

# The Academic Program

## College of Engineering Majors

In the first two years, students in the College of Engineering take a set of course designed to provide a firm foundation for later specialization. This set of courses conforms to the Common Curriculum, which is established by the College Curriculum Governing Board (CCGB) and administered through Engineering Advising. During the sophomore year, students choose and affiliate with an undergraduate Major; thereafter, they take courses to satisfy the Bachelor of Science degree in that Major.

Here is the list of Engineering Majors:

Biological Engineering (BE)  
Chemical Engineering (ChemE)  
Civil Engineering (CE)  
Computer Science (CS)  
Electrical and Computer Engineering (ECE)  
Engineering Physics (EP)  
Environmental Engineering (EnvE)-pending  
Geological Sciences (GeoS)  
Independent Major (IM)  
Information Science, Systems, and Technology (ISST)  
Materials Science and Engineering (MSE)  
Mechanical Engineering (ME)  
Operations Research and Engineering (ORE)

### Requirements for Graduation

The detailed requirements of the Common Curriculum appear in the University Announcement Courses of Study, which is revised annually. Students should become familiar with this material, because they are ultimately responsible for meeting all graduation requirements.

The Common Curriculum and the

Bachelor of Science degree require a certain number of credits in courses belonging to ten categories, as listed on page 21.

### Category 1. Mathematics

Students must earn a grade of at least C- in MATH 191 (or 190), 192, 293 or 294, and an approved Major-specific math course. Students who do not meet this requirement the first time they take a course must immediately repeat the course and earn a satisfactory grade. Students may not enroll in the next course in the sequence until they have done so. (A grade lower than C- the second time will generally result in dismissal from the engineering program.) Courses taken a second time to meet this requirement do not yield additional credit toward a degree.

### Category 2. Physics

Students must earn at least C- in MATH 191 (or 190) or have substantial previous contact with introductory calculus combined with coregistration in MATH 191 (or 190) before taking PHYS 112. Similarly, at least C- is required in each subsequent math course before taking the physics course for which it is a prerequisite (MATH 293 is a co or prerequisite to PHYS 213; MATH 294 is a co or prerequisite to PHYS 214).

### Category 3. Chemistry

Students who do not intend further study in chemistry should enroll in CHEM 211 during either semester of the freshman year. Students choosing the CHEM 207-208 sequence must enroll in CHEM 207 during the fall semester of the freshman year so that they may enroll in CHEM 208 during the spring term. CHEM 211 may be used as a prerequisite for CHEM 208. If one semester of chemistry is required, either CHEM 211 or 207 may be used.

#### **Category 4. First-Year Writing Seminars**

During each semester of the freshman year, students must choose a first-year writing seminar from among more than 100 courses offered by over thirty different departments in the humanities, social sciences, and expressive arts.

These courses, which offer the benefits of small class size, provide an opportunity to practice writing English prose.

#### **Category 5. Technical Writing**

Students can fulfill the upper-level technical-writing requirement in one of the six ways shown below. For more information see [www.engineering.cornell.edu/ECP/index.htm](http://www.engineering.cornell.edu/ECP/index.htm).

1. ENGRC 350 or ENGRC 335, taught by the Engineering Communications Program.
2. The Writing-Intensive Co-op, an opportunity to combine work and academics. Some co-op students do a significant amount of writing on the job, and, under certain circumstances, this writing might satisfy the college's technical-writing requirement.
3. An officially designated writing-intensive (W-I) engineering course:  
ENGRD/AEP 264  
CHEME 432  
MSE 403/404 (both)  
MSE 405/406 (both)  
MAE 427  
BEE 450 with co-registration in BEE 493  
BEE 473 with co-registration in BEE 493  
BEE 489
4. ENGRC 302, a one-credit attachment to an engineering course that is not one of the officially designated W-I courses (see #3 above). An instructor may wish to extend the writing done in their course for a given semester so that it will fulfill the technical-writing requirement. With the approval of the CCGB's Subcommittee on Technical Writing, the instructor may have stu-

dents co-register in ENGRC 302. May be taken more than once, with different courses. By permission of engineering instructor.

5. COMM 260, 263, or 352, taught by the Department of Communication (in the College of Agriculture and Life Sciences)
6. A petition. Occasionally, a student realizes that they will be doing a significant amount and variety of technical writing elsewhere in the Engineering College. It may be appropriate to submit a petition to the CCGB's Subcommittee on Technical Writing, for permission to use their upcoming writing (not past writing) to meet the technical-writing requirement.

#### **Category 6. Computing**

COM S 100, Intro to Computer Programming, is normally taken in the freshman year to fulfill the computer programming requirement.

Before taking COM S 100, some students take COM S 099, Fundamental Concepts of Computers, offered in the fall only. This two-credit S/U course is meant for students with virtually no programming experience; students with previous programming experience may not take it. Basic programming concepts and problem analysis are studied. COM S 099 may not be used as credit toward graduation.

#### **Category 7. Engineering Distribution**

The Common Curriculum requires three distribution courses (9 credits). One course, an intro to engineering course (designated by ENGR1), is to be completed during the freshman year. The remaining two distribution courses (designated by ENGRD) should be completed by the end of the third semester. Some majors may require additional distribution courses, taken after a student affiliates with a major. All common-curriculum distribution requirements must be fulfilled by the end of the sophomore year.

The intro to engineering courses intro-



Lecture and Laboratory  
BIO G 105, Introductory Biology  
BIO G 107, General Biology (summer only)  
CHEM 389, Physical Chemistry I  
ENGRD 252, The Physics of Life

### **Category 8. Liberal Studies**

#### **Distribution**

The following liberal studies distribution requirements begin with the class entering in 2003. Students who entered before that may choose to use the new requirements.

Global and diverse societies require that engineers have an awareness of historical patterns, an appreciation for different cultures, professional ethics, the ability to work in multifaceted groups, and superior communications skills. Cornell has a rich curriculum in the humanities, arts, and social sciences, enabling every engineering student to obtain a truly liberal education. A minimum of six courses (totaling at least 18 credits) is required, and they should be chosen with as much care and foresight as courses from technical areas.

- The six courses must be chosen from at least three of the following six groups
- At least two courses must be from the first three groups (CA, HA, LA).
- At least two courses must be at the 200 level or higher.

Please refer to the web page of Cornell Engineering Advising ([www.engineering.cornell.edu/studentServices/advising.cfm](http://www.engineering.cornell.edu/studentServices/advising.cfm)) or visit Engineering Advising, 167 Olin Hall, for a complete list of acceptable courses in those groups.

#### **Group 1. Cultural Analysis (CA)**

Courses in this area study human life in particular cultural contexts through interpretive analysis of individual behavior, discourse, and social practice. Topics include belief systems (science, medicine, and religion), expressive arts and symbolic behavior (visual arts, performance, poetry, myth, narrative and ritual), iden-

tity (nationality, race, ethnicity, gender, and sexuality), social groups and institutions (family, market, and community), power and politics (states, colonialism, and inequality).

#### **Group 2. Historical Analysis (HA)**

Courses in this group interpret continuities and changes—political, social, economic, diplomatic, religious, intellectual, artistic, and scientific—through time. The focus may be on groups of people, dominant or subaltern, a specific country or region, an event, a process, or a time period.

#### **Group 3. Literature and the Arts (LA)**

Offerings in this area explore literature and the arts in two different but related ways. Some courses focus on the critical study of artworks and on their history, aesthetics, and theory. These courses develop skills of reading, observing, and hearing and encourage reflection on such experiences; many investigate the interplay among individual achievement, artistic tradition, and historical context. Other courses are devoted to the production and performance of artworks (in creative writing, performing arts, and media such as film and video). These courses emphasize the interaction among technical mastery, cognitive knowledge, and creative imagination.

#### **Group 4. Knowledge, Cognition, and Moral Reasoning (KCM)**

Offerings in this area investigate the bases of human knowledge in its broadest sense, ranging from cognitive faculties (such as perception) shared by humans and animals, to abstract reasoning, to the ability to form and justify moral judgments. Courses investigating the sources, structure, and limits of cognition may use the methodologies of science, cognitive psychology, linguistics or philosophy. Courses focusing on moral reasoning explore ways of reflecting on ethical questions that concern the nature

of justice, the good life, or human values in general.

### **Group 5. Social and Behavioral Analysis (SBA)**

Courses in this area examine human life in its social context through the use of social-scientific methods, often including hypothesis testing, scientific sampling techniques, and statistical analysis. Topics studied range from the thoughts, feelings, beliefs, and attitudes of individuals to interpersonal relations between individuals (e.g., in friendship, love, conflict) to larger social organizations (e.g., the family, society, religious or educational or civic institutions, the economy, government) to the relationships and conflicts among groups or individuals (e.g., discrimination, inequality, prejudice, stigmas, conflict resolution).

### **Group 6. Foreign Languages (not literature courses)**

Courses in this area teach language skills, inclusive of reading, writing, listening, and spoken non-English languages, at beginning to advanced levels.

### **Category 9. Electives**

Six credits of approved electives are required and are approved by the student's faculty advisor. Because these courses should help develop and broaden the skills of the engineer, advisors will generally accept the following as approved electives: one introduction to engineering course, engineering distribution courses, courses stressing oral or written communication, upper-level engineering courses, advanced courses in mathematics, and rigorous courses in the biological and physical sciences. Advisors are likely to approve courses in business, economics, and language that serve the student's educational and academic objectives. In other cases, a student's interests might be better served by approved electives that expand the Major or other parts of the curriculum, including the liberal studies requirement. (No

ROTC courses may be used as approved electives unless they are co-listed by an academic department.)

Students are free to take as many courses offered at the university in addition to the minimum engineering curriculum requirement as they wish before meeting graduation requirements.

No course with a number <100 can be applied toward graduation requirements.

### **Category 10. Major requirements**

The requirements of the Majors are discussed on page 22-87. They include:

1. Major-required courses, i.e. courses in the Major itself.
2. Major-approved electives (9 credits)
3. Major-complementary courses (9 credits). These courses, taken outside the Major, ensure breadth of engineering studies.

### **Residence Requirements**

Candidates for an undergraduate degree in engineering must spend at least four semesters or an equivalent period of instruction as full-time students at Cornell. They must also spend at least three semesters of this time affiliated with an engineering Major.

Students who are on a voluntary leave of absence are permitted to register for courses extramurally only with the approval of their major (or the college, for unaffiliated students). No more than 18 credits earned through extramural study or acquired as transfer credit (or any combination thereof) following matriculation may be used to satisfy the requirements for the bachelor's degree in engineering. Students cannot complete their last semester extramurally.

Degree candidates may spend periods of time studying away from the Cornell campus with appropriate authorization. Information on programs sponsored by other universities and on procedures for direct enrollment in foreign universities is available at the Cornell Abroad office, 474 Uris Hall. Programs should be planned in consultation with the staff of Engineering

Advising, who can provide information on credit-evaluation policies and assist in the petitioning process.

### **Freshman Year Requirements**

By the end of the freshman year, engineering students are expected to have completed (or received credit for) the following core requirements:

- MATH 191 (or 190) and MATH 192;
- Two of the following: CHEM 211, 207, 208, PHYS 112, 213, 214\*
- COM S 100;
- Two (2) first-year writing seminars;
- One (1) intro to engineering course (ENGR designation);
- Two (2) physical education courses

### **Preparing for a Major**

Some Majors begin with courses that cannot be taken without prior completion of certain prerequisites. Students planning to affiliate with such a Major must decide to do so early enough to take the prerequisite courses, even though they will not formally affiliate until after the prerequisites have been completed. Information on prerequisites of each Major is available in the charts on pages 22-87 in this handbook and in Courses of Study.

### **Learning About Majors/Careers in Engineering**

The Engineering 150 Seminar Program (ENGRG 150)

All freshmen are pre-enrolled in an ENGRG 150 section. This one-credit fall course provides first-year students with an opportunity to get to know their faculty advisors on a more personal level. Meeting regularly with their advisees gives advisors an opportunity to learn about each student, to assist in resolving problems as they arise, and to help new students adjust to the demands of the engineering curriculum.

Activities in ENGRG 150 may include discussion of engineering careers, active research in the college and engineering in general, ethics, and workshops on study and exam skills useful to engineering students. Practicing engineers, advising staff, and faculty members from different disciplines may join the group from time to time.

### **Faculty Advisors**

Every student in the College of Engineering is assigned a faculty advisor. As Engineering faculty, the advisors are able to help students learn about engineering through the ENGRG 150 seminar, through one-on-one meetings, and through informal activities sponsored by the college, departments/schools, and student organizations. For more information on faculty advisors, see page 109.

### **Peer Advisors**

As part of the Engineering 150 seminar, freshmen are assigned one or two peer advisors—sophomores, juniors, and seniors who have volunteered to help new students understand the course selection process, meet other engineering students, and adjust to life at Cornell. They can offer useful information about courses, tips on studying, student activities, organizations, and other need-to-know facts about campus life from a student's point of view.

### **Introduction to Engineering Courses**

Introduction to engineering courses are designed to initiate students to the engineering process in a variety of contexts. Some intro courses are major specific, while others cover engineering more broadly, introducing two or more majors. Engineering students are required to take at least one introduction to engineering course in the first or second semester at

\*Students with an interest in pre-med or other health-related careers, Biological, Chemical, Civil, or Environmental Engineering, or the Science-of-Earth Systems option in Geological Sciences should enroll in the CHEM 207-208 sequence during the freshman year.

Cornell. See *Courses of Study* for individual course descriptions.

### **Engineering Spring Career Fair**

In cooperation with Engineering Career Services, the Engineering Student Council (ESC) coordinates a spring career fair for full-time, internship, and co-op recruitment.

### **National Engineers Week**

The Engineering Student Council (ESC) initiated the celebration of National Engineers Week at Cornell University in 1998. During February of each year, the ESC coordinates seven days of events organized by the council and other engineering-affiliated groups, including the following:

*Engineering Day at the Mall* Cornell engineering organizations staff booths for children in the Ithaca community to learn about science and engineering concepts.

*Diversity Dinner* In cooperation with NSBE, SHPE, and SWE, the ESC coordinates a dinner to celebrate cultural diversity in the College. The event includes faculty, administration, and corporate speakers, as well as student entertainers.

### **Major Information Fair**

In October and April of each year, students may attend the information fair sponsored by many of the engineering departments and Engineering Advising. The fair gives unaffiliated students an opportunity to explore a variety of engineering majors by learning about each major's curriculum, course requirements, research, and career opportunities.

### **Alumni**

The Cornell Engineering Alumni Association (CEAA) is the alumni association for the College of Engineering. Founded in 1903, the CEAA has grown into a major support organization for the college. Each year nearly two thousand alumni maintain their connection to the college through membership in the

CEAA.

The CEAA serves as a link between the college and its alumni by

- introducing freshmen to young engineering professionals during Alumni Speakers Week in their ENGRG 150 sections.
- sponsoring the Manufacturing Seminar which brings alumni back to campus as speakers.
- sponsoring an innovative project to assist engineering alumni with career development.
- supporting prestigious awards for excellence in teaching and outstanding student groups.
- providing ongoing opportunities for networking through regional alumni programs and the annual Engineering Conference.

### **MentorNet**

MentorNet is a national electronic industrial mentoring network for women in engineering and science. It pairs undergraduate and graduate women in engineering, science, and math with engineers and scientists working in industry and national laboratories. Through relationships with their mentors, students become acquainted with opportunities in technical and industrial careers, gain access to professional networks, and receive personal and professional guidance, support, and encouragement. The program provides a framework and training for all participants to pursue a year-long mentoring relationship through e-mail.

### **Engineering Interdisciplinary Projects**

Many projects exist within the college in which students can get involved, usually for credit. These include

- the ASCE Concrete Canoe Competition (Civil Engineering)
- the ASCE Steel Bridge Competition (Civil Engineering)
- BRAIN, the Big Red Artificial

Intelligence Navigator (Electrical and Computer Engineering)

- BOOM—Bits On Our Mind (Computer Science)
- the Hybrid Electric Vehicle (Mechanical/Electrical Engineering)
- the Robocup Project (Mechanical Engineering/Computer Science)
- the SAE Formula Race Car (Mechanical Engineering)
- Videoconferencing system development (mostly software), research with Professor Toby Berger in Electrical and Computer Engineering

### **Undergraduate Major Consultants/ Associate Directors**

A faculty member serves as associate director or undergraduate-Major consultant of each engineering Major. This faculty member is responsible for managing the Major. Major consultants can be valuable sources of information for students who want to learn more about their respective undergraduate majors.

### **Company and University Web Sites**

Most companies have web sites. Students may look at the sites for companies that have sparked their interest through advertisements and on-campus visits. To get ideas of new companies, students may explore the web using keywords for the kinds of engineering that interest them. Many companies post job descriptions for engineering positions. Students can review these to see what is expected of engineers in those companies.

All universities and engineering institutions have web sites, with a wealth of information about graduate programs. Through these sites, students may find what cutting edge; state-of-the-art research is being done around the world. Web sites like *Peterson's Guides* ([www.petersons.com](http://www.petersons.com)) are a good way to find out what the programs are like at various institutions.

### **Engineering Student Organizations**

Each engineering Major has at least one student organization. In addition to the major-specific organizations, there are student chapters of the American Indian Science and Engineering Society (AISES), the National Society of Black Engineers (NSBE), the Society of Hispanic Professional Engineers (SHPE), and the Society of Women Engineers (SWE), which are open to all students. A complete listing of engineering student organizations can be found beginning on page 153.

### **The Sundial**

*The Sundial* is emailed to students every week during the regular semester. This electronic publication provides important information that students should be aware of and includes events in the college that can help students learn about engineering. Such events include speakers on engineering topics, company information sessions, student organization activities, and career services offerings.

### **Printed Material from Majors**

Majors produce undergraduate handbooks for use by their students. In addition to required course work and options specific to the major, many majors include information about what the corresponding engineering discipline is about. Major handbooks can be obtained from the appropriate undergraduate Major offices.

### **Web Pages—Majors, Faculty Students**

The College of Engineering web site [www.engineering.cornell.edu](http://www.engineering.cornell.edu) has links to the web sites for the individual departments/schools of engineering. These web sites provide information on the undergraduate and graduate programs as well as links to faculty, graduate student, and research pages.

## **Engineering Cooperative Education Program (Co-op)**

The Engineering Cooperative Education Program is an excellent way for students to explore engineering in the real world. It is "a program that integrates a student's academic and career interests with paid, productive work experience at employer sites nationwide and beyond." For additional information, see page 117.

## **Career Services Library**

A comprehensive collection of books, directories, (hard copy and electronic) job bulletins, and audio/videotapes is available to help students investigate career options or prospective employers. The main library is located at the Cornell Career Services office, 103 Barnes Hall. Engineering Co-op and Career Services (201 Carpenter Hall) also maintains a small collection of supplementary guides and directories.

Employer literature supplied by firms that recruit on campus can help students prepare for interviews. This information is available at both the university and the college facilities. Employer binders and videotapes are maintained in the Engineering Library (Carpenter Hall, first floor).

## **Summer Internships**

Engineering Co-op and Career Services (201 Carpenter Hall), in conjunction with Cornell Career Services (103 Barnes Hall), receives listings for summer jobs during the academic year, largely during the early spring semester. Job listings for students are placed on the CornellTrak link of the Cornell Career Services web site at [www.career.cornell.edu/students](http://www.career.cornell.edu/students).

## **Externships**

Students can obtain an insider's view of a career major by shadowing Cornell alumni in their workplaces during January break. The FRESH Externship program is offered exclusively for freshmen during the March spring break. Through extern-

ships, students can observe the day-to-day activities of their Cornell sponsor, discuss specific jobs and careers with alumni and their colleagues, and sometimes obtain limited hands-on experience. Externships are available in various industries and geographic locations. Externship length, determined by the sponsor, is generally one day to several days.

For more information on externships visit website [www.career.cornell.edu/careerConnections/default.html](http://www.career.cornell.edu/careerConnections/default.html) and select either Extern Program or FRESH.

Relatives, Friends, and Friends of Friends Who Know about Engineering

Talking to friends and acquaintances who are engineers is a good way to learn about the personal experiences of someone in the profession. Students are encouraged to visit with practicing engineers and to ask questions that can help them learn about both the positive and more difficult aspects of being an engineer.

## **Applying for Major Affiliation**

Students must apply for affiliation with a Major during the first semester of the sophomore year, although earlier affiliation may be granted at the discretion of the Major. To apply for affiliation, students visit the office of the undergraduate Major consultant in the Major of their choice and complete an Application for Major Affiliation. To affiliate, students must (1) have a cumulative grade point average (GPA)  $\geq 2.0$  and (2) have satisfied the Major's course and grade requirements (see page 21).

Occasionally, a student falls just short of meeting standard affiliation requirements but demonstrates potential in the Major. In such cases, a Major may offer "conditional affiliation". Conditional affiliation involves a written agreement signed by both the Major and the student. Students must meet the requirements specified in the conditional affiliation

agreement to continue in the Major.

All students must be affiliated or conditionally affiliated with a Major by the end of the fourth semester or they will be withdrawn from the College of Engineering. Future enrollment in the College of Engineering is dependent on affiliation or participation in a terminal semester.

### **Major Descriptions, Flow Charts, and Checklists**

Each major program is described in detail in *Courses of Study*. Charts on pages 22-87 in this handbook present the courses that make up these Majors. Because it is difficult to depict the flexibility that makes it possible to take some courses in semesters other than those indicated, these charts are meant only to suggest the structure of the program. The sequence of course may also be influenced by advanced placement or transfer credit.

Requirements for graduation differ from Major to Major. In addition to completing the requirements of the common curriculum students must take a range of courses that constitutes the Major; they must earn grades that are adequate to remain in good standing; (see page 130 for specific Major requirements for good standing); and they must accumulate sufficient credits for graduation. Each of these three parameters differs by Major, and students are responsible for knowing and meeting the requirements of the Major with which they affiliate. Specific Major requirements are set forth later in this publication and in *Courses of Study*. Students who have questions regarding the interpretation of these requirements should consult the undergraduate Major consultants (listed on page 9) and their faculty advisor.