
xx-xxx	General Education Course	9
		48
	Spring	
24-401	Engineering Analysis	12
24-xxx	ME Technical Elective	9-12
xx-xxx	Free Elective	9
xx-xxx	Free Elective	9
xx-xxx	General Education Course	9
		48-51

Mechanical Engineering and BME

First Year

	Fall	Units
21-120	Differential & Integral Calculus	10
24-101	Fundamentals of Mechanical Engineering	12
33-106	Physics for Engineering Students	12
99-101	Computing Skills Workshop	3
xx-xxx	Writing/Expression Course	9
		46
	Spring	
21-122	Integration, Differential Equations & Approximations	10
42-101	**Introduction to BME**	**12**
xx-xxx	Restricted Technical Elective	10-13
03-121	**Modern Biology**	**9**
xx-xxx	General Education Course	9
		50-53

Second Year

	Fall	Units
21-259	Calculus in Three Dimensions	9
24-221	Thermodynamics I	10
24-261	Statics	10
xx-xxx	Restricted Technical Elective	10-13
41-201	**Professional Issues in BME**	**3**
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		51-54
	Spring	
21-260	Differential Equations	9
24-231	Fluid Mechanics	10
24-262	Stress Analysis	12
xx-xxx	Restricted Technical Elective	10-13
42-404	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		50-53

Third Year

	Fall	Units
24-311	Numerical Methods	9
24-322	Heat Transfer	10
24-351	Dynamics	12
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
		49
	Spring	
24-371	Electromechanical Systems	10
24-321	Thermal-Fluids Engineering	12
24-352	Dynamic Systems Control	12
42-341	**Introduction to Biomechanics**	**9**
24-302	Mechanical Engineering Seminar	2
		45

Fourth Year

	Fall	Units
24-441	Engineering Design	12
42-xxx	**BMEC Track Elective**	**9**
42-xxx	**BMEC Track Elective**	**9**
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
		48
	Spring	
42-401	**BME Design**	**12**
24-xxx	**BMEC Track Elective**	**9**
24-xxx	ME Technical Elective	9-12
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
		48-51

* As a double major, you should take 24-441 ME Design in Fall and 42-401 BME Design in Spring (sr.)
42-401 BME Design replaces 24-401 Engineering Analysis for the MechE-BME Double Majors. Three Biomechanics electives must be chosen from: 42-312 Metallic and Ceramic Biomaterials; 42-424 Biological Transport; 42-441 Cardiovascular Biomechanics; 42-444 Medical Devices; 42-453 Rehabilitation Engineering; 42-502 Cellular Biomechanics; BIOE 1720 Biomechanics II: Biodynamics of Movement (Univ of Pittsburgh Dept of Bioengineering); and BIOE 1064 Biomechanics III: Tissues and Organs (Univ of Pittsburgh Dept of Bioengineering). At least one CMBT elective chosen should also satisfy the second 24-xxx ME Technical Elective.
Minimum number of units for degree: 393

Sample Schedule for BME-ChE Double Majors in the CMBT Track

Chemical Engineering

First Year

	Fall	Units
21-120	Differential & Integral Calculus	10
76-xxx	Designated Writing Course	9
99-101	Computing Skills Workshop	3
06-100	Intro. to Chemical Engineering	12
09-105	Modern Chemistry	10
		44
	Spring	
21-122	Integration, Differential Equations & Approximations	10
xx-xxx	Intro. to Engineering Course	12
33-106	Physics I for Engineers	12
xx-xxx	General Education Course	9
		43

Second Year

	Fall	Units
06-222	Sophomore ChemE Seminar	1
21-259	Calculus in Three Dimensions	9
06-221	Thermodynamics	9
09-106	Modern Chemistry II	10
15-100	Introductory/Intermediate Programming	10
xx-xxx	General Education Course	9
		48
	Spring	
06-261	Fluid Mechanics I	9
06-262	Math: Methods of Chem. Engineering	12
09-221	Lab I: Introduction to Chemical Analysis	12
33-107	Physics II for Engineers	12
xx-xxx	General Education Course	9
		54

Third Year

	Fall	Units
06-321	Chemical Engineering Thermodynamics	9
06-322	Junior ChemE Seminar	2
06-323	Heat and Mass Transfer	9
09-217	Organic Chemistry I	9
09-347	Advanced Physical Chemistry	12
xx-xxx	General Education Course	9
		50
	Spring	
06-361	Unit Operations of ChemE	9
06-362	Chemical Engineering Process Control	9
06-363	Process Laboratory	6
02-232	Biochemistry	9
xx-xxx	Elective	9
xx-xxx	General Education Course	9
		51

Fourth Year

	Fall	Units
06-421	Chemical Process System Design	12
06-422	Chemical Reaction Engineering	9
06-423	Unit Operations Laboratory	9
xx-xxx	Elective	9
xx-xxx	General Education Course	9
		48
	Spring	
06-461	Process Design Project	6
06-462	Economics & Optimization	6
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxxs	General Education Course	9
		48

Chemical Engineering and BME

First Year

	Fall	Units
21-120	Differential & Integral Calculus	10
76-xxx	Designated Writing Course	9
99-101	Computing Skills Workshop	3
06-100	Intro. to Chemical Engineering	12
09-105	Modern Chemistry	10
		44
	Spring	
21-122	Integration, Differential Equations & Approximations	10
42-101	**Intro. to Biomedical Engineering**	**12**
33-106	Physics I for Engineers	12
03-121	**Modern Biology**	**9**
xx-xxx	General Education Course	9
		52

Second Year

	Fall	Units
06-222	Sophomore ChemE Seminar	1
21-259	Calculus in Three Dimensions	9
06-221	Thermodynamics	9
09-106	Modern Chemistry II	10
15-100	Introductory/Intermediate Programming	10
42-201	**Professional Issues in BME**	**3**
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		51
	Spring	
06-261	Fluid Mechanics I	9
06-262	Math: Methods of Chem. Engineering	12
09-221	Lab I: Introduction to Chemical Analysis	12
33-107	Physics II for Engineers	12
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		54

Third Year

	Fall	Units
06-321	Chemical Engineering Thermodynamics	9
06-323	Heat and Mass Transfer	9
09-217	Organic Chemistry I	9
09-347	Advanced Physical Chemistry	12
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
		57
	Spring	
06-361	Unit Operations of ChemE	9
06-362	Chemical Engineering Process Control	9
06-363	Transport Process Laboratory	6
03-232	**Biochemistry**	**9**
42-321	Cellular & Molecular Biotechnology	9
xx-xxx	General Education Course	9
		51

Fourth Year

	Fall	Units
06-421	Chemical Process System Design	12
06-422	Chemical Reaction Engineering	9
06-423	Unit Operations Laboratory	9
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
		48
	Spring	
06-461	Process Design Project	6
06-462	Economics & Optimization	6
42-401	**BME Design**	**12**
xx-xxx	**CMBT Track Elective***	**9**
xx-xxx	**CMBT Track Elective***	**9**
xx-xxx	General Education Course	9
		51

*Cellular and Molecular Biotechnology Electives: Choose from 42-422 Bioprocess Design, 42-424 Biological Transport, 42-426 Biosensors and BioMEMS, 42-502 Cellular Biomechanics, 42-723/12-723 Biological Processes in Environmental Systems and 03-240 Cell Biology. (03-232 Biochemistry counts as both a required course for ChE and a CMBT track elective.)

Minimum number of units for degree: 408

Sample Schedule for BME-CEE Double Majors in the CMBT Track

Civil & Environmental Engineering

First Year

	Fall	Units
12-100	Intro. to Civil & Environmental Eng.	12
21-120	Differential & Integral Calculus	10
33-106	Physics I for Engineers	12
99-101	Computing Skills Workshop	3
xx-xxx	General Education Course	9
		46
	Spring	
xx-xxx	Introduction to Engineering	12
21-122	Integration, Differential Equations & Approximations	10
33-107	Physics II for Engineers	12
xx-xxx	General Education Course	9
		43

Second Year

	Fall	Units
12-251	Intro. to Environmental Engineering	9
12-252	Environmental Engineering Lab	3
12-271	Intro. to Computer Apps in Civil & Environmental Engineering	9
09-101	Intro.to Experimental Chemistry	3
09-105	Modern Chemistry I	10
xx-xxx	General Education Course	9
		43
	Spring	
12-235	Statics	9
21-260	Differential Equations	9
15-100	Introductory/Intermediate Programming	10
xx-xxx	General Education Course	9
xx-xxx	Elective	9
		46

Third Year

	Fall	Units
12-301	Civil & Environmental Eng. Projects	12
12-331	Solid Mechanics	9
12-332	Solid Mechanics Lab	3
27-357	Materials Selection	6
12-358	Materials Lab	3
xx-xxx	General Education Course	9
21-259	Calculus in 3-D	9
		51
	Spring	
12-355	Fluid Mechanics	9
12-356	Fluid Mechanics Lab	3
12-335	Soil Mechanics	9
12-336	Soil Mechanics & Materials Lab	3
xx-xxx	General Education Course	9
xx-xxx	Elective	9
xx-xxx	Elective	9
		51

Fourth Year

	Fall	Units
12-401	Civil & Environmental Eng. Design	15
12-411	Engineering Economics	6
36-211	Probability & Statistics	9
-or-		
36-220	Engineering Statistics & Quality Control	
xx-xxx	General Education Course	9
xx-xxx	Elective	9
		48
	Spring	
xx-xxx	General Education Course	9
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
		45

Civil & Environmental Engineering and MBE

First Year

	Fall	Units
12-100	Intro. to Civil & Environmental Eng.	12
21-120	Differential & Integral Calculus	10
33-106	Physics I for Engineers	12
99-101	Computing Skills Workshop	3
xx-xxx	General Education Course	9
		46
	Spring	
42-101	**Into. to Biomedical Engineering**	**12**
21-122	Integration, Differential Equations & Approximations	10
33-107	Physics II for Engineers	12
03-121	**Modern Biology**	**9**
xx-xxx	General Education Course	9
		52

Second Year

	Fall	Units
12-251	Intro. to Environmental Engineering	9
12-252	Environmental Engineering Lab	3
12-271	Intro. to Computer Apps in Civil & Environmental Engineering	9
09-101	Intro. to Experimental Chemistry	3
09-105	Modern Chemistry I	10
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		43
	Spring	
12-235	Statics	9
21-260	Differential Equations	9
15-100	Introductory/Intermediate Programming	10
xx-xxx	General Education Course	9
42-201	**Professional Issues in BME**	**3**
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		49

Third Year

	Fall	Units
12-301	Civil & Environmental Eng. Projects	12
12-331	Solid Mechanics	9
12-332	Solid Mechanics Lab	3
27-357	Materials Selection	6
12-358	Materials Lab	3
xx-xxx	General Education Course	9
21-259	Calculus in 3-D	9
		51
	Spring	
12-355	Fluid Mechanics	9
12-356	Fluid Mechanics Lab	3
12-335	Soil Mechanics	9
12-336	Soil Mechanics & Materials Lab	3
42-321	**Cellular & Molecular Biotech**	**9**
xx-xxx	General Educaton Course	9
xx-xxx	General Educaton Course	9
		51

Fourth Year

	Fall	Units
12-401	Civil & Environmental Eng. Design	15
12-411	Engineering Economics	6
36-211	Probability & Statistics	9
-or-		
36-220	Engineering Statistics & Quality Control	9
12-xxx	CEE Upper Level Elective	9
xx-xxx	General Education Course	9
		48
	Spring	
xx-xxx	**CMBT Track Elective***	**9**
xx-xxx	**CMBT Track Elective***	**9**
xx-xxx	**CMBT Track Elective***	**9**
42-401	**BME Design**	**12**
xx-xxx	General Education Course	9
		48

* Cellular and Molecular Biotechnology Electives: Choose from 42-422 Bioprocess Design, 42-424 Biological Transport, 42-426 Biosensors and BioMEMS, 42-502 Cellular Biomechanics, 42-723/12-723 Biological Processes in Environmental Systems and 03-240 Cell Biology. (03-232 Biochemistry counts as both a required course for ChE and a CMBT track elective.)

Minimum number of units for degree: 388.

Sample Schedule for BME-ME Double Majors in the CMBT Track

Mechanical Engineering

First Year

	Fall	Units
21-120	Differential & Integral Calculus	10
24-101	Fundamentals of Mechanical Eng.	12
33-106	Physics for Engineering Students	12
99-101	Computing Skills Workshop	3
xx-xxx	Writing/Expression Course	9
		46
	Spring	
21-122	Integration, Differential Equations & Approximations	10
xx-xxx	Introductory Engineering Elective	12
xx-xxx	Restricted Technical Elective	10-13
xx-xxx	General Education Course	9
		41-44

Second Year

	Fall	Units
21-259	Calculus in Three Dimensions	9
24-221	Thermodynamics I	10
24-261	Statics	10
xx-xxx	Restricted Technical Elective	10-13
xx-xxx	General Education Course	9
		48-51
	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

Third Year

	Fall	Units
24-302	Mechanical Engineering Seminar I	1
24-311	Numerical Methods	9
24-322	Heat Transfer	10
24-351	Dynamics	10
24-xxx	MechE Technical Elective	9-12
xx-xxx	General Education Course	9
		48-51
	Spring	
24-371	Electromechanical Systems	10
24-303	Mechanical Engineering Seminar II	1
24-321	Thermal-Fluids Engineering	12
24-352	Dynamic Systems Control	12
xx-xxx	General Education Course	9
		46

Fourth Year

	Fall	Units
24-401	Engineering Analysis	12
-or-		
24-441	Engineering Design	12
xx-xxx	Free Elective	9
xx-xxx	Free Elective	9
xx-xxx	Free Elective	9
xx-xxx	General Education Course	9
		48
	Spring	
24-401	Engineering Analysis	12
-or-		
24-441	Engineering Design	12
24-xxx	MechE Tech Elective	9
xx-xxx	Free Elective	9
xx-xxx	Free Elective	9
xx-xxx	General Education Course	9
		48

Mechanical Engineering and BME

First Year

	Fall	Units
21-120	Differential & Integral Calculus	10
24-101	Fundamentals of Mechanical Eng.	12
33-106	Physics for Engineering Students	12
99-101	Computing Skills Workshop	3
xx-xxx	Writing/Expession Course	9
		46
	Spring	
21-122	Integration, Differential Equations & Approximations	10
42-101	**Introduction to BME**	**12**
33-107	Physics for Eng Students II	12
03-121	**Modern Biology**	**9**
xx-xxx	General Education Course	9
		52

Second Year

	Fall	Units
21-259	Calculus in Three Dimensions	9
24-221	Thermodynamics I	10
24-261	Statics	10
09-105	Modern Chemistry I	10
42-201	**Professional Issues in BME**	**3**
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		51
	Spring	
21-260	Differential Equations	9
24-231	Fluid Mechanics	10
24-262	Stress Analysis	12
15-100	Introductory/Intermediate Programming	10
42-202	**Physiology**	**9**
-or-		
42-203	**BME Laboratory**	**9**
		50

Third Year

	Fall	Units
24-311	Numerical Methods	9
24-322	Heat Transfer	10
24-351	Dynamics	10
24-xxx	ME Technical Elective	9
xx-xxx	General Education Course	9
		47
	Spring	
24-371	Electromechanical Systems	10
24-303	Mechanical Engineering Seminar	2
24-321	Thermal-Fluids Engineering	12
24-352	Dynamic Systems Control	12
42-321	**Cellular & Molecular Biotech**	**9**
xx-xxx	General Education Course	9
		54

Fourth Year

	Fall	Units
24-441	Engineering Design	12
24-xxx	ME Technical Elective	9
xx-xxx	**CMBT Track Elective***	**9**
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
		48
	Spring	
xx-xxx	General Education Course	9
xx-xxx	General Education Course	9
xx-xxx	**CMBT Track Elective***	**9**
xx-xxx	**CMBT Track Elective***	**9**
42-401	**BME Design**	**12**
		48

* Cellular and Molecular Biotechnology Electives: Choose from 42-422 Bioprocess Design, 42-424 Biological Transport, 42-426 Biosensors and BioMEMS, 42-502 Cellular Biomechanics, 42-723/12-723 Biological Processes in Environmental Systems, 03-232 Biochemistry and 03-240 Cell Biology.

Minimum number of units for degree: 396.

Engineering and Public Policy

The comparative curriculum charts on pages 142-147 have been modified significantly.

Chemical Engineering
Single Major

Sophomore Year

	Fall	Units
21-259	Calculus in Three-Dimensions	9
06-221	Thermodynamics	9
06-222	Sophomore Chemical Engineering Seminar	1
09-106	Modern Chemistry II	10
15-100/	Introductory Intermediate Programming /	
33-107	Physics for Engineering Students II	10-12
xx-xxx	General Education Course	9
		48-50
	Spring	
06-261	Fluid Mechanics	9
06-262	Mathematical Methods of Chemical Engineering	12
09-221	Lab 1: Introduction to Chemical Analysis	12
33-107/	Physics for Engineering Students II /	
15-100	Introductory Intermediate Programming	12-10
xx-xxx	General Education Course	9
		54-52

Junior Year

	Fall	Units
06-321	Chemical Engineering Thermodynamics	9
06-323	Heat and Mass Transfer	9
06-322	Junior Chemical Engineering Seminar	2
09-217	Organic Chemistry I	9
09-347	Advanced Physical Chemistry	12
xx-xxx	General Education Course	9
		50
	Spring	
06-361	Unit Operations of Chemical Engineering	9
06-362	Chemical Engineering Process Control	9
06-363	Transport Processes Laboratory	6
03-232	Biochemistry	9
xx-xxx	Elective	9
xx-xxx	General Education Course	9
		51

Senior Year

	Fall	Units
06-421	Chemical Process Systems Design	12
06-422	Chemical Reaction Engineering	9
06-423	Unit Operations Laboratory	9
xx-xxx	Elective	9
xx-xxx	General Education Course	9
		48
	Spring	
06-461	Process Design Project	6
06-462	Economics & Optimization	6
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	General Education Course	9
		48

Minimum number of units required for degree: 386

Chemical Engineering/
Engineering and Public Policy
Double Major

Sophomore Year

	Fall	Units
21-259	Same	9
06-221	Same	9
	(Seminar Requirement is met by 19-102)	
09-106	Same	10
15-100/		
33-107	Same	10-12
73-100	Principles of Economics	9
19-102	EPP Sophomore Seminar	3
		50-52
	Spring	
06-261	Same	9
06-262	Same	12
09-221	Same	12
33-107/		
15-100	Same	12-10
xx-xxx	EPP Social Analysis Elective*	9
		54-52

Junior Year

	Fall	Units
06-321	Same	9
06-323	Same	9
	(Seminar requirement is met by 19-102)	
09-217	Same	9
09-347	Same	12
xx-xxx	EPP Social Analysis Elective*	9
		48
	Spring	
06-361	Same	9
06-362	Same	9
09-363	Same	6
36-220	Engineering Stats and Quality Control (replaces 03-232)	9
19-451	EPP Project	12
xx-xxx	EPP Social Analysis Elective*	9
		54

Senior Year

	Fall	Units
06-421	Same	12
06-422	Same	9
06-423	Same	9
19-452	EPP Project	12
xx-xxx	EPP Social Analysis Elective*	9
		51
	Spring	
06-461	Same	6
06-462	Same	6
xx-xxx	EPP Technical Elective	9
xx-xxx	EPP Technical Elective	9
36-310	Fundamentals of Statistical Modeling	9
xx-xxx	EPP Social Analysis Elective*	9
		48

Minimum number of units required for degree: 392

* 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 Engineering
Single Major

Sophomore Year

	Fall	Units
12-251	Introduction to Environmental Engineering	9
12-252	Environmental Engineering Lab	3
12-271	Intro Computer Apps in Civil & Environmental Engr	9
09-101	Intro to Experimental Chemistry	3
09-105	Modern Chemistry I	10
xx-xxx	H&SS Elective	9
		43
	Spring	
12-235	Statics	9
21-260	Differential Equations	9
15-100	Introductory / Intermediate Programming	10
xx-xxx	H&SS or CFA Elective	9
xx-xxx	Elective 1	9
		46

Junior Year

	Fall	Units
12-301	Civil and Environmental Engineering Projects	12
12-331	Solid Mechanics	9
12-332	Solid Mechanics Lab	3
27-357	Materials Selection	6
12-358	Materials Lab	3
xx-xxx	H&SS or CFA Elective	9
21-259	Calculus in Three Dimensions	9
		51
	Spring	
12-355	Fluid Mechanics	9
12-356	Fluid Mechanics Lab	3
12-335	Soil Mechanics	9
12-336	Soil Mechanics and Materials Lab	3
xx-xxx	H&SS or CFA Elective	9
xx-xxx	Elective 2	9
xx-xxx	Elective 3	9
		51

Senior Year

	Fall	Units
12-401	Civil and Environmental Engineering Design	15
12-411	Engineering Economics	6
36-220	Prob & Stat or Engr Stat and Qual Control	9
xx-xxx	H&SS or CFA Elective	9
12-xxx	Elective 4	9
		48
	Spring	
xx-xxx	H&SS or CFA Elective	9
xx-xxx	Elective 5	9
xx-xxx	Elective 6	9
xx-xxx	Elective 7	9
xx-xxx	Elective 8	9
		45

Minimum number of units required for degree: 373

Civil Engineering/
Engineering and Public Policy
Double Major

Sophomore Year

	Fall	Units
12-251	Same	9
12-252	Same	3
12-271	Same	9
09-101	Same	3
09-105	Same	10
73-100	Principles of Economics	9
19-102	EPP Sophomore Seminar	3
		46
	Spring	
12-235	Same	9
21-260	Same	9
15-100	Same	10
xx-xxx	EPP Social Analysis Elective	9
xx-xxx	Basic Science Elective (09-106, 33-104, or 03-121)	9
		46

Junior Year

	Fall	Units
12-301	Same	12
12-331	Same	9
12-332	Same	3
27-357	Same	6
12-358	Same	3
xx-xxx	EPP Social Analysis Elective*	9
21-259	Same	9
		51
	Spring	
12-355	Same	9
12-356	Same	3
12-335	Same	9
12-336	Same	3
xx-xxx	EPP Social Analysis Elective*	9
xx-xxx	Same (12-3xx Restricted Elective req'ment suggested)	9
19-451	EPP Project	12
		54

Senior Year

	Fall	Units
12-401	Same	15
12-411	Same	6
36-220	Engineering Statistics and Quality Control	9
xx-xxx	EPP Social Analysis Elective	9
19-452	EPP Project	12
		51
	Spring	
xx-xxx	EPP Social Analysis Elective	9
36-310	Fundamentals of Statistical Modeling	9
xx-xxx	EPP Technical Elective	9
xx-xxx	EPP Technical Elective	9
xx-xxx	EPP Technical Elective	9
		45

Minimum number of units required for degree: 382

* One of these must be taken from the following list:

88-302	Behavioral Decision Making
88-223	Decision Analysis and Decision Support Systems
19-426	Environmental Decision Making

Computer Science
Single Major

Sophomore Year

	Fall	Units
15-113	Systems Skills in C	5
15-212	Principles of Programming	12
36-217	Probability Theory and Random Processes	9
xx-xxx	Science/Engineering Course	9
xx-xxx	Minor Requirement / Free Elective	9
xx-xxx	Humanities and Arts Elective	9
		53
	Spring	
15-213	Introduction to Computer Systems	12
15-xxx	Computer Science Elective	9
21-241	Matrix Algebra	9
xx-xxx	Engineering / Science Course	9
xx-xxx	Humanities and Arts Elective	9
		48

Junior Year

	Fall	Units
15-xxx	Computer Science Elective	9
15-xxx	Computer Science Elective	9
xx-xxx	Minor Requirement / Free Elective	9
xx-xxx	Humanities and Arts Elective	9
xx-xxx	Minor Requirement / Free Elective	9
		45
	Spring	
15-451	**Algorithm Design and Analysis**	**9**
15-xxx	Computer Science Elective	9
xx-xxx	Minor Requirement / Free Elective	9
xx-xxx	Humanities and Arts Elective	9
		36

Senior Year

	Fall	Units
15-xxx	Computer Science Elective	12
xx-xxx	Minor Requirement / Free Elective	9
xx-xxx	Humanities and Arts Elective	9
xx-xxx	Minor Requirement / Free Elective	9
		39
	Spring	
15-xxx	Computer Science Elective	9
xx-xxx	Minor Requirement / Free Elective	9
xx-xxx	Minor Requirement / Free Elective	9
xx-xxx	Humanities and Arts Elective	9
		36

Minimum number of units required for degree: 360

Computer Science/
Engineering and Public Policy
Double Major

Sophomore Year

	Fall	Units
15-113	Same	5
15-212	Same	12
36-217	Same	9
xx-xxx	Same	9
xx-xxx	Same	9
73-100	Principles of Economics+	9
19-102	EPP Sophomore Seminar	3
		56
	Spring	
15-213	Same	12
15-xxx	Same	9
24-241	Same	9
xx-xxx	Same	9
xx-xxx	EPP Social Analysis Elective*	9
		48

Junior Year

	Fall	Units
15-xxx	Same	9
15-xxx	Same	9
xx-xxx	EPP Technical Elective	9
xx-xxx	EPP Social Analysis Elective*	9
xx-xxx	EPP Technical Elective	9
		45
	Spring	
15-451	Same	9
15-xxx	Same	9
19-451	EPP Project	12
xx-xxx	EPP Social Analysis Elective*	9
		39

Senior Year

	Fall	Units
15-xxx	Same	12
19-452	EPP Project	12
xx-xxx	EPP Social Analysis Elective*	9
xx-xxx	EPP Technical Elective	9
		42
	Spring	
15-xxx	Same	9
36-220	Engr Stats and Quality Control	9
xx-xxx	EPP Technical Elective	9
xx-xxx	EPP Social Analysis Elective*	9
		36

Minimum number of 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

	Fall	Units
18-200	Emerging Trends in ECE	1
18-2x0	ECE Core Course	12
18-202	Mathematical Foundations of Electrical Engineering *or*	12
21-127	Introduction to Modern Mathematics (18-240 co req)	9
33-107	Physics for Engineering Students II	12
xx-xxx	General Education Course	9
		43 / 46
	Spring	
18-2x0	ECE Core Course	12
18-202	Mathematical Foundations of Electrical Engineering *or*	12
21-127	Introduction to Modern Mathematics (18-240 co req)	9
36-217	Probability and Statistics	9
xx-xxx	General Education Course	9
xx-xxx	Free Elective	9
		48 / 51

Junior Year

	Fall	Units
xx-xxx	ECE Breadth Course 1	12
xx-xxx	ECE Breadth Course 2	12
xx-xxx	Math/Science Elective 1	9
xx-xxx	General Education Course	9
xx-xxx	Free Elective	3 / 6 / 9
		45 / 48 / 51
	Spring	
xx-xxx	ECE Depth Course	12
xx-xxx	ECE Breadth Course 3	12
xx-xxx	Math / Science Elective 2	9
xx-xxx	General Education Course	9
xx-xxx	Free Elective	3 / 6 / 9
		45 / 48 / 51

Senior Year

	Fall	Units
xx-xxx	ECE Coverage Course 1	12
xx-xxx	Engineering Elective	12
xx-xxx	General Education Course	9
xx-xxx	Free Elective	9
xx-xxx	Free Elective	3 / 6 / 9
		48 / 51
	Spring	
xx-xxx	Capstone Design (e.g., ECE Coverage Course 2)	12
xx-xxx	General Education Course	9
xx-xxx	Free Elective	9
xx-xxx	Free Elective	9
xx-xxx	Free Elective	3 / 6 / 9
		43 / 45 / 48

Minimum number of units required for degree: 360

Electrical and Computer Engineering/ Engineering and Public Policy
Double Major

Sophomore Year

	Fall	Units
18-200	Same	1
18-2x0	Same	12
18-202	*or*	12
21-127	Same	9
33-107	Same	12
73-100	Principles of Economics	9
19-102	EPP Sophomore Seminar	3
		46 / 49
	Spring	
18-2x0	Same	12
18-202	*or*	12
21-127	Same	9
36-217	Same	9
xx-xxx	EPP Social Analysis Elective	9
xx-xxx	EPP Social Analysis Elective	9
		48 / 51

Junior Year

	Fall	Units
xx-xxx	Same	12
xx-xxx	Same	12
36-217/220	Same	9
xx-xxx	EPP Technical Elective	9
		42
	Spring	
xx-xxx	Same	12
xx-xxx	Same	12
19-451	EPP Project	12
xx-xxx	EPP Social Analysis Elective*	9
		45

Senior Year

	Fall	Units
xx-xxx	Same	12
xx-xxx	EPP Technical Elective	9
19-452	EPP Project	12
xx-xxx	EPP Social Analysis Elective	9
		42
	Spring	
xx-xxx	Same	12
xx-xxx	EPP Technical Elective	9
36-217/220	Second Statistics Course	9
xx-xxx	EPP Social Analysis Elective	9
xx-xxx	EPP Technical Elective	9
		48

Minimum number of units required for degree: 361

* One of these must be taken from the following list:

88-302	Behavioral Decision Making
88-223	Decision Analysis and Decision Support Systems
19-426	Environmental Decision Making

Materials Science and Engineering
Single Major

Sophomore Year

	Fall	Units
21-259	Calculus in Three Dimensions	9
21-126	Introduction to Mathematical Software	3
33-107	Physics for Engineering Students II	12
27-299	Professional Development I	1
27-215	Thermodynamics of Materials	12
27-201	The Structure of Materials	6+3
27-202	Defects in Materials	6+3
		55
	Spring	
21-260	Differential Equations	9
09-105	Modern Chemistry I	10
09-101	Introduction to Experimental Chemistry	3
27-216	Transport in Materials	9
27-205	Introduction to Material Characterization	3
27-217	Phase Relations and Diagrams	9+3
xx-xxx	H&SS Elective	9
		55

Junior Year

	Fall	Units
33-225	Quantum Physics and Structure of Matter	9
or		
09-117	Organic Chemistry	9
or		
03-121	Modern Biology	9
27-399	Professional Development II	1
27-xxx	MSE Restricted Elective [1]	6
27-301	Microstructure and Properties I	6+3
27-367	Selection and Performance	6
xx-xxx	Free Elective	9
xx-xxx	H&SS Elective	9
		49
	Spring	
36-220	Engineering Statistics and Quality Control	9
27-xxx	MSE Restricted Elective [2]	6
27-xxx	MSE Restricted Elective [3]	6
xx-xxx	Free Elective [2]	9
xx-xxx	Free Elective [3]	9
xx-xxx	H&SS Elective	9
		48

Senior Year

	Fall	Units
27-401	MSE Capstone Course	12
27-499	Professional Development III	1
27-xxx	MSE Restricted Elective [4]	6
27-xxx	MSE Restricted Elective [5]	6
xx-xxx	Free Elective [4]	9
xx-xxx	H&SS Elective	9
xx-xxx	H&SS Elective	9
		52
	Spring	
27-xxx	MSE Restricted Elective [6]	6
27-xxx	MSE Restricted Elective [7]	6
27-xxx	MSE Restricted Elective [8]	6
xx-xxx	Free Elective [5]	9
xx-xxx	H&SS Elective	9
		36

Minimum number of units required for degree: 379*

* Was 382. MSE restricted electives reduced from 48 to 45 units, approved May 2005. This may be met with five (5) 9 unit MSE restricted electives. The above chart incorrectly shows 48 units of 6 unit electives vs 45 units of 9 unit electives. Any combination of MSE restricted electives totaling 45 units is acceptable. EPP remains 385.

Materials Science and Engineering/
Engineering and Public Policy
Double Major

Sophomore Year

	Fall	Units
21-259	Same	9
21-126	Same	3
33-107	Same	12
	(Seminar requirement is met by 19-102)	
27-215	Same	12
27-201	Same	6+3
27-202	Same	6+3
19-102	EPP Sophomore Seminar	3
		57
	Spring	
21-260	Same	9
09-105	Same	10
09-101	Same	3
27-216	Same	9
27-205	Same	3
27-217	Same	9+3
73-100	Principles of Economics	9
		55

Junior Year

	Fall	Units
33-225	Same	9
or		
09-117	Same	9
or		
03-121	Same	9
	(Seminar requirement is met by 19-102)	
27-xxx	Same	6
27-301	Same	6+3
27-302	Same	6+3
xx-xxx	EPP Social Analysis Elective*	9
xx-xxx	EPP Social Analysis Elective*	9
		48
	Spring	
36-220	Same	9
27-xxx	Same	6
27-xxx	Same	6
xx-xxx	EPP Technical Elective	9
19-451	EPP Project	12
xx-xxx	EPP Social Analysis Elective*	9
		51

Senior Year

	Fall	Units
27-401	Same	12
	(Seminar requirement is met by 19-102)	
27-xxx	Same	6
27-xxx	Same	6
xx-xxx	EPP Technical Elective	9
19-452	EPP Project	12
xx-xxx	EPP Social Analysis Elective*	9
		54
	Spring	
27-xxx	Same	6
(Per catalog double majors take 36 vs 45 units of restricted electives)		
36-310	Fundamentals of Statistical Modeling	9
xx-xxx	EPP Social Analysis Elective*	9
xx-xxx	EPP Technical Elective	9
		33

Minimum number of units required for degree: 385

* One of these must be taken from the following list:

88-302	Behavioral Decision Making
88-223	Decision Analysis and Decision Support Systems
19-426	Environmental Decision Making

Mechanical Engineering
Single Major

Sophomore Year

	Fall	Units
21-259	Calculus in Three Dimensions	9
24-221	Thermodynamics I	10
24-261	Statics	10
xx-xxx	Restricted Technical Elective*	10-13
xx-xxx	General Education Course**	9
		48-51
	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

	Fall	Units
24-302	Mechanical Engineering Seminar	2
24-311	Numerical Methods	9
24-322	Heat Transfer	10
24-351	Dynamics	12
24-xxx	Mechanical Engineering Technical Elective	9-12
xx-xxx	General Education Course	9
		50-54
	Spring	
24-371	Electromechanical Systems	10
24-302	Mechanical Engineering Seminar (If not taken in fall)	(2)
24-321	Thermal-Fluids Engineering	12
24-352	Dynamic Systems and Control	12
xx-xxx	General Education Course	9
		43(45)

Senior Year

	Fall	Units
24-401 or 24-441	Engineering Analysis or Engineering Design	12
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	General Education Course	9
		48
	Spring	
24-441 or 24-401	Engineering Design or 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

	Fall	Units
21-259	Same	9
24-221	Same	10
24-261	Same	10
xx-xxx	Same	10-13
73-100	Principles of Economics	9
19-102	EPP Sophomore Seminar	3
		51-54
	Spring	
21-260	Same	9
24-231	Same	10
24-262	Same	12
xx-xxx	Same	10-13
xx-xxx	EPP Social Analysis Elective	9
		50-53

Junior Year

	Fall	Units
	(Seminar requirement is met by 19-102)	
24-311	Same	9
24-322	Same	10
24-351	Same	12
36-220	Engineering Statistics and Quality Control	9
xx-xxx	EPP Social Analysis Elective*	9
		49
	Spring	
24-371	Same	10
	(Seminar requirement is met by 19-102)	
24-321	Same	12
24-352	Same	12
19-451	EPP Project I	12
		46

Senior Year

	Fall	Units
24-442	Engineering Design EPP	12
xx-xxx	EPP Technical Elective	9
19-452	EPP Project (replaces single major 24-401 requirement)	12
xx-xxx	EPP Technical Elective	9
xx-xxx	EPP Social Analysis Elective*	9
		51
	Spring	
36-310	Fundamentals of Statistical Modeling	9
24-xxx	Same	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

College of Fine Arts

Student Defined Majors in The College of Fine Arts

To apply for a Student Defined Major in the College of Fine Arts one:

1. Must be a student in good standing in the University and have completed at least one semester successfully.
2. Must have a cumulative QPA of 2.75 or better. A student whose QPA is under 2.75 may still submit a proposal. If the proposal is accepted by the Associate Deans, the student must apply for transitional status for the following semester and will have one semester to improve his or her QPA to the 2.75 minimum. If the student is not successful in raising the QPA to the 2.75 minimum, he or she may lose the affiliation with the current home department in the College of Fine Arts. If this happens the student must either be re-admitted back into the old program or seek admittance into another department or college.
3. Must have a statement of purpose that explains how and why the proposed course of study will be the best way for the student to receive an education and degree from Carnegie Mellon. This statement should detail the academic backbone of the program and project possible career paths after graduation.
4. Must outline the proposed courses to be taken and the semester in which they might be taken.
5. Must have a faculty mentor in the College of Fine Arts who has agreed to mentor the student through the completion of the degree. This mentor should be from the school where the student is taking the majority of his or her courses, and be approved by the Associate Deans.
6. Once the proposal has been submitted to the Associate Deans and they have reviewed it, the student will be required to go to the academic advisors in the school/schools where he or she will be taking courses and have them sign-off on the courses which are specific to their schools. Once the student has obtained all the necessary signatures, the completed proposal should be returned to CFA 100 for final review and approval by the Associate Deans.

All signed documentation should be submitted to the Office of the Dean of Fine Arts, CFA 100, by the first Monday in November in the fall semester, and by the last Monday in March in the spring semester. The proposal will be considered by the Associate Deans of the College, in consultation with the appropriate School Heads and Academic Advisors. Proposals that come in after these dates will be considered, but may not be able to be processed until the following semester. In that case, the student has the option to become a transitional student for a semester.

Under most circumstances the degree conferred at graduation will be a Bachelor of Arts. To continue in the program a student must show academic progress toward the degree. The academic actions of the College will apply to all student-defined majors. The Office of the Dean, in consultation with the faculty mentor and academic advisor, will determine certification of the degree.

School of Music

Corrections to material on pages 189-194 of the 2004-2006 Undergraduate Catalog.

General Requirements for BFA Candidates
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 performance are required to give public performances in their junior and senior years.

Candidates for the Bachelor of Fine Arts degree in applied areas other than piano are required to pass a piano proficiency test.
Candidates for all School of Music degrees are required to pass four repertoire proficiency tests, and to participate in a major choral ensemble or major instrumental ensemble as assigned and to attend Convocation every semester of residence in the School of Music.

Music Curriculum

The music curriculum is based on the following five building blocks:
Studio
Theory
History
Ensemble
Academics

1. **Studio** - This is the heart of the school. Students receive individualized instruction with senior faculty in their major area of study: performance or composition.
2. **Theory** - These courses are designed to help students develop listening skills, to acquire theoretical knowledge, to recognize structural techniques and manipulate technological resources. It includes courses in sight-reading, ear-training, eurhythmics, harmony, contrapuntal techniques, analysis of musical forms, 20th century techniques, orchestration, score reading, and electronic and computer music for compositional and educational purposes. One music support course in the piano, organ, and instrumental curricula must be an analysis course.
3. **History** - These courses cover in depth the music of the western world and survey the styles and musical structures of nonwestern music.
4. **Ensemble** - This area includes student participation in some of the following ensembles: Carnegie Mellon Philharmonic, Wind Ensemble, Jazz Ensemble, Concert Choir, Repertory Chorus, Jazz Vocal Ensemble, Opera/Music Theater Production, Baroque Ensemble, Contemporary Ensemble, Repertoire Orchestra, Flute Ensemble, Percussion Ensemble, Horn Choir, Trombone Choir, and various chamber groups.
5. **Academics** - The School of Music requires one general studies course (outside of the School) per semester and six semesters of elective courses for graduation. These accumulated credits may be applied to minors or majors in other disciplines. Exceptional students in good academic and musical standing within the School are permitted to take additional courses beyond the number required for graduation. There is no charge for extra credits taken at Carnegie Mellon. One elective course in the piano, organ and instrumental curricula must be a literature, repertoire, and pedagogy course.

Credits - The total number of units required for graduation is 387 for voice majors; 372 for non-voice majors. Three units equal one credit.

Piano
First Year

	Fall	Units
57-501	Studio	9
57-4xx	Major Ensemble	6
57-193	Skills of Accompanying I	3
57-152	Harmony I	6
57-161	Eurhythmics I	3
57-181	Solfege I	3
57-189	Repertoire and Listening for Musicians I	3
xx-xxx	CFA Survey Course	9
76-xxx	Designated Writing Course	9
		51

	Spring	
57-501	Studio	9
57-4xx	Major Ensemble	6
57-194	Skills of Accompanying II	3
57-153	Harmony II	6
57-162	Eurhythmics II	3
57-182	Solfege II	3
57-190	Repertoire and Listening for Musicians II	3
57-173	Music Survey Course	9
57-101	Introduction to Music Technology	6
99-xxx	Computer Skills Workshop	3
		51

Second Year

	Fall	Units
57-501	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-151	Principles of Counterpoint	6
57-163	Eurhythmics III	3
57-183	Solfege III	3
57-289	Repertoire and Listening for Musicians III	3
57-209	Music History I	9
xx-xxx	General Studies Course	6
		48

	Spring	
57-501	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-164	Eurhythmics IV	3
57-184	Solfege IV	3
57-290	Repertoire and Listening for Musicians IV	3
57-210	Music History II	9
57-xxx	Music Support Course (Theory/History)	6
xx-xxx	Elective	6
		48

Third Year

	Fall	Units
57-501	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-408	Form and Analysis	6
57-xxx	Music Support Course (Theory/History)	6
xx-xxx	General Studies Course	9
xx-xxx	Elective	6
		45

	Spring	
57-501	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-xxx	Music Support Course (Theory/History)	12
xx-xxx	General Studies Course	9
xx-xxx	Elective	6
		45

Fourth Year

	Fall	Units
57-501	Studio	9
57-xxx	Performance Elective	9
57-xxx	Music Support Course (Theory/History)	12
xx-xxx	General Studies Course	9
xx-xxx	Elective	3
		42

	Spring	
57-501	Studio	9
57-xxx	Performance Elective	9
57-xxx	Music Support Course (Theory/History)	12
xx-xxx	General Studies Course	9
xx-xxx	Elective	3
		42

Organ
First Year

	Fall	Units
57-502	Studio	9
57-4xx	Major Ensemble	6
57-191	Keyboard Studies I	3
57-152	Harmony I	6
57-161	Eurhythmics I	3
57-181	Solfege I	3
57-189	Repertoire and Listening for Musicians I	3
xx-xxx	CFA Survey Course	9
76-xxx	Designated Writing Course	9
		51

	Spring	
57-502	Studio	9
57-4xx	Major Ensemble	6
57-192	Keyboard Studies II	3
57-153	Harmony II	6
57-162	Eurhythmics II	3
57-182	Solfege II	3
57-190	Repertoire and Listening for Musicians II	3
57-173	Music Survey Course	9
57-101	Introduction to Music Technology	6
99-xxx	Computer Skills Workshop	3
		51

Second Year

	Fall	Units
57-502	Studio	9
57-4xx	Major Ensemble	6
57-291	Keyboard Studies III	3
57-151	Principles of Counterpoint	6
57-163	Eurhythmics III	3
57-183	Solfege III	3
57-289	Repertoire and Listening for Musicians III	3
57-209	Music History I	9
xx-xxx	General Studies Course	6
		48

	Spring	
57-502	Studio	9
57-4xx	Major Ensemble	6
57-292	Keyboard Studies IV	3
57-164	Eurhythmics IV	3
57-184	Solfege IV	3
57-290	Repertoire and Listening for Musicians IV	3
57-210	Music History II	9
57-xxx	Music Support Course (Theory/History)	6
xx-xxx	Elective	6
		48

Third Year

	Fall	Units
57-502	Studio	9
57-4xx	Major Ensemble	6
57-459	Score Reading/Keyboard Harmony	6
57-408	Form and Analysis	6
57-xxx	Music Support Course (Theory/History)	6
xx-xxx	General Studies Course	9
xx-xxx	Elective	3
		45

	Spring	
57-502	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Music Support Course (Theory/History)	12
xx-xxx	General Studies Course	9
xx-xxx	Elective	9
		45

Fourth Year

	Fall	Units
57-501	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-xxx	Music Support Course (Theory/History)	12
xx-xxx	General Studies Course	9
xx-xxx	Elective	3
		42

	Spring	
57-502	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-xxx	Music Support Course (Theory/History)	12
xx-xxx	General Studies Course	9
xx-xxx	Elective	3
		42

Voice
First Year

	Fall	Units
57-500	Studio	9
57-417	Major Ensemble	6
57-191	Keyboard Studies I	3
57-152	Harmony I	6
57-161	Eurhythmics I	3
57-181	Solfege I	3
57-189	Repertoire and Listening for Musicians I	3
xx-xxx	CFA Survey Course	9
57-111	Dance I	3
57-220	English Diction	3
82-161	Elementary Italian I	12
		60

	Spring	
57-500	Studio	9
57-417	Major Ensemble	6
57-192	Keyboard Studies II	3
57-153	Harmony II	6
57-162	Eurhythmics II	3
57-182	Solfege II	3
57-190	Repertoire and Listening for Musicians II	3
57-173	Music Survey Course	9
57-112	Dance II	3
57-221	Italian Diction	3
76-xxx	Designated Writing Course	9
		57

Second Year

	Fall	Units
57-500	Studio	9
57-417	Major Ensemble	6
57-291	Keyboard Studies III	3
57-163	Eurhythmics III	3
57-183	Solfege III	3
57-289	Repertoire and Listening for Musicians III	3
57-211	Dance III	3
57-240	Acting I	6
57-431	Literature and Repertoire (Italian)	3
82-121	Elementary German I	12
		51

	Spring	
57-500	Studio	9
57-417	Major Ensemble	6
57-292	Keyboard Studies IV	3
57-164	Eurhythmics IV	3
57-184	Solfege IV	3
57-290	Repertoire and Listening for Musicians IV	3
57-202	Opera History	9
57-212	Dance IV	3
57-241	Acting II	6
57-223	German Diction	3
99-xxx	Computer Skills Workshop	3
		51

Third Year

	Fall	Units
57-500	Studio	9
57-417	Major Ensemble	6
57-xxx	Production Course	6
57-315	Dance V	3
57-339	Acting III	6
57-433	Literature and Repertoire (Musical Theatre)	3
82-101	Elementary French I	12
		45

	Spring	
57-500	Studio	9
57-417	Major Ensemble	6
57-xxx	Production Course	6
57-316	Dance VI	3
57-340	Acting IV	6
57-434	Literature and Repertoire (Musical Theatre)	3
57-222	French Diction	3
57-432	Literature and Repertoire (French)	3
57-101	Introduction to Music Technology	6
		45

Fourth Year

	Fall	Units
57-500	Studio	9
57-417	Major Ensemble	6
57-xxx	Production Course	6
57-415	Dance VII	3
57-439	Acting V	6
57-435	Literature and Repertoire (German)	3
xx-xxx	Elective	6
		39

	Spring	
57-500	Studio	9
57-417	Major Ensemble	6
57-xxx	Production Course	6
57-416	Dance VIII	3
57-440	Acting VI	6
57-436	Literature and Repertoire (English/Contemporary)	3
xx-xxx	Elective	6
		39

Instrumental
First Year

	Fall	Units
57-xxx	Studio	9
57-4xx	Major Ensemble	6
57-191	Keyboard Studies I	3
57-152	Harmony I	6
57-161	Eurhythmics I	3
57-181	Solfege I	3
57-189	Repertoire and Listening for Musicians I	3
xx-xxx	CFA Survey Course	9
76-xxx	Designated Writing Course	9
		51

	Spring	
57-xxx	Studio	9
57-4xx	Major Ensemble	6
57-192	Keyboard Studies II	3
57-153	Harmony II	6
57-162	Eurhythmics II	3
57-182	Solfege II	3
57-190	Repertoire and Listening for Musicians II	3
57-173	Music Survey Course	9
57-101	Introduction to Music Technology	6
99-xxx	Computer Skills Workshop	3
		51

Second Year

	Fall	Units
57-xxx	Studio	9
57-4xx	Major Ensemble	6
57-291	Keyboard Studies III	3
57-151	Principles of Counterpoint	6
57-163	Eurhythmics III	3
57-183	Solfege III	3
57-289	Repertoire and Listening for Musicians III	3
57-209	Music History I	9
xx-xxx	General Studies Course	6
		48

	Spring	
57-xxx	Studio	9
57-4xx	Major Ensemble	6
57-292	Keyboard Studies IV	3
57-164	Eurhythmics IV	3
57-184	Solfege IV	3
57-290	Repertoire and Listening for Musicians IV	3
57-210	Music History II	9
57-xxx	Music Support Course (Theory/History)	6
xx-xxx	Elective	6
		48

Third Year

	Fall	Units
57-xxx	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-408	Form and Analysis	6
57-xxx	Music Support Course (Theory/History)	6
xx-xxx	General Studies Course	9
xx-xxx	Elective	6
		45

	Spring	
57-xxx	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-xxx	Music Support Course (Theory/History)	12
xx-xxx	General Studies Course	9
xx-xxx	Elective	6
		45

Fourth Year

	Fall	Units
57-501	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-xxx	Music Support Course (Theory/History)	12
xx-xxx	General Studies Course	9
xx-xxx	Elective	3
		42

	Spring	
57-501	Studio	9
57-4xx	Major Ensemble	6
57-xxx	Performance Elective	3
57-xxx	Music Support Course (Theory/History)	12
xx-xxx	General Studies Course	9
xx-xxx	Elective	3
		42

Composition
First Year

	Fall	Units
57-521	Studio	9
57-4xx	Major Ensemble	6
57-191	Keyboard Studies I	3
57-152	Harmony I	6
57-161	Eurhythmics I	3
57-181	Solfege I	3
57-189	Repertoire and Listening for Musicians I	3
xx-xxx	CFA Survey Course	9
76-xxx	Designated Writing Course	9
		51

	Spring	
57-521	Studio	9
57-4xx	Major Ensemble	6
57-192	Keyboard Studies II	3
57-153	Harmony II	6
57-162	Eurhythmics II	3

57-182	Solfege II	3
57-190	Repertoire and Listening for Musicians II	3
57-173	Music Survey Course	9
57-101	Introduction to Music Technology	6
99-xxx	Computer Skills Workshop	3
		51

Second Year

	Fall	Units
57-521	Studio	9
57-4xx	Major Ensemble	6
57-291	Keyboard Studies III	3
57-151	Principles of Counterpoint	6
57-163	Eurhythmics III	3
57-183	Solfege III	3
57-189	Repertoire and Listening for Musicians	3
57-209	Music History I	9
57-257	Orchestration I	6
		48

	Spring	
57-521	Studio	9
57-4xx	Major Ensemble	6
57-292	Keyboard Studies IV	3
57-164	Eurhythmics IV	3
57-184	Solfege IV	3
57-290	Repertoire and Listening for Musicians	3
57-210	Music History II	9
57-258	20th Century Techniques	6
xx-xxx	Elective	6
		48

Third Year

	Fall	Units
57-521	Studio	9
57-xxx	Performance Elective	3
57-332	Introduction to Conducting	6
57-408	Form and Analysis	6
57-271	Orchestration II	6
xx-xxx	General Studies Course	9
xx-xxx	Elective	3
		42

	Spring	
57-521	Studio	9
57-xxx	Performance Elective	3
57-336	Instrumental/Choral Conducting	6
57-xxx	Music Theory Course	6
57-272	Orchestration III	6
xx-xxx	General Studies Course	9
xx-xxx	Elective	3
		42

Fourth Year

	Fall	Units
57-521	Studio	9
57-4xx	Major Ensemble	6
57-347	Electronic and Computer Music	6
57-459	Score Reading/Keyboard Harmony	6
xx-xxx	General Studies Course	12
xx-xxx	Elective	6
		45

	Spring	
57-521	Studio	9
57-4xx	Major Ensemble	6
57-349	Supervised Theory Teaching	6
57-xxx	Music Theory Course	6
xx-xxx	General Studies Course	12
xx-xxx	Elective	6
		45

Minor in Conducting for Students in the School of Music

Admission Requirements:

1. The student must apply to enter the program in the office of the Director of Student Services (CFA 108) and have an interview with a member of the conducting faculty.

2. A 3.0 cumulative overall QPA and good academic standing are required for acceptance into the minor in conducting. Note that only a limited number of students can be accepted into the program.

3. In addition to the prerequisite courses listed below, the student must display superior solfege skills, by completing Advanced Solfege I and II with "A" or "B" grades or by demonstrating the equivalent level of skills.

4. Introduction to Conducting and Instrumental/Choral Conducting must be completed during the sophomore year with "A" grades before the student can register for the advanced conducting courses.

5. Conducting Practicum must be taken during the same semester as Independent Study in Conducting.

6. A 3.0 cumulative overall QPA is required for graduation with the minor in conducting

Prerequisite Courses		**39 units**
57-152	Harmony I	6
57-153	Harmony II	6
57-161	Eurhythmics I	3
57-162	Eurhythmics II	3
57-173	Music Survey Course	9
57-191	Keyboard Studies I	3
57-192	Keyboard Studies II	3

Corequisite Course for Voice Majors		**6 units**
57-151	Principles of Counterpoint	6

Required Courses		**45 units**
57-332	Introduction to Conducting	6
57-336	Instrumental/Choral Conducting	6
57-408	Form and Analysis	6
57-257	Orchestration I	6
57-271	Orchestration II	6
57-459	Score Reading/Keyboard Harmony	6
57-364	Conducting Practicum	3
57-618	Independent Study in Conducting	6

Electives (choose from the following courses)		**12 units**
57-220	English Diction	3
57-221	Italian Diction	3
57-222	French Diction	3
57-223	German Diction	3
57-258	20th Century Techniques	6
57-272	Orchestration III	6
57-335	Analysis Seminar	6
57-337	Sound Recording	6
57-338	Sound Editing and Mastering	6
57-360	Brass Methods	3
57-363	String Methods	3
57-431	Literature and Repertoire (Italian)	3
57-432	Literature and Repertoire (French)	3
57-435	Literature and Repertoire (German)	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

Minimum units required for Conducting minor: 57

Minor in Music Technology for Students in the School of Music

Admission Requirements:

1. The student must apply to enter the program in the office of the Director of Student Services (CFA 108).

Prerequisite Course		**3 units**

Computer Skills Workshop must be passed before taking any of the required technology courses.

99-xxx	Computer Skills Workshop	3

Introductory Music Courses		**15 units**
57-152	Harmony I	6
57-173	Music Survey Course	9

Required Music Technology Courses		**33 units**
57-101	Introduction to Music Technology	6
57-337	Sound Recording	6
57-338	Sound Editing and Mastering	6
57-347	Electronic and Computer Music	6
57-438	Multitrack Recording	9

Technical Courses (Choose 2) **15-19 units**

Other technical courses may also be approved by the advisor for music minors.

xx-xxx	H&SS Multimedia Course	9
15-100	Introductory/Intermediate Programming	10
15-229	MultiMedia Programming and Computer Science	9
33-114	Physics of Musical Sound	9
54-165	Introduction to Sound Design for Theater I	6
57-610	Internship	9

Minimum units required for Music Technology Minor: 63

The College of Humanities and Social Sciences

General Education Course Listings

Throughout the year, changes are made to the General Education Course listing found on pages 201-202 of the 2004-2006 Catalog. Current course offerings may be viewed by visiting this URL: http://www.hss.cmu.edu/departments/deans_office/aac/genedforms.html.

The Major in Economics and Statistics

Faculty Advisor: Oded Meyer
Office: Baker Hall 232C

The major in Economics and Statistics provides an interdisciplinary course of study aimed at students with a strong interest in the empirical analysis of economic data. A collaborative effort between the Department of Statistics and the Undergraduate Economics Program, the major's curriculum provides students with a solid foundation in the theories and methods of both fields. Students in this major are trained to advance the understanding of economic issues through the analysis, synthesis and reporting of data using the advanced empirical research methods of statistics and econometrics. Graduates are well positioned for admission to competitive graduate programs, including those in statistics, economics and management, as well as for employment in positions requiring strong analytic and conceptual skills – especially those in economics, finance, education, and public policy.

Curriculum

I Prerequisites **65 units**

1. Writing Prerequisite **9 units**

Choose One:

73-270	Professional Writing for Economics
76-270	Writing in the Professions
76-271	Intro to Professional and Technical Writing

2. Mathematical Foundations **38 units**

21-120	Differential and Integral Calculus
21-122	Integration, Diff Equations and Approximations
21-256	Multivariate Analysis and Approximation
21-241	Matrix Algebra

3. Statistical Foundations **18 units**

36-201 Introduction to Statistical Reasoning and Practice*

and one of the following:

36-202	Introduction to Statistical Methods
36-208	Regression Analysis (cross listed as 70-208)
36-309	Experimental Design for Behavioral & Social Sciences

** Acceptable equivalents for 36-201 are 36-207, 36-220, 36-247.*

II Disciplinary Core **108 units**

1. Economics Core **36 units**

Complete one:

73-100	Principles of Economics
73-150	Introduction to Microeconomics

and the following three:

73-200	Macroeconomics
73-251	Economic Theory
73-261	Econometrics

2. Statistics Core **36 units**

36-225	Introduction to Probability and Statistics I
36-226	Introduction to Probability and Statistics II
36-401	Modern Regression
36-402	Advanced Data Analysis (Project Course)

3. Economics Electives **18 units**
Choose two courses.

4. Statistics Electives **18 units**
Choose two courses at the 36-300 level or above.

Sample Program

The following sample program illustrates one (of several) ways to satisfy the requirements of the Economics and Statistics Major. Keep in mind that the program is flexible and can support other possible schedules (see comment following the schedule).

Year	Fall	Spring
Freshman	21-120 36-201 73-100 ---- ----	21-122 36-202 ---- ---- ----
Sophomore	21-256 36-225 73-200 ---- ----	21-241 36-226 73-251 ---- ----
Junior*	36-401 73-261 Writing Req. Econ Elective ----	36-402 Stats Elective ---- ---- ----
Senior	Stats Elective ---- ---- ---- ----	Econ Elective ---- ---- ---- ----

* A student could spend, for example year 3 abroad and move year 3 courses to year 4.

Department of Modern Languages

The Majors in Chinese, French & Francophone Studies, German, Japanese and Hispanic Studies

Modern Languages majors are available in Chinese, French & Francophone Studies, German, Japanese and Hispanic Studies as well as in European Studies and Russian Studies. These majors are designed to lead to acquisition of communicative language proficiency and substantive knowledge of other cultures.

The Major in Chinese 96-99 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 0-36 units

Students need to complete Elementary Chinese I & II (82-131 & 82-132) and Intermediate Chinese I (82-231) courses, or Intensive Elementary Chinese (82-135). Exemption of these courses can be granted based on the result of the placement test administered by the program faculty.

1. Core Courses in Chinese 39-42 units*

Complete all four courses:
82-232 Intermediate Chinese II**
82-331 Advanced Chinese I
82-332 Advanced Chinese II
82-333 Introduction to Chinese Language & Culture

* Placement out of 82-232 is possible. Students who place out of 82-232 need to take one more course at the 300-level with a minimum of 9 units. The selection should be made between the following two courses based on the specific needs of each individual student:

82-335 Selected Readings in Chinese
82-337 Mandarin Chinese for Oral Communication

** This course may be substituted by 82-235 (Intensive Intermediate Chinese).

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
82-388 Understanding Second Language Fluency
82-480 Social and Cognitive Aspects of Bilingualism
82-580 Senior Seminar

3. Core Course(s) in History & Society (minimum) 9 units

Complete one of the following History courses after consultation with the Major Advisor and the designated History or Modern Languages professor:
79-270 Chinese Culture & Society
79-271 Modern China

4. Chinese and Interdisciplinary Electives (minimum) 36 units

Complete two courses from List A and two courses from List B, or two courses from List A, one course from List B and one course from List C. More courses from other departments will be added to List C as they are available.

List A: Core Chinese Electives (minimum) 18 units

82-337 Mandarin Chinese for Oral Communication (I)
82-433 Topics on Contemporary Culture of China
82-434 Studies in Chinese Traditions
82-436 Introduction to Classical Chinese
82-43x Introduction to Chinese Literature
82-43x Advanced Business Chinese
82-43x Classical Chinese II
82-531/532 Special topics: Chinese*

* Students may repeat with new topics.
The x-numbered courses will be added over the next few years when more teaching staff is available.

List B: Chinese Electives (minimum) 9 units

82-334 Structure of Chinese
82-335 Selected Readings in Chinese
82-337 Mandarin Chinese for Oral Communication (I)
82-338 Mandarin Chinese for Oral Communication (II)
82-33x Media Literacy in Chinese
82-33x Chinese Americans in Literature
82-433 Topics on Contemporary Culture of China
82-434 Studies in Chinese Traditions*
82-436 Introduction to Classical Chinese
82-43x Introduction to Chinese Literature
82-43x Advanced Business Chinese
82-43x Classical Chinese II

List C: Interdisciplinary electives 9 units

Students should consult Academic Audit and their advisor for the most up to date interdisciplinary electives appropriate for the Chinese major curriculum. These electives should contain a component related to the Chinese major.

Architecture

48-351	Human Factors in Architecture
48-442	Asian Architecture
48-551	Ethics and Decision Making in Architecture

Art

60-373	Aesthetics from a Global Point of View
60-399	Art History/Theory Independent Study

Business

70-342	Managing across Cultures
70-365	International Trade and International Law
70-430	International Management

English

76-318	Communicating in the Global Marketplace
76-339	Advanced Studies in Film: Darkness, Despair, Desire
76-350	Asian American Literature
76-386	Language and Culture
76-387	Sociolinguistics
76-442	Communication across Cultures

History

79-225	Religions of China
79-236	18th Century China through Literature
79-247	East Asians in Film
79-270	Chinese Culture & Society
79-271	Modern China
79-283	East Asia and World War II
79-301	Ritual, Culture, and Identity
79-306	East Asians in Film
79-365	Climate Change, Energy Policy and Environmental Protection

Philosophy

80-180	The Nature of Language
80-181	Language and Thought
80-276	Philosophy of Religion
80-380	Philosophy of Language

Psychology

85-375	Cross Cultural Psychology
85-421	Language and Thought

Social and Decision Science

88-357	Comparative Foreign Policy: China, Russia and the US

5. 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.

Chinese (B.A.)

Sample Curriculum

This sample curriculum assumes that all prerequisites for 82-331 are fulfilled prior to the Junior year.

Junior Year		Senior Year	
Fall	**Spring**	**Fall**	**Spring**
Advanced Chinese I 82-331	Advanced Chinese II 82-332	Core Chinese Elective List A	Core Chinese Elective List A
Introduction to Chinese Language and Culture 82-333	Core History Course	Chinese Elective List B or List C	Chinese Elective List B
Core Modern Language Department Course	Elective	Spanish or Interdisciplinary Elective List A or List B	Senior Seminar 82-580
Elective	Elective	Elective	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 level courses) during their freshman and sophomore years.

Department of Social and Decision Sciences

In the Statistical and Research Methods for Decision Analysis category of electives, 36-309 Experimental Design for Behavioral and Social Sciences is deleted (see pages 266 and 269).

Tepper School of Business

Undergraduate Economics Program

Dennis Epple, Program Head
http://business.tepper.cmu.edu/default.aspx?id=143001

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 delivered with and directly administered by the Tepper School of Business, has been carefully designed to prepare students for careers as economic analysts in either the private or public sector, for advanced professional studies in business, law and public policy, as well as for entry into Ph.D. programs in economics, finance, and related fields. To these ends, the program's academic requirements provide a solid understanding of the central ideas of economics, while retaining the flexibility necessary to accommodate students' wide variety of goals and interests. Essential skills are provided through the mathematics, statistics, computer programming and writing requirements. In addition, the H&SS general education requirements provide a broad introduction to the ideas of the humanities, arts, and sciences necessary for putting economic issues in context. The economics core courses provide the solid foundation in the field necessary for all students. Advanced electives provide students the opportunity to customize their course of studies, culminating in the students' exploration of their special interests in their senior projects.

For students who are majors in other departments, the program offers both a second major and a minor in economics. Additionally, qualified students may seek to enter the Tepper School of Business' accelerated master's degree program, which offers the opportunity to earn both a bachelors degree and a Masters of Science in Quantitative Economics in only five years. Students interested in these programs are invited to contact the Economics Department's advisors for further information.

B.S. in Economics

This degree is jointly awarded by the Tepper School of Business and the College of Humanities and Social Sciences. To receive a Bachelor of Science degree in Economics, students must complete mathematics, programming, statistics and writing prerequisites, the economics core sequence, advanced economics/focus area electives, and a senior project.

Mathematics Prerequisites — 29 Units

21-120	Differential and Integral Calculus	10
21-122	Integration, Differential Equations, and Approximation	10
21-256	Multivariate Analysis and Approximation [a]	9

[a] Students may also meet this requirement by taking 21-259, Calculus in Three Dimensions.

Programming Prerequisite — 10 Units

15-100	Introductory/Intermediate Programming	10

Statistics Prerequisite — 9 Units

Choose one [a]*:*

21-325	Probability	9
36-217	Probability Theory and Random Processes	9
36-225	Introduction to Probability and Statistics I	9

[a] These courses do not replace the statistical reasoning requirement of the H&SS General Education Program (which is fulfilled by 36-201).

Writing Prerequisite — 9 Units

Choose one:

70-340	Business Communications	9
73-270	Professional Writing for Economists	9
76-270	Writing in the Professions	9
76-271	Introduction to Professional and Technical Writing	9

Economics Core Requirements — 45 Units

Complete all of following:

73-100	Principles of Economics [a]	9
73-200	Macroeconomics	9
73-226	Quantitative Economic Analysis	9
73-251	Economic Theory	9
73-261	Econometrics	9

[a] Students may also satisfy this requirement by taking 73-150 (Principles of Economics with Calculus) or 88-220 (Policy Analysis I).

Advanced Electives — 36 Units

This requirement is satisfied by completing a departmentally approved track in a selected focus area. Each such track consists of a menu of courses from which the student must complete four. Since course offerings vary over time, focus area tracks are periodically updated and revised. Students should contact the Economics Department or check the Economics website for current information. Students must consult with their economics advisor for approval of their focus area selection. Presently, the Economics Program offers the following focus areas:

- Business Economics
- Financial Markets
- Quantitative Economics
- Public Economics
- Behavioral Economics

Additionally, students may work with their advisor to structure alternative tracks based on their particular interests and course availability.

Senior Project — 9 Units

73-497	Senior Project	9

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.gsia.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 prerequisite and corequisite requirements. Course descriptions, prerequisites, and corequisites can be found at the back of this catalog.

Sample Schedule
First Year

Fall		49 Units
21-120	Differential and Integral Calculus	10
36-201	Statistical Reasoning	9
73-100	Principles of Economics	9
99-101 or 99-102	Computing Skills Workshop	3
xx-xxx	Elective	9
xx-xxx	Elective	9

Spring		47 Units
21-122	Integration, Differential Equations, and Approximation	10
73-101	1st Year Seminar in Economics [a]	9
15-100	Introductory/Intermediate Programming	10
73-150	Principles of Economics with Calculus	9
xx-xxx	elective	9

[a] Although not a requirement for the degree, students considering an economics major are strongly encouraged to meet their H&SS

Freshman Seminar requirement by taking the 1st Year Seminar in Economics.

Second Year

	Fall	45 Units
21-256	Multivariate Analysis and Approximation	9
36-225	Introduction to Probability and Statistics I	9
73-200	Macroeconomics	9
xx-xxx	elective	9
xx-xxx	elective	9

	Spring	45 Units
73-226	Quantitative Economic Analysis	9
73-251	Economic Theory	9
xx-xxx	elective	9
xx-xxx	elective	9
xx-xxx	elective	9

Third Year

	Fall	45 Units
73-261	Econometrics	9
73-270	Writing for Economists	9
xx-xxx	Advanced Economics Focus Area Elective	9
xx-xxx	elective	9
xx-xxx	elective	9

	Spring	45 Units
xx-xxx	Advanced Economics Focus Area Elective	9
xx-xxx	elective	9
xx-xxx	elective	9
xx-xxx	elective	9
xx-xxx	elective	9

Fourth Year

	Fall	45 Units
73-497	Senior Project	9
xx-xxx	Advanced Economics Focus Area Elective	9
xx-xxx	elective	9
xx-xxx	elective	9
xx-xxx	elective	9

	Spring	45 Units
xx-xxx	Advanced Economics Focus Area Elective	9
xx-xxx	elective	9
xx-xxx	elective	9
xx-xxx	elective	9
xx-xxx	elective	9

Additional Major in Economics

The requirements for an additional major in Economics are the same as those for the B.S. in Economics, except that the H&SS General Education requirements are waived. Interested students must meet with an economics advisor prior to submitting an application.

Minor in Economics

The requirements for a minor in Economics consist of mathematics requirements, a statistics requirement, and six economics courses, as follows:

Mathematics Requirements		19 Units
21-120	Differential and Integral Calculus [a]	10

Choose one:

21-256	Multivariate Analysis and Approximation	9
21-259	Calculus in Three Dimensions	9

Statistics Requirements		18 Units
Choose one:		
36-201	Introduction to Statistical Methods	9
36-207	Probability and Statistics for Business Applications [a]	9
36-220	Engineering Statistics and Quality Control	9

or any course from the statistics requirement for B.S. in Economics.

Choose one:

36-208	Regression Analysis [b]	9
36-226	Introduction to Probability and Statistics II	9
73-226	Quantitative Economic Analysis	9
88-250	Regression Methods in the Social Sciences	9

[a] 36-207 is equivalent to 70-207.
[b] 36-208 is equivalent to 70-208.

Economics Requirements		54 Units
Complete all of following:		
73-100	Principles of Economics [a]	9
73-200	Macroeconomics	9
73-251	Economic Theory	9
xx-xxx	Advanced Economics Elective [b]	9
xx-xxx	Advanced Economics Elective [b]	9
xx-xxx	Advanced Economics Elective [b]	9

[a] Students may also satisfy this requirement by taking 73-150 (Principles of Economics with Calculus) or 88-220 (Policy Analysis I).

[b] See the Economics Department or check the Economics website for a list of approved courses.

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.

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 66-501/502 (18 units). Completion of an honors thesis also satisfies the students' senior project requirement. To qualify for the Honors Program, students must maintain at least a 3.5 Q.P.A. in their economics core and elective courses, as well as a minimum 3.25 overall Q.P.A.

Accelerated Master's Degree Programs

The Masters of Science in Quantitative Economics (M.S.Q.E.) is the Tepper School of Business' professional degree in economics. Exceptional students may qualify for admission into an accelerated program, earning both a B.S. in Economics and an M.S. in Quantitative Economics by remaining one additional year at Carnegie Mellon. For the most recent information, see http://econ.gsia.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.

Undergraduate Business Administration Program (page 333)

Additional Major Requirements

Requirements for an additional major in Business Administration:

Students seeking an additional major in BA are required to complete all of the courses in the three core sequence listed below:

Business Core:

70-122 Introduction to Accounting
70-311 Organizational Behavior
70-332 Business, Society and Ethics
70-340 Business Communications
70-345 Oral Communications
70-371 Production and Operations Management
70-381 Marketing
70-391 Finance
70-451 Management Information Systems[9]
70-401 Management Game[10]
70-300 or 70-400 Electives (2)

[9] Students in IS and CS must select a 70-4XX course from the Computing and Information Technology Track

[10] Students seeking an additional major in BA may not substitute 70-440 for 70-401

Mathematics/Computing:

21-120 Calculus
21-256 Multivariate Analysis and Approximation

21-257 Models and Methods of Optimization or
21-292 Operations Research

70-207 Probability and Statistics for Business
70-208 Regression and Forecasting
99-101 or
99-102 Computing Skills Workshop
15-1XX Programming Course

Economics

73-100 Principles of Economics
73-200 Macroeconomics
73-251 Economic Theory

Minor in Business Administration

Requirements:

Prerequisite Math/Statistics Courses:

Two semester course in Calculus
One semester course in Statistics (or 70/36-207 or 36-220)

Required:

70-311 Organizational Behavior
70-381 Marketing
73-100 Principles of Economics (or 73/88-110, Laboratory Economics)
21-257 Models and Methods for Optimization or
21-292 Operations Research I

Select Two:

70-122 Introduction to Accounting
70-371 Production and Operations Management
70-391 Finance
70-342 Managing Across Cultures
70-430 International Management
70-436 Corporate Social Responsibility
70-451 Management Information Systems[11]
70-480 International Marketing
70-481 Market Research
70-483 Marketing Communications
70-484 Direct Marketing

[11] Students in IS and CS cannot take 70-451; they may select another 70-4XX course from the Computing and Information Technology Track.

Minor in Management (CFA Students Only)

Required:

70-311 Organizational Behavior
70-381 Marketing
73-100 Principles of Economics (or 73/88-110, Laboratory Economics)

Select 3:

70-342 Managing Across Cultures
70-430 International Management
70-436 Corporate Social Responsibility
70-480 International Marketing
70-481 Market Research
70-483 Marketing Communications
70-484 Direct Marketing

Minor in Supply Chain Management (CIT Students Only)

This minor is offered to CIT students by the Tepper School of Business. The minor consists of business courses that are quantitative in nature and oriented to manufacturing and operations, making them well suited for engineering students. Given the increased interest by many companies in optimization, logistics and supply chain management, engineering students may find this minor to be an attractive option.

Select One:

21-257 Models and Methods for Optimization
21-292 Operations Research I

Required:

70-371 Production and Operations Management
70-471 Logistics and Supply Chain Management

Select One:

70-122 Introduction to Accounting
70-391 Finance I
70-460 Mathematical Models for Consulting
70-474 Quality Principles and Techniques

Please check the Undergraduate Business Administration website, http://business.tepper.cmu.edu, for updates.

Carnegie Mellon University in Qatar

Chuck Thorpe, Dean
Robert Kail, Associate Dean
http://www.qatar.cmu.edu/

Carnegie Mellon University in Qatar is Carnegie Mellon's first undergraduate branch campus. The campus opened in 2004 as part of a collaborative effort with the Qatar Foundation to bring outstanding American education programs to the Middle East. The University shares their commitment to maintain the same quality of instruction and standard of student performance demanded on the main campus.
The campus offers two academic programs, Business Administration and Computer Science. To learn more about them, see their main campus college sections in this catalog. The purpose of this section is to describe the policies of the Qatar campus that are independent from those of the Pittsburgh campus and outline procedures that are common to students in both programs in Qatar.

Degree Offerings

Carnegie Mellon in Qatar offers two undergraduate degrees:
- Bachelor's of Science in Business Administration
- Bachelor's of Science in Computer Science

Policy Statement

Carnegie Mellon in Qatar complies with common University policies unless otherwise noted. The curriculum requirements for the Business Administration and Computer Science majors are identical to those of the Tepper School of Business and the School of Computer Science. Academic standards and Actions apply to both programs.

Academic Advising

Academic advising is the process through which Carnegie Mellon provides the necessary resources for students to make good choices. The primary purpose of academic advising is to assist students as they develop meaningful educational plans compatible with their life goals. Although the Carnegie Mellon University in Qatar curriculum is well defined, there will be opportunities, both within and beyond curricular constraints, for students to participate in courses and activities that support their academic and personal development. While the ultimate responsibility for making decisions about life and educational plans rest with each individual student, an academic advisor assists them by suggesting options and by discussing possible outcomes of the choices they make. Business or computer science students at Carnegie Mellon University in Qatar can expect that their academic advisor will:

- Help them define their academic, career and life goals;
- Help them evaluate progress toward their goals;
- Help them understand curricular requirements, guide them as they select courses, and help them identify other meaningful educational experiences;
- Help them determine whether or not they need assistance with study skills (time management, organizing course information, stress management, etc.), and, if necessary, refer them to institutional and community support services;
- Monitor their progress as they move through the undergraduate program.

Students are required to meet with their advisor at least once each semester to ensure that they are making normal progress towards their degree. It is the individual student's responsibility to make certain that he or she fulfills the requirements for graduation.

Suggested Course Sequence

What follows are suggested course sequences for the BA and CS curriculums for Qatar campus students. These sequences vary in some cases in the order that students take courses from the suggested sequence on the main campus but meet the same four-year course requirements. Students are strongly encouraged to meet with their advisor to ensure that they are making normal progress towards a degree. They should be careful to observe any prerequisite and co-requisite requirements for each course. These are in the course descriptions found at the back of this catalog.

Business Administration Suggested Course Sequence

The Business Administration suggested course sequence includes placeholders for depth courses for a business track. Students may replace these courses with those of a different approved minor or additional major.

Freshmen Year

	Fall	Units
15-100	Intro/Inter Programming	10
21-120	Calculus	10
70-100	Introduction to Business	9
70-201	Professional and Service Projects*	
76-101	Interpretation and Argument	9
79-104	Introduction to World History	9
		47

* Business majors must complete 70-201, Professional and Service Projects, by the end of the sophomore year. Transfer students must complete the course within two years after entering the BA Department. The course involves career-related and service activities in which the student participates over a period lasting as long as four semesters. Students should not register until the semester in which they expect to complete their activities.

This course does not count in determining whether business majors are carrying a full load.

	Spring	
21-256	Multivariate Analysis and Approximation	9
73-100	Principles of Economics	9
xx-xxx	Breadth Course	9
xx-xxx	Breadth Course	9
xx-xxx	Breadth Course	9
		45

Sophomore Year

	Fall	Units
21-257	Models and Methods of Optimization	9
70-122	Introduction to Accounting	9
70-207	Probability & Statistics for Business	9
73-200	Macroeconomics	9
xx-xxx	Breadth Course	9
		45

	Spring	
70-208	Regression & Forecasting	9
70-311	Organizational Behavior	9
70-340	Business Communications	9
73-251	Economic Theory	9
xx-xxx	Breadth Course	9
		45

Junior Year

	Fall	Units
70-371	Production and Operations Management	9
70-381	Marketing	9
70-451	Management Information Systems	9
70-365	Depth Course	9
xx-xxx	Breadth Course	9
		45

	Spring	
70-332	Business and Society	9
70-345	Oral Communications	9
70-391	Finance	9
xx-xxx	Breadth Course	9
70-xxx	Depth Course	9
		45

Senior Year

	Fall	Units
70-xxx	Depth Course	9
70-xxx	Depth Course	9
xx-xxx	Elective	9
xx-xxx	Elective	9
xx-xxx	Elective	9
		45

	Spring	
70-401	Management Game	12
70-xxx	Depth Course	9
70-xxx	Depth Course	9
xx-xxx	Elective	9
xx-xxx	Elective	9
		48

Total units required: 364

Suggested Computer Science Course Sequence:
The Computer Science suggested course sequence includes the courses for the Business Administration minor. Students may replace these courses with those of a different approved minor or additional major.

Freshman Year

	Fall	Units
15-100	Introductory Programming	10
15-128	Freshman Immigration Course	1
21-120	Differential & Integral Calculus	10
70-100	Introduction to Business	9
76-101	Interpretation and Argument	9
79-104	Introduction to World History	9
		48

	Spring	
15-200	Advanced Programming	9
21-127	Concepts of Mathematics	9
21-256	Multivariate Analysis and Approximation	9
xx-xxx	Science/Engineering Course	9
xx-xxx	Humanities and Arts Elective	9
		45

Sophomore Year

	Fall	Units
15-211	Fundamental Data Structures/Algorithms	12
70-122	Introduction to Accounting	9
70-207	Probability & Statistics for Business	9
xx-xxx	Science/Engineering Course	9
xx-xxx	Humanities and Arts Elective	9
		48

	Spring	
15-113	Systems Skills in C	5
15-251	Great Theoretical Ideas in Computer Science	12
21-241	Matrix Algebra	9
73-100	Principles of Economics	9
xx-xxx	Humanities and Arts Elective	9
		44

Junior Year

	Fall	Units
15-212	Principles of Programming	12
15-213	Introduction to Computer Systems	12
15-xxx	Computer Science Elective	9
21-257	Models and Methods of Optimization	9
		42

	Spring	
15-xxx	Computer Science Elective	12
15-xxx	Computer Science Elective	9
70-311	Organizational Behavior	9
70-391	Finance	9
xx-xxx	Humanities and Arts Elective	9
		48

Senior Year

	Fall	Units
15-451	Algorithm Design and Analysis	12
15-xxx	Computer Science Elective	12
70-381	Marketing	9
xx-xxx	Humanities and Arts Elective	9
xx-xxx	Science/Engineering Course	9
		51

	Spring	
15-xxx	Computer Science Elective	12
15-xxx	Computer Science Elective	9
xx-xxx	Humanities and Arts Elective	9
xx-xxx	Science/Engineering Course	9
		39

Minimum number of units required for the degree: 360

Academic Standards and Actions

Academic standards and actions apply to both programs

Grading

See pp. 48-49 for grading regulations for undergraduate students.

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 academic actions.

Dean's List

Students earn Dean's List recognition in a given semester by achieving one of two minimum standards. They must either earn a semester QPA of 3.75 or higher (while taking at least 36 factorable units and receiving no incompletes) or earn a semester QPA of 3.50 or higher (while taking at least 45 factorable units and receiving no incompletes).

Other Actions

Students are subject to academic action if they fail to make minimal progress toward their degree. Minimal progress is 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.

The criteria for first year students are different – they are not subject to academic actions unless they complete fewer than 36 factorable units or their semester QPA is below 1.75.

Probation

Probation occurs when a student's semester record fails to meet the minimal standards listed above. Students remove themselves 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).

The school may continue a student's probation 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, the school will suspend them. 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, then Drop but the school may bypass one or more of these steps in an unusual case.

Other Regulations Affecting Student Status

Course Overloads

A Qatar Campus student must have attained a QPA of at least 3.00 in the previous semester to carry an overload (defined as more than 51 units) of up to 63 units. If a student carrying an overload is in severe academic difficulty during the semester, the department may withdraw the student from the overload course.

Adding a Class

Students may add classes to their schedule under the following rules:

1. Students may only add a full semester course through the first 10 class days of the semester.
2. They may only add half semester mini courses through the first 5 class days of the course.

Withdrawing from Courses

The Qatar campus follows the Carnegie Mellon policies on withdrawing from courses:

1. Students who wish to withdraw from a course without receiving a "W" grade must do so before the published University deadline. After that date, students may withdraw from a course up to the last day of classes and receive a "W" as a grade for it. After the last day of classes students may not withdraw from a class.
2. Students carrying a full-time course load (defined as at least 36 factorable units) may not drop down below 36 units after the 10th regularly scheduled day of classes.

Non-Carnegie Mellon Courses

Students may receive credit for courses taken outside of Carnegie Mellon if they successfully petition the Director of Undergraduate Programs in advance for permission. Students must take these courses for a letter grade and instruction must be in English for non-language courses. Credit (but not the grade) will transfer for courses with 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 Administration, Computer Science, Economics, and Mathematics/Statistics core classes at a four-year institution. Students may not receive credit for more than five non-Carnegie Mellon courses during their undergraduate career. The only exceptions are for students studying abroad, they may petition to take up to five additional courses during their time off campus.

Transfer Students

Students may transfer between the Business Administration and Computer Science programs or to the Qatar Campus from Carnegie Mellon's Pittsburgh campus on a space available/academic performance basis. First year students, however, may not apply for transfer until they receive their spring mid-semester grades. Transfer students from other universities must apply through the Carnegie Mellon in Qatar Admission office. If the Admission office finds the applicant admissible, they forward the application to the Associate Dean who then determines if there is space available in the program and if the student's past academic performance warrants admission.

University Honors

Students maintaining a 3.5 QPA after seven semesters of full time enrollment or raising their QPA to 3.5 upon completing their graduation requirements graduate with university Honors.

College Honors

Students with outstanding academic records (a minimum overall QPA of 3.50 at the end of their junior year) 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 participation in group seminars on research techniques. They then present a summary of their research project at the Undergraduate Research Symposium in May. They graduate with "College Honors" if the resulting thesis paper is of sufficient quality to meet the approval of a faculty committee.

Graduation Requirements

In order to graduate with a Bachelor of Science in Business Administration or Computer Science, students must meet all requirements specified for that 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 receiving a degree.
A student may seek permission to modify graduation requirements by petition to the Associate Dean.

New Course Descriptions

Chemistry

Undergraduate Course Additions

09-341 The Color of Minerals and Inorganic Pigments
Intermittent: 9 units
Prerequisistes: 09-348 and 09-221
The color of minerals is a property easily noticeable by the expert and the casual viewer alike, and has made minerals attractive to people for millennia. Artists in particular have made use of minerals to create inorganic pigments that formed the bulk of the artistic palette until the industrial revolution. Historically, the craft of painting was closely linked to the practice of pigment manufacture, with painters procuring their materials in raw form directly from the chemist/ apothecary, and often performing themselves the final purification and grinding of the minerals into pigments. With the advent of mass-produced and marketed art materials in the nineteenth century, the distance between chemist and artist increased until the two worlds have little to do with one another. This class aims to reconnect the two disciplines for a study of their common ground: particularly the color of minerals. This color is underscored by inorganic chemistry, which governs the formation and properties of minerals. Students will learn about the origin of the color of minerals with primary focus on colors that originate from electronic transitions and will work collaboratively on hands-on laboratory research projects that involve the synthesis, characterization, and use of inorganic pigments. They will also create displays to illustrate for the public at-large the strong link between inorganic chemistry and art. Students will interact with the scientists of the Hillman Hall of Minerals and Gems of the Carnegie Museum of Natural History and of the Artist's Materials Center of Carnegie Mellon. A series of researchers who work at the boundary between art and chemistry will give guest lectures. This is a project course open students of chemistry and art. The course and its projects are designed to expand the expertise of students in both disciplines, while exposing them to the methods, demands, and aims of the other. 3 hrs. lec., 3 hrs. lab or studio

09-604 An Introduction to Chemical Kinetics
Spring: Mini Session 6 units
Rate laws and reaction mechanisms. Solving kinetics problems using the Laplace transform method. Transient and steady-state methods. Potential energy surfaces and reaction paths. Basic concepts of statistical mechanics and theories of reaction rates. Bimolecular and unimolecular reactions. Reactions in solution. Pre-requisite: 09-603 or permission of instructor.

09-612 An Introduction to Quantum Chemistry
Spring: Mini Session 6 units
Pre-requisite: 09-603 or permission of instructor
Introduction to quantum princ
iples. The main topics to be covered include Schroedinger equation, particle in a box, the harmonic oscillator, and rigid rotor. Applications to vibrational, rotational, and electronic spectroscopy.

Mechanical Engineering

Undergraduate Course Additions

24-302 Mechanical Engineering Seminar
(replaces 24-302 1 unit, and 24-303 1 unit)
Fall and Spring: 2 units
Prerequisite: none
The purpose of this course is to help students develop good presentation skills and to provide a forum for presentations and discussions of professional ethics. Students will make at least two presentations, one of which is related to professional ethics. Student grades will be based on their presentation skills and their participation in class discussions. 1 hr.rec.

24-390 Mechanical Engineering Co-op
All Semesters, 0-3 units
Prerequisite: Special permission required
The Department of Mechanical Engineering at Carnegie Mellon considers practical learning opportunities important educational options for its undergraduate students. One such option is cooperative education, which provides a student with an extended work experience with a company or government institution. To participate, students must possess at least junior status and have an overall grade point average of 3.0 or above. Students must complete a Co-Op Approval Form and submit it for approval. If the application is approved, the course will be added to the student's schedule and the student will be assessed tuition for 0-3 units for each semester that the student participates. Upon completion of the co-op experience, students must submit a 1-2 page report of their work experience, and a 1-2 page evaluation from the company supervisor to the ME Undergraduate Education Committee. If the reports are approved, a "P" grade will be assigned. International students should also be authorized by the Office of International Education (OIE). More information regarding CPT is available on OIE's website.

Materials Science and Engineering

Undergraduate Course Additions

27-324 Introduction to Polymer Science and Engineering
Fall 9 units
This course introduces the fundamental properties of polymer materials and the principles underlying the design as well as the engineering and manufacturing of polymer materials. The basic characteristics of macromolecules will be discussed followed by an introduction to relevant forming technologies and their significance to material performance. Technologically relevant engineering properties of polymer materials will be introduced with focus on mechanical, electrical, and optical properties. Selected case studies and design projects will introduce students to the various stages of technical product development, i.e. problem analysis, material selection and processing plan. (3 hours per week, prerequisites 27.100, 27.215).

27-445 Structure, Properties and Performance Relationships in Magnetic Materials
Spring: 9 units
This course introduces the student to intrinsic properties of magnetic materials including magnetic dipole moments, magnetization, exchange coupling, magnetic anisotropy and magnetostriction. This is followed by discussion of extrinsic properties including magnetic hysteresis, frequency dependent magnetic response and magnetic losses. This will serve as the basis for discussing phase relations and structure/properties relationships in various transition metal magnetic materials classes including iron, cobalt and nickel elemental magnets, iron-silicon, iron-nickel, iron-cobalt and iron platinum. This will be followed by a discussion of rare earth permanent magnets, magnetic oxides, amorphous and nanocomposite magnets. Polymers used in magnetic tape applications will also be covered.

Biomedical Engineering

Undergraduate Course Additions

42-101 Introduction to Biomedical Engineering (F/S, 12)
Pre-requisite OR co-requisite: 03-121 Modern Biology
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 four areas: biotechnology, biomechanics, biomaterials and tissue engineering and bioimaging and will introduce the basic life sciences and engineering concepts associated with these topics.

42-200 Sophomore BME Research Project (F/S, 3-12)
Research projects under the direction of a regular or courtesy BME faculty member. Arrangements may also be made via the Associate Head of BME for off-campus projects at local hospitals provided that a regular or courtesy BME faculty member agrees to serve as a co-advisor. The nature of the project, the number of units and the criteria for grading are to be determined between the student and the research advisor. The agreement should be summarized in a one-page project description with sign-off by the research advisor and a copy submitted for review and filing to the student's academic advisor. A final written report or oral presentation of the results is required. Units may vary from 3 to 12 according to the expected time commitment.

42-201 Professional Issues in Biomedical Engineering (F/S, 3)
Prerequisite: 42-101 Introduction to Biomedical Engineering
This course helps students learn to understand technical and professional challenges biomedical engineers face. First, it introduces students to applications of technology in medicine and biology. Second, it provides an overview of professional topics involving bioethics, regulatory issues, communication skills, team work, and contemporary issues. Outside speakers describe real world problems and professional issues in biotechnology and bioengineering, and progress toward their solution. Students have the opportunity to visit state-of-the-art laboratories in such areas as bioimaging, musculoskeletal biomechanics, rapid prototyping and manufacturing, and cardiac assist devices.

42-202 Physiology (F, 9)
Prerequisite: 03-121 Modern Biology, or permission of instructor
This course is an introduction to human physiology and includes units on all major organ systems. Particular emphasis is given to the musculoskeletal, cardiovascular, respiratory, digestive, excretory, and endocrine systems. Modules on molecular physiology tissue engineering and physiological modeling are also included. Due to the close interrelationship between structure and function in biological systems, each functional topic will be introduced through a brief exploration of anatomical structure. Basic physical laws and principles will be explored as they relate to physiologic function.

42-203 Biomedical Engineering Laboratory (S, 9)
Prerequisites: 42-101 Introduction to Biomedical Engineering and 03-121 Modern Biology. Pre-medical students may substitute 03-124 Modern Biology Laboratory.
This laboratory course is designed to provide students with the ability to make measurements on and interpret data from living systems. The experimental modules reinforce concepts from 42-101 Introduction to Biomedical Engineering and expose students to four areas of biomedical engineering: bioimaging, biomaterials, biomechanics, and cellular and molecular biotechnology. Several cross-cutting modules are included as well. The course includes weekly lectures to complement the experimental component.

42-300 Junior BME Research Project (F/S, 3-12)
Research projects under the direction of a regular or courtesy BME faculty member. Arrangements may also be made via the Associate Head of BME for off-campus projects at local hospitals provided that a regular or courtesy BME faculty member agrees to serve as a co-advisor. The nature of the project, the number of units and the criteria for grading are to be determined between the student and the research advisor. The agreement should be summarized in a one-page project description with sign-off by the research advisor and a copy submitted for review and filing to the student's academic advisor. A final written report or oral presentation of the results is required. Units may vary from 3 to 12 according to the expected time commitment.

42-311/27-510 Polymeric Biomaterials (S, 9)
Prerequisites: None, but 09-105 Introduction to Modern Chemistry and 42-101 Introduction to Biomedical Engineering will be useful.
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.

42-312/27-511 Metallic and Ceramic Biomaterials (F, 9)
Prerequisites: None, but 09-105 Introduction to Modern Chemistry and 42-101 Introduction to Biomedical Engineering will be useful.
The course addresses basic and applied concepts of metals and ceramics as biomaterials. The students will be exposed to the principles, properties and applications of amorphous and crystalline inorganic and metallic systems for biological applications. Specific emphasis will be placed on processing biochemical activity, biodegradation mechanisms, and various properties relevant for biological response. Cellular interactions with various surfaces and immunological responses will also be covered. Applications of biomaterials to be discussed include tissue engineering, 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.

42-321 Cellular and Molecular Biotechnology (S, 9)
Prerequisites: (42-203 Physiology OR 03-121 Modern Biology OR 03-232 Biochemistry) AND (06-262 Mathematical Methods of Chemical Engineering OR 21-260 Differential Equations) OR permission of instructor.
This course will provide students with an introduction to biotechnology in an engineering context. The focus will be on using microorganisms to prepare therapeutically and technologically relevant biochemicals. Topics to be covered include cellular and microbial metabolism, recombinant DNA methodologies, bioreactor design, protein separation and purification, and systems approaches to biotechnology.

42-334/03-310 Introduction to Computational Biology (S, 9)
Prerequisites: (21-112 Calculus II OR 21-118 Calculus of Approximation) AND 03-121 Modern Biology AND (99-101 OR 99-102 OR 99-103 Computing Skills Workshop).
This course covers the application of computers to solve problems in biology and medicine. Since computers are increasingly used in biological research, the course is valuable for all biological sciences majors and interested students from other departments. It is intended for students without computer programming experience (students with a desire to apply programming methods to these problems should take the more advanced course 03-510, Computational Biology). Topics covered are computational molecular biology (analysis of protein and nucleic acid sequences), biological modeling and simulation (including computer models of neuron behavior, biochemical kinetics, and simulation of mutation), and biological imaging. Course work consists primarily of homework assignments making use of software packages for these applications. Students may only use one of the following for credit: 42-334/03-310, 03-311, 42-434/03-510 or 42-734/03-710.

42-341 Introduction to Biomechanics (S, 9)
Prerequisites: 21-260 Differential Equations AND (24-262 Stress Analysis OR 12-331 Solid Mechanics OR equivalent). Useful, but not required: 24-141 Statics and Dynamics AND 24-202 Mechanics of Deformable Solids.
This course provides a general survey of the application of solid mechanics and rigid body dynamics to the study of the human cardiovascular and musculoskeletal systems. The mechanical properties and behavior of heart, blood vessel, bone, muscle and connective tissues are discussed and methods for the analysis of human motion are developed. Both analytic and experimental results are presented through readings from reports in recent journals and the relevance of these results to the solution of unsolved problems is highlighted. The development of appropriate models for particular problems is also considered.

42-347 Rehabilitation Engineering (F, 12)
Prerequisite: 42-202 Physiology
Rehabilitation engineering involves the application of engineering sciences to design, develop, adapt, and apply assistive technologies to problems confronted by individuals with disabilities in functional areas, such as mobility, communications, hearing, vision, and cognition, and in activities associated with employment, independent living, education, and integration into the community. It differs from classical biomedical engineering by its focus on improving the quality of people's lives, rather than improving their medical treatment. This course will require participation in simulations of disabilities and projects to develop new technologies.

42-400 Senior BME Research Project (F/S, 3-12)
Research projects under the direction of a regular or courtesy BME faculty member. Arrangements may also be made via the Associate Head of BME for off-campus projects at local hospitals provided that a regular or courtesy BME faculty member agrees to serve as a co-advisor. The nature of the project, the number of units and the criteria for grading are to be determined between the student and the research advisor. The agreement should be summarized in a one-page project description with sign-off by the research advisor and a copy submitted for review and filing to the student's academic advisor. A final written report or oral presentation of the results is required. Units may vary from 3 to 12 according to the expected time commitment.

42-413 Biomaterial Interfaces (S, 12)
The topic for this spring's course will be Fundamentals and Applications of Surfactants and Macromolecules at Interfaces. We will talk about the interfacial physical chemistry of surfactants, synthetic polymers and biopolymers including proteins and DNA. Applications will be drawn from materials technology, pharmaceutical processing,

and biotechnology. Students are welcome to take this course for credit or to sign up as an auditor. The latter choice might be suitable for those who have satisfied their course requirements but are interested in learning more about complex fluids or bio-interfacial phenomena

42-419 Biomaterial/Host Interactions (F, 12)
Prerequisite: senior standing in Biomedical Engineering, or consent of instructor.
The goal of this course is to provide students with hands-on experience in investigating host responses to materials. Implant studies of tissue-engineering materials will be performed using animal models in a laboratory setting, and students will gain experience in the analysis of host responses. Material biocompatibility and tissue regeneration will be addressed. Characterization techniques will include histology, real-time polymerase chain reaction, and immunofluorescent staining. Laboratory work will be complemented with lectures.

42-422 Bioprocess Design (S, 9)
Prerequisite: 42-321 Cellular and Molecular Biotechnology OR (03-232 Biochemistry AND 06-422 Chemical Reaction Engineering).
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 are to build an integrated, technical knowledge base of the manufacture of biologically based pharmaceuticals and the US biotechnology industry. Working knowledge of basic cell and modern biology, biochemistry, and differential equations/partial differential equations is assumed.

42-424 Biological Transport (S, 9)
Prerequisites: 06-262 Mathematical Methods of Chemical Engineering OR 21-260 Differential Equations. Useful, but not required: 06-261 Fluid Mechanics, 12-355 Fluid Mechanics, or 24-231 Fluid Mechanics.
Analysis of transport phenomena in life processes on the molecular, cellular, organ and organism levels. Material covered: Fick's Laws; electrolyte diffusion; coupled diffusion and chemical reaction; membrane transport mechanisms; osmosis; Donnan equilibrium; receptor-mediate binding; ultrafiltration and nephron function; blood flow; pharmacokinetic modeling.

42-426 Biosensors and BioMEMS (S, 9)
Prerequisites: 03-231 OR 03-232 Biochemistry.
This course emphasizes the principles of biomolecule-based sensing, including molecular recognition, biomolecular binding kinetics and equilibrium; methods of detection and signal transduction, including optical, colorimetric, fluorescence, potentiometric, and gravimetric techniques; statistical principles of high throughput screening; microfluidic and microarray device design principles and fabrication technologies; molecular motors.

42-431/18-496 Bioimaging (S, 9)
Prerequisite: 18-396
The goals of this course are to provide students with the basic mathematical and signal processing tools to help them solve a variety of bioimaging problems. These tools will be introduced in the context of a bioimaging application and the course will concentrate on the state-of-the-art multiresolution tools. Students will then use these tools to solve a practical bioimaging problem through an independent project.

42-434/03-510 Computational Biology (S, 12)
Prerequisites: 03-121 Modern Biology and (15-200 Advanced Programming or 15-211 Fundamental Data Structures and Algorithms).
This course covers a range of applications of computers to solve problems in biology and medicine. Specific topics covered are computational molecular biology (analysis of protein and nucleic acid sequences), biological modeling and simulation (including computer models of neuron behavior, biochemical kinetics, and simulation of mutation), and biological imaging. Course work will include use of software packages for these applications, reading of scientific papers, and programming assignments. Students may only use one of the following for credit, 42-334/03-310, 03-311, 42-434/03-510 or 42-734/03-710.

42-441 Cardiovascular Biomechanics (F, 9)
Prerequisite: 42-341 Introduction to Biomechanics
This course covers the solid and fluid mechanics of the heart and vascular system as well as the mechanics of medical devices used to assist or replace cardiovascular function.

42-444 Medical Devices (S, 9-12)
Prerequisites: Junior or Senior status
This course is an introduction to the engineering, clinical, legal and regulatory aspects of medical device performance and failure. Topics covered include phenomenological and mechanistic descriptions of processes such as wear, corrosion fatigue, fretting, in addition to the characterization of bone and other biological materials as it relates to device performance requirements including biocompatibility. The course also involves case studies of orthopedic fixation devices and prostheses, pacemakers, heart valves and artificial organs. A portion of the course is a final design project which involves the design of a new medical device or the redesign of an existing device.

42-502/24-759 Cellular Biomechanics (S, 9)
This course discusses how mechanical quantities and processes such as force, motion, and deformation influence cell behavior and function, with a focus on the connection between mechanics and biochemistry. Specific topics include: (1) the role of stresses in the cytoskeleton dynamics as related to cell growth, spreading, motility, and adhesion; (2) the generation of force and motion by moot molecules; (3) stretch-activated ion channels; (4) protein and DNA deformation; (5) mechanochemical coupling in signal transduction; (6) protein trafficking and secretion; and (7) the effects of mechanical forces on gene expression. Emphasis is placed on the biomechanics issues at the cellular and molecular levels; their clinical and engineering implications are elucidated.

42-731/18-799 Advanced Bioimaging (F, 12)
Prerequisite: 18-791, or permission of instructor.
The goals of this course are to provide students with the following: the ability to use mathematical techniques such as linear algebra, Fourier theory and sampling in more advanced signal processing settings; fundamentals of multiresolution and wavelet techniques; and in-depth coverage of some bioimaging applications such as compression and denoising. Upon successful completion of this course, student will be able to: explain the importance and use of signal representations in building more sophisticated signal processing tools, such as wavelets; think in basic time-frequency terms; describe how Fourier theory fits in a bigger picture of signal representations; use basic multirate building blocks, such as a two-channel filter bank; characterize the discrete wavelet transform and its variations; construct a time-frequency decomposition to fit a given signal; explain how these tools are used in various applications; and apply these concepts to solve a practical bioimaging problem through an independent project.

42-735/16-725 Medical Image Analysis (S, 12)
Prerequisites: Permission of the instructor, knowledge of C++, vector calculus and basic probability.
The fundamentals of computational medical image analysis will be explored, leading to current research in applying geometry and statistics to segmentation, registration, visualization, and image understanding. Student will develop practical experience through projects using the National Library of Medicine Insight Toolkit (ITK), a new software library developed by a consortium of institutions including CMU. In addition to image analysis, the course will describe the major medical imaging modalities and include interaction with practicing radiologists at UPMC.

English

Undergraduate Course Additions

76-266 Survey of Forms: Nonfiction
Spring or fall: 9 units
Prerequisite: *Credit for 76-101 or a designated writing course*
The National Endowment for the Arts defines "creative nonfiction" as "factual prose that is also literary." In this survey course, students will read a wide range of work that falls into this lively genre, including memoir, travel writing, the personal essay, and nature writing. Weekly writing assignments will give students the chance to work on short pieces of their own creative nonfiction.

76-344 Utopias
Fall or spring: 9 units
Utopian fiction has a long history, starting well before Thomas More gave the title *Utopia* to his description of an ideal society early in the 16th century. Such fiction has been written in many forms, some for elite and some for popular audiences, much of it recently in the form of science fiction. Utopian fiction investigates how human societies can be established and managed to make the best possible use of natural and human resources and thereby create a version of social justice that is both legal and economic. The course will start with Plato's *Republic,* More's *Utopia,* and Bacon's *New Atlantis*, and go on to the remarkable array of 19th and early 20th-century utopias created by authors like Edward Bellamy, H. G. Wells, and Charlotte Perkins Gilman. Then we will examine some later 20th-century fictions and their slide toward dystopias like Huxley's *Brave New World*, and Orwell's *1984*. Throughout the term we will be looking at some important films and televised narratives with a utopian/ dystopian emphasis.

76-319 Environmental Rhetoric
Fall: 9 units
Who speaks for Nature? The poet, the hiker, the rancher, the scientist, or the activist? How do theses different stances "represent" the meaning of environment in their words and actions? This introduction to ways we talk about the environment and understand our relation to the natural world will trace an American history that has combined mystical celebration with militant critique, and scientific research with public debate.
We will read some of the landmark voices in this public discussion, including writers such as Henry Thoreau, John Muir, Rachel Carson, Aldo Leopold, and Edward Abbey, and we will see their influence in popular films and activist groups, from the radical Earth First! to Greenpeace, to the mainstream Sierra Club and Nature Conservancy. We will explore the competing discourses that have emerged in the American debate (the conservationists versus preservationists, the scientific ecologists versus deep ecologists), looking at both their rhetorical strategies and their response to the fundamental environmental question: is nature best understood as a resource, as an object of scientific inquiry, or as spirit?

76-466 Nonfiction Workshop
Fall or Spring: 9 units
Prerequisite: *76-266 with a grade of A or B*
There is a great range of writing that falls into the genre called "creative nonfiction," including memoir, the essay, and literary journalism. In this workshop, students will read short and full-length works by some of the masters in the field, and hone their own skills as writers. By the end of the semester, students must have forty pages of polished writing.

History

Undergraduate Course Additions

79-167 Freshman Seminar: Rivers as Environmental Gateways to American History
Intermittent: 9 units
This course will explore the critical role that rivers have played throughout American history from a number of perspectives. These include a discussion of rivers as natural bodies; human uses of rivers as transportation avenues (rivers as infrastructure), pollution sinks and sources of water supply; human attempts to alter and shape rivers; rivers as hazards; the use and meaning of rivers to different groups in society; and, images of rivers in literature and popular imagination.

79-168 Freshman Seminar: From Peasants to Ph.D.s: The History of Immigration to the US
Intermittent: 9 units
Immigration has been a major transforming force in American history. This course will trace the history of immigration to the United States and examine how historical, social, political and economic factors have both affected and been affected by immigration. We will identify and discuss the common experience of migrants across a number of time periods and ethnic groups, as well as the differences that make each group's story unique. Finally, we will examine the evolution of American responses to various immigrant groups, questioning whether the responses reflected or helped to shape the opinions of Americans in the respective time periods.

79-200 Historical Evidence and Interpretation
Fall and Spring: 12 units
"Historical Evidence and Interpretation" is a course designed for history majors and other students who want to learn about how historians really work. This course considers how historians practice their craft in interpreting great events. The emphasis is on learning to supplement standard secondary accounts of an event with primary sources such as memoirs, government documents, speeches, interviews, newspapers, maps, eye-witnesses and UN resolutions. Other unusual sources include poetry, music, film, satire, and political cartoons. The goal is for the student to develop a familiarity with the skills an historian uses to identify a research topic, make use of a wide array or sources, and present his or her findings in a proper scholarly fashion.

79-202 The History of Public Policy in the United States
Intermittent: 9 units
This course will describe and analyze public policy as the making of laws and rules and their implementation by government over time. Public policy will be analyzed as an alternative to private markets for making collective decisions. The US began in 1787 as a minimal state providing mainly collective goods such as national defense, with markets making most of the decisions about the allocation of resources. The course will be organized around the general presumption that a justification for government activity is to do things that markets do not do well, that is, to remedy "market failures." Among the policy areas to be considered are environmental protection, science and technology policy, competition policy, trade policy, health policy and social security. The course will consider the possibility that government intervention to remedy market failures can make things worse as well as better.

79-214 18th Century European History
Intermittent: 9 units
The goal of this course will be to examine, in both breadth and depth, the history of Europe between roughly 1715 (the death of Louis XVI) and 1815 (the fall of Napoleon). Broad themes to be covered include "old regime" Europe, European religiosity and secularism, the Enlightenment, the development of public opinion, the rise of Prussia, the industrial revolution in Britain and the continent, mercantilism, and trends in the arts. Students will be expected to attend lectures, participate in class discussion, write two exams, read and discuss a number of primary and secondary sources, submit weekly opinion papers, and complete a term paper on an 18th-century European topic.

79-218 The Roots of Rock & Roll
Intermittent: 9 units
This course spends 8 weeks on early blues and country "roots" music (like Bessie Smith and Woody Guthrie) of the 1920s-1950s before turning, in the last third of the semester, to the 1960s revolutions of Bob Dylan, Jimi Hendrix, Janis Joplin and other rock & roll legends. The format is informal lecture and discussion on Tues/Thurs afternoons – plus a required film screening and discussion every Wednesday evening, 6:30-9:20pm. Besides reading 3-4 books and many articles, assignments include weekly music listening, four short essays and a longer final paper.

79-225 Religions of China
Intermittent: 9 units
How have Chinese addressed universal questions of personal meaning and survival, and of social connection and authority, with the help of religion? This course is interested in solutions elaborated over the centuries by Chinese of all social classes. Without neglecting the textual canon, we are particularly interested in changing styles of ritual organization and practice. We examine mutual borrowing and competition among shamanism, ancestor worship, Confucianism,

Buddhism, and Daoism, and the adaptation of each to varying social contexts and state policies up to the present. Much of the material is in the form of original sources including descriptive accounts, introduced by religious historians, and fiction. The latter part of the course uses anthropological works to account for the religious practices currently flourishing in both Taiwan and Mainland China.

79-234 Body Politics: Women and Health in America
Intermittent: 9 units
Women's bodies have been the sites of long-standing, and sometimes deadly, political battles. This course takes a topical approach to the history of American women's health in the nineteenth and twentieth centuries in order to understand why women's bodies have been such heated sites of struggle. It covers topics such as the history of contraception, abortion, menstruation, sexuality, female anatomy, rape, domestic abuse, menopause, pregnancy, and childbirth. It explores how American culture has constructed these issues over time, while also examining women's organizing around them. Paying attention to the biological, socio-cultural, economic, and political dimensions of these various subjects, this course investigates how biology and science are not simply objective, but often subjective, being deeply implicated in the politics and history of inequality.

79-237 City Histories: Delhi and London
Intermittent: 9 units
The British Empire connected two great cities – London and Delhi – but even before the British came to India, Tudor London and Mughal Delhi presented a dazzling display of imperial politics and culture to the world. This course looks at the parallel destinies of these metropolises. It proceeds from that early-modern period into the age of Queen Victoria and her Indian Viceroys, down until today's post-colonial era. Finally, it examines some of the ways in which late-modern political events, environmental change and migration have affected these two civic spaces. Art, travel, diaries, poetry, film, music and other documents will supplement the main textbooks. At the end of the course, you are expected to have learned something about South Asian and British history, about city cultures in 'East' and 'West' and to have reflected about the changing roles for metropolises in a contemporary globalized world.

79-248 Ownership & Property in Historical Perspective: Land, Bodies, Ideas & Information
Intermittent: 9 units
This course surveys the changing relationship between private property and the public domain from the 17th century to the present. We will look at economic, social, and political justifications concerning the ownership of land, bodies, ideas and information. The course will begin with an exploration of the roots of our present day property regimes: the land enclosure movement in early modern England (where peasants were forcibly removed from common land so that it could be converted into private estates) and the development of intellectual property law in English and American jurisprudence. We will then undertake an examination of how ideas about property and the public domain have evolved as people began to make property claims on new things, including: slaves, works of literature and art, radio bandwidth, software code, the environment, reproductions of books and music (especially over the internet), one's own body, cell lines, tissues, organs, and regions of the genome. We will conclude with a discussion of how Western ideas about the private and the public are being spread around the world through international trade agreements, and how these concepts often come into conflict with local views of ownership.

79-250 Europe's Two Revolutions: Dynamics of Change in the 19th Century
Intermittent: 9 units
"Europe's Two Revolutions" is a comparative history of Europe in the nineteenth century, focusing on France, Britain and Germany. The "Two Revolutions" title acknowledges that much of the history of Europe in this period can be understood as the legacies of the French Revolution of 1789-94, which unleashed new ideas about the nature of political life, and the Industrial Revolution, which brought a host of new social and economic problems to the continent. We approach the topic using a variety of sources including personal memoirs and eyewitness accounts, government reports, fictional accounts, speeches, and political writings of the time as well as more recent studies. We discuss the development of such important political and social movements as nationalism, feminism, conservatism and socialism, seeking to capture both similarities and differences in the ways these movements developed in the three countries. In addition to illuminating large trends in the nineteenth century, the course provides background for the study of twentieth-century European history, and for the history of other regions of the world that have been affected both by the revolutionary traditions born in France and processes of industrialization.

79-254 The Pacific Islands: History and Culture
Intermittent: 9 units
This semester, we are focusing on Hawaii—a Pacific Island, an American state, and a popular tourist spot. Hawaii at once fills our imagination and occupies a strategic niche in United States policies. Since its "discovery" by Captain Cook, Hawaii has attracted visitors and has welcomed visitors not only from the United States but from all over the world. The story has not always been positive: we will take a historical perspective on the changes in Hawaii over the past two and a half centuries, and we will explore the culture of the islands. We will read accounts by "outsiders" and accounts by kama'aina, "children of the land," residents of Hawaii. We will also consider representations of the islands in media other than text, films, for instance, and visual arts. The goal is to explore the complexity of a place that is often stereotyped as "paradise," but exemplifies problems of conquest and commercialization, of ethnic groups and boundaries, of commercialization and globalization, and of identity politics and independence movements. Readings include anthropological texts, literature, and selected essays.

79-271 Modern China
Intermittent: 9 units
Assuming no prior familiarity with China or its culture, this course examines China's continuous changes from the 1800s on, in its cultural traditions, identities, daily life, social relations, and self-perceptions, engendered by both internal initiatives and external contact. We look at how changes unfolded in mass movements and in individual lives, in statecraft thought and in societal practices. We examine the roles of such historical actors as the extended family, modern reformers, the state, and ethnic groups. Participants learn to use primary sources in making historical observation and to critique some analytical approaches to modern Chinese history. Since we rely heavily on assigned readings, active class participation is essential in this course.

79-284 Gender Relations, the Family, and Women in Russian History: 1861 to Present
Intermittent: 9 units
Using film, novels, interviews, and historical sources, this course will explore the history of gender relations, the family, and women in Russia. Beginning in the late nineteenth century, we will explore family relations in both noble and peasant families, the laws governing marriage, divorce and children, restrictions on women's movement and education, and gender roles. We will look at the explosive changes of the Russian revolution and the radical experiments with free love and communal childrearing. We will trace the development of opportunities for women in the 1930s, the painful demographic impact of WWII, and the changing culture of the post war years. We will end by examining the difficulties that rural and urban families are currently facing in the transition to a market economy.

79-289 Development of South Asian Culture and Society
Intermittent: 9 units
This course will familiarize students with an overview of South Asian culture and society from a historical standpoint. It provides a broad perspective on the present –day countries of India, Pakistan and Bangladesh, and also the South Asian diasporas across the contemporary world. While it does not require any prior background in Asian history, it demands a willingness to read and encounter a variety of historical and cultural materials from the region. Audio-visual materials and literature extracts will be extensively used to supplement and enrich the readings.

79-299 US-Arab Encounters
Intermittent: 9 units
What is the nature of the relationship between the United States and the Arab countries? This is an innovative cross-cultural course that will enable Carnegie Mellon students in Pittsburgh and at the Carnegie Mellon campus in Qatar to interact with one another and with students at other American and Arab universities in exploring the US-Arab relationship. The goal is to improve awareness and understanding. Students will delve into themes and questions within an interdisciplinary framework that includes history, international relations, conflict resolution and media studies. Topics range from the role of religion in society to an investigation of the part media plays in shaping US and Arab perceptions. Carnegie Mellon students in

Pittsburgh and Qatar will utilize the newest web-camera and videoconferencing for the traditional in-class part of the course and enjoy a chance to work collaboratively on projects with students elsewhere in the US and the Arab world via an on-line discussion forum. Students registering for this class should be prepared for a substantial time commitment to allow for the opportunity to meet and work in real time with students far from Pittsburgh. Participating schools include: Tufts, Harvard, Clark, Virginia Commonwealth, Birzeit, Qatar, American University of Cairo, American University of Beirut, and Philadelphia University (Jordan).

79-309 The Politics of American Military Recruitment: Historical Perspectives
Intermittent: 9 units
This course examines a number of major policy choices in recruiting American men and women into military service, and the political and cultural controversies that have surrounded those choices, from the late 18th century to today (with the focus on World War I to the present). The main topics to be covered – all from a historical perspective — will likely include most or all of the following: 1) the draft, the all-volunteer military, and the Reserves/National Guard as methods of military recruitment; 2) the exclusion/incorporation of African Americans, women, and gays into military service; 3) the recruitment and training of enlistees and draftees; 4) the recruitment and training of military officers; and 5) protest movements against military recruitment. The course will be discussion based and centered on analysis of required readings for each class. Evaluation of students' performance will be based on: a) participation and leadership in class discussions, b) a mid-term and final exam, and 3) a term paper based on primary historical sources, or a critical book review, that elaborates one or more of the themes raised in class (approximately 2500 words).

79-318 Slavery, the Civil War, and Reconstruction
Intermittent: 9 units
This course explores one of the most enduringly salient eras of American history, the three decades between 1848 and 1877, during which Americans fought the bloodiest battle in their history, the American Civil War. We will explore the institution of slavery, the roots of sectional crisis, the war, emancipation, and the turbulent aftermath of the war, known as Reconstruction. This course is not primarily a military history course; rather, it examines the political, economic, social, and cultural history of these years, seeking to understand why the Civil War and emancipation happened and what those pivotal events have meant throughout American history.

79-319 The City and the Country in Modern Europe
Intermittent: 9 units
This course focuses on modern European culture and politics through the lens of the relationship between urban and rural life. Drawing on historical, literary, and anthropological sources, the class will first explore how representations of the city and the countryside have continually shaped and been shaped by Europeans' understanding of history, geography, society, and the nation-state. After this broad overview, we will proceed by examining a set of topics that reveal the primary forces that have led to radical changes in both urban and rural life since the 1950s in the countries of western Europe. Among the topics that will be considered are migration, consumerism, tourism, the spatial organization of class and ethnic identity, recurrent crises of industry and agriculture, environmental movements, the impact of mass media, the conduct of democratic politics, and the development policies of the European Union. Throughout the course our main concern will be to understand how these general forces have generated conflicts over power and values that have transformed the everyday experience and sense of possibilities for the future of ordinary Europeans who live in very different kinds of urban and rural communities.

79-320 Women and Social Protest
Intermittent: 9 units
This course examines the history of women's rights agitation in the United States from the early nineteenth-century to the present. It investigates both well-known struggles for women's equality—including the battles for women's voting rights, an Equal Rights Amendment, and access to birth control—and also explores the history of lesser-known struggles for economic and racial justice. Because women often differed about what the most important issues facing their sex were, this course explores not only the issues that have united women, but also those that have divided them. Do women constitute a coherent category? And can a women's rights movement represent all women? These are some of the questions at the heart of this class.

79-367 Delinquency, Crime, and Juvenile Justice: The Modern Period, 1950 to the Present
Intermittent: 9 units
This course will examine juvenile delinquency in historical, sociocultural, and policy contexts since the end of World War II (1950 to the present), and will focus mainly on the United States. Readings will be drawn from historical, sociological, psychological, literary, and journalistic accounts of juvenile delinquency and the operations of the juvenile justice system. We will also analyze the treatment of delinquents as revealed in original case files of a mid-century juvenile court, and in approximately a half-dozen films produced between the 1950s and 1990s (e.g., "West Side Story" and "Boyz N the Hood"). (We will set a mutually agreeable time to view and discuss these films as a class, but you will also be able to view/review them in Hunt Library.) Finally, we will attempt to arrange one or two class visits to juvenile justice institutions in the Pittsburgh area. The course will be run in a seminar format; student initiative and participation in each class discussion are essential. Evaluation will be based on several writing assignments (including midterm and final examinations) and on oral presentations and class participation.

79-379 Women in American History
Intermittent: 9 units
This course explores the history of women in the United States since the mid-eighteenth century. We will examine the sometimes common, but often divergent, experiences of women as they attempted to negotiate and improve their lives in changing historical circumstances. Our discussions will include the experiences of women of color as well as women from different classes and regions.

79-395 The Arts in Pittsburgh
Intermittent: 9 units
This course will examine the arts in Pittsburgh, both historically and in the present. We will focus especially on art exhibits and musical events scheduled by the city's museums and concert halls during the semester. The "curriculum" will derive from the artistic presentations themselves, which will provide a springboard for reading assignments, seminar discussions, and research papers in the history of music and art. We will also examine the historical development of cultural institutions in Pittsburgh. The History Department will pay for students' admission to all museums and studios. However, students will be charged a supplemental fee of $110 to help subsidize the considerable expense of purchasing tickets for concerts and performances by the Pittsburgh Symphony, Pittsburgh Opera, Chamber Music Society, and Renaissance and Baroque Society. Attendance at all art exhibits and musical events is required. Prerequisite: Availability to attend art exhibits on several Friday and Saturday afternoons, and to attend musical events on several Monday and Friday evenings.

79-396 Music and Society in 19th/20th Century Europe and the U.S.
Intermittent: 9 units
This course will explore the interrelations between society and classical and popular music in the nineteenth and twentieth centuries in Europe and the United States. We will examine the importance of different musical forms in the life of society and how music contributed to the making of political consciousness, especially in the twentieth century. In addition to reading assignments, seminar discussions, and research papers in the history of music, students will be taken to the performances of the Pittsburgh Symphony, Pittsburgh Opera, and Chamber Music Society. A supplemental fee of $110 will be charged to subsidize part of the considerable expense of purchasing tickets for concerts and performances. Prerequisite: Availability to attend musical events on several Monday, Friday, and Saturday evenings.

79-404 Extreme Ethnography
Intermittent: 9 units
Observation, participation and direct experience of "the field" are hallmarks of anthropological ways of knowing, and their representation has played a foundational role in ethnographic writing both past and present. Yet reflexive and postmodernist explorations of these topics have triggered contentious debates over the nature of anthropology as a scientific or humanistic enterprise, and over its ethical, political and epistemological value. In this seminar, we will approach such questions through an exploration of the extremes of ethnographic fieldwork and writing. We will consider such topics as: the colonial history and politics of explorers and ethnographers; liminality and the place of extreme experience—such as cultural dislocation, violence, derangement, intoxication, sex, possession, and

dreaming-in fieldwork and writing; field-notes as an ethnographic genre, and their relationship to "official" published ethnography; ethnographic surrealism and surrealist ethnography; the dimensions of sensory experience (visual, auditory, olfactory, etc.) in fieldwork and ethnography; collecting and the powers of "exotic" objects; inter-subjectivity and its implications; and experimentation with alternate ethnographic forms, such as autobiography, film, diary, and poetry. **Please Note**: students electing to take this class should have a background in anthropology.