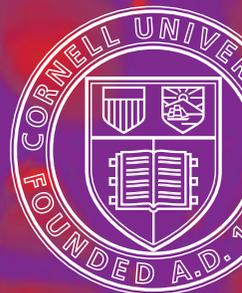


ENG

CORNELL ENGINEERING

ENGINEERING UNDERGRADUATE HANDBOOK

Fall 2011



Name: _____

Campus Address: _____

Phone: _____

E-mail: _____

**College of Engineering
Cornell University
ABET Accredited Programs for 2011–12**

ABET (Accreditation Board for Engineering and Technology) is recognized by the Council for Higher Education Accreditation (CHEA) as the organization responsible for the accreditation of educational programs leading to degrees in engineering, engineering technology, computing, and applied science.

The following undergraduate-degree Majors are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410.347.7700:

- Biological Engineering
- Chemical Engineering
- Civil Engineering
- Electrical and Computer Engineering
- Environmental Engineering
- Materials Science and Engineering
- Mechanical Engineering

Preface

This handbook is intended to support you as an entering and continuing undergraduate in the College of Engineering at Cornell University. (Some curriculum requirements may not be relevant to continuing students.) It has been prepared as a handy reference guide to the requirements, programs, policies, and procedures of the college. We hope that you will find the information you need for both planning and understanding your engineering education.

The College of Engineering would also like to emphasize the importance of the social and ethical implications of the work of engineers as a contribution to the improvement of society. You are fortunate to be a part of an educational community composed of people from many different parts of the world and from diverse ethnic groups in the United States. This diversity gives Cornell a rich multicultural character, and living in the Cornell community can be an opportunity to learn respect for the customs of others and to experience cultural pluralism in today's world. We encourage you to seek out and explore courses and activities that address issues of race, gender, and ethnic diversity to gain a more valuable educational experience and to prepare for the practice of engineering.

Although this handbook embraces the development of an undergraduate engineering education, it does not constitute a complete or definitive statement of the policies of Cornell University and the College of Engineering. The university announcement *Courses of Study* is the official document of the university for defining academic programs and requirements. In addition, the final authority for academic degree requirements of the College of Engineering is jointly administered by the faculty of the College of Engineering, the College Curriculum Governing Board, and the faculty of the individual Majors within Engineering. For more complete information, consult the sources mentioned in this handbook, *Courses of Study*, and Engineering Advising in 167 Olin Hall.

We hope you find this handbook a useful resource as you progress through your years at Cornell. We wish you much success and welcome your suggestions for improvement of the handbook.

Fran Shumway

Director, Engineering Advising

Beth Howland

Associate Director, Engineering Advising

Melissa Hutson Bazley

Assistant Director, Engineering Advising

Responsibility for Meeting Degree Requirements

Ultimately, students are responsible for understanding the degree requirements for their Majors and for planning their courses of study accordingly. They should consult the appropriate undergraduate office (listed on pages 10–11) for more specific information. The Major will provide a consultant who can answer specific questions and make binding decisions relating to the fulfillment of degree requirements. Faculty advisors will assist in course selection, but they are not responsible for ensuring that the courses selected meet degree requirements. That is the responsibility of the student.

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University and College Mission, Vision, and Values

Cornell University's Mission and Values

"I would found an institution where any person can find instruction in any study."

Ezra Cornell, 1868

Cornell is a learning community that seeks to serve society by educating the leaders of tomorrow and extending the frontiers of knowledge.

In keeping with the founding vision of Ezra Cornell, our community fosters personal discovery and growth, nurtures scholarship and creativity across a broad range of common knowledge, and engages men and women from every segment of society in this quest. We pursue understanding beyond the limitations of existing knowledge, ideology, and disciplinary structure. We affirm the value to individuals and society of cultivation and enrichment of the human mind and spirit.

Our faculty, students, alumni, and staff strive toward these objectives in a context of freedom with responsibility. We foster initiative, integrity, and excellence, in an environment of collegiality, civility, and responsible stewardship. As the land-grant university for the state of New York, we apply the results of our endeavors in service to our alumni, the community, the state, the nation, and the world.

College of Engineering Undergraduate Programs Mission

The College of Engineering is dedicated to the transformation of its excellence in research and design to a correspondingly outstanding educational experience in engineering and applied science for a diverse group of baccalaureate students.

Specific missions are to:

- enroll and graduate a highly qualified and diverse undergraduate student body and enable their success.
- continuously improve the quality of the undergraduate education by ongoing evaluation of the common curriculum, assessment of teaching and learning, and implementation of improvements to the program based on those results.
- infuse the results of ongoing research, the capabilities of technology, the excitement of hands-on learning, and the experience of design projects into the undergraduate curricula.
- provide high-quality information and guidance to undergraduate students about the college, about curricula, and about future employment possibilities.
- oversee the educational progress of all students and encourage and enhance their success, both prior to affiliation with a Major and within the Major.
- collaborate with the faculty and administration of other Cornell colleges and organizations external to Cornell to efficiently provide the best possible undergraduate education.

Vision

Cornell Engineering will utilize the world-class intellectual resources and interdisciplinary opportunities of the college and university to prepare its undergraduate students for lifelong creation of knowledge and solutions to complex real-world problems.

Values

We believe that all students who enroll in the engineering college undergraduate program are capable of successfully graduating with a B.S. degree. We understand that young people in the typical undergraduate age range are maturing rapidly and therefore may change their professional and personal aspirations and may struggle with adjustments to campus life and academic expectations. It is our responsibility to maintain a curricular schedule that allows students to change directions and services to assist them in making informed decisions. We respect the variability of learning styles spanned by our students and faculty. We embrace the responsibilities of Cornell faculty members for preeminent research as well as for excellent undergraduate education. Furthermore, we highly value the need of everyone in our college community to balance workload and personal life. We prize an inclusive, respectful college environment in which community bonds and community responsibility exceed competitiveness.

Educational Objectives

College of Engineering graduates will demonstrate early in their careers an ability to:

- apply their general educational experience and specific knowledge of mathematics, science, and engineering to a wide variety of careers including industry, advanced engineering study, nontraditional engineering-related career paths, and graduate study.
- perform in a modern diverse working environment in which they will work in multidisciplinary teams and communicate effectively with both professional colleagues and the public.
- lead design processes that include consideration of the impact designs have on people, societies, and nature.
- model, analyze, and solve complex problems from a systems perspective.
- recognize contemporary global issues and their professional and ethical responsibility to contribute to solutions for the social, economic, and environmental challenges faced by humanity.
- engage in self-directed learning, including the pursuit of graduate study and professional development activities.

Student Learning Outcomes

In terms of their general abilities, our graduates will

1. Have a broad education, including liberal studies.
2. Be proficient in oral and written communication.
3. Be proficient in information literacy, i.e. be able to locate, evaluate, and effectively interpret claims, theories, and assumptions in science and engineering.
4. Have experience with teamwork.
5. Be aware of professional and ethical responsibilities.

In terms of their discipline, students will be well grounded in the mathematical, scientific, and engineering skills that are the basis of their discipline. More specifically, our graduates will have:

1. The ability to design experiments, analyze the data, and interpret the results.
2. The ability to design, model, and analyze engineering systems.
3. The ability to formulate and solve problems.

The ability to use the techniques and tools necessary for the practice of their discipline.

Guide to Important Resources

College of Engineering

Office of the Dean, 242 Carpenter Hall, 255.4326

Associate Dean for Undergraduate Programs, 167 Olin Hall, 255.8240

Assistant Dean for Student Services, 167 Olin Hall, 255.8240

Career Services, 201 Carpenter Hall, 255.5006

Cooperative Education Program, 201 Carpenter Hall, 255.5006

Diversity Programs in Engineering, 146 Olin Hall, 255.6403

Engineering Advising, 167 Olin Hall, 255.7414

Engineering Communications Program, 465 Hollister Hall, 255.7199

Engineering Learning Initiatives, 167 Olin Hall, 255.9622

Engineering Library, Carpenter Hall, 255.5933

Engineering Registrar, 158 Olin Hall, 255.7140

Personal Counseling Services

Cornell United Religious Work, Anabel Taylor Hall, 255.4214

Counseling and Psychological Services, level one, Gannett Health Services, 255.5208

Diversity Programs in Engineering, 146 Olin Hall, 255.6403

EARS (Empathy, Assistance, and Referral Service), 211 Willard Straight Hall,
255.EARS

Engineering Advising, 167 Olin Hall, 255.7414

Let's Talk Walk-in Service, for hours/locations, go to [www.gannett.cornell.edu/
services/counseling/caps/talk/index.cfm](http://www.gannett.cornell.edu/services/counseling/caps/talk/index.cfm)

Suicide Prevention and Crisis Service, Ithaca, NY 14850, 272.1616 (24 hrs.)

Tutorial and Academic Support Services

Diversity Programs in Engineering, 146 Olin Hall, 255.6403

Engineering Advising, 167 Olin Hall, 255.7414

Engineering Learning Initiatives, 167 Olin Hall, 255.9622

Learning Strategies Center, 420 Computing and Communications Center, 255.6310

Mathematics Support Center, 256 Malott Hall, 255.3905

Office of Undergraduate Biology, 216 Stimson Hall, 255.5233

Physics Tutoring, 115 Rockefeller Hall, 255.6310
Student Disability Services, 4th floor, Computing and Communications Center,
254.4545
Writing Workshop, 174 Rockefeller Hall, 255.6349

Career and Professional Development Services

Cornell Career Services, 103 Barnes Hall, 255.5221
Engineering Career Services, 201 Carpenter Hall, 255.5006
Engineering Cooperative Education Program, 201 Carpenter Hall, 255.5006
Master of Engineering Program, 223 Carpenter Hall, 255.0976

Other Resources

Bursar's Office, 260 Day Hall, 255.6413 or 255-2336
Campus Life Management, 2336 Balch Hall, 255.5511
Continuing Education and Summer Sessions, B20 Day Hall, 255.4987
Dean of Students Office, 401 Willard Straight Hall, 255.6839
Financial Aid and Student Employment, 203 Day Hall, 255.5145
Gannett Health Center, Gannett Health Services, 255.5155
Housing and Dining Office, 206 Robert Purcell Community Center, 255.5368
International Students and Scholars Office, B50 Caldwell Hall, 255.5243
Judicial Administrator, 120 Day Hall, 255.4680
Office of Academic Diversity Initiatives, 200 Computing and Communications
Center, 255.3841, 255-6384
Office of Internal Transfer, 220 Day Hall, 255.4386
Ombudsman, 118 Stimson Hall, 255.4321
Student Disability Services, 4th floor, Computing and Communications Center,
254.4545
University Registrar, B7 Day Hall, 255.4232, univreg@cornell.edu
Willard Straight Ambassadors, 401 Willard Straight Hall, 255.6839
Workforce Diversity and Inclusion, 160 Day Hall, 255.3976

Undergraduate Major Consultants/Associate Directors and Major Coordinators

A faculty member serves as associate director or undergraduate-Major consultant of each Engineering Major. Major consultants can be valuable sources of information for students who want to learn more about their respective undergraduate Majors.

Biological Engineering (BE)

Jean Hunter
jbh5@cornell.edu
207 Riley-Robb Hall, 255.2297

Brenda Marchewka
bls19@cornell.edu
207B Riley-Robb Hall, 255.2173

Chemical Engineering (ChemE)

T. Michael Duncan
tmd10@cornell.edu
352 Olin Hall, 255.8715

Carol Casler
cad1@cornell.edu
226 Olin Hall, 255.1489

Civil Engineering (CE)

James Jenkins
jtj2@cornell.edu
263 Hollister Hall, 255.7185

Nadine Porter
ndp5@cornell.edu
221 Hollister Hall, 255.3412

Computer Science (CS)

Thorsten Joachims
ugrad-faculty-director@cs.cornell.edu
4153 Upson Hall, 255.1372

Nicole Roy
nicole@cs.cornell.edu
303 Upson Hall, 255.0982

Electrical and Computer Engineering (ECE)

Sheila S. Hemami
hemami@ece.cornell.edu
332 Rhodes Hall, 254-5128

Carrie Wood
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223 Phillips Hall, 255.4344

Engineering Physics (EP)

Bruce Kusse
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206 Clark Hall

Kelli Hulslander
kjh8@cornell.edu
261 Clark Hall, 255.0638

Environmental Engineering (EnvE)

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Nadine Porter
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221 Hollister Hall, 255.3412

Jean Hunter
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207 Riley-Robb Hall, 255.2297

Brenda Marchewka
bls19@cornell.edu
207B Riley-Robb Hall, 255.2173

Independent Major (IM)

Associate Dean Charles Seyler
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167 Olin Hall, 255.0393

Cindy Pakkala
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167 Olin Hall, 255.8240

Information Science, Systems, and Technology (ISST)

Paul Ginsparg
ginsparg@cornell.edu
301 College Avenue, 255-7371

Christine Stenglein
cms242@cornell.edu
303 Upson Hall, 255.9837

Michael Todd
mjt7@cornell.edu
229 Rhodes Hall, 255.9135

Cindy Jay
cjh6@cornell.edu
203 Rhodes Hall, 255.5088

Materials Science and Engineering (MSE)

TBA

Michele Conrad
mmc2@cornell.edu
214 Bard Hall, 255.9159

Mechanical Engineering (ME)

Wolfgang Sachse
ME_DUS@cornell.edu
325 Thurston Hall, 255.5065

Nanette Peterson
np18@cornell.edu
108 Upson Hall, 255.3573

Operations Research and Engineering (ORE)

Leslie Trotter
assocdir@orie.cornell.edu
235 Rhodes Hall, 255-5360

Cindy Jay
cjh6@cornell.edu
203 Rhodes Hall, 255.5088

Science of Earth Systems (SES)

Natalie Mahowald
nmm63@cornell.edu
2140 Snee Hall, 255.5166

Savannah Sawyer
ss376@cornell.edu
2124 Snee Hall, 255.5466

Requirements for the Bachelor of Science Degree

Category	Credits
1. Mathematics	15–16
MATH 1910, 1920, 2930 or 2940, and a mathematics course chosen by the Major.	
2. Physics	8–12
PHYS 1112 and 2213, and, depending on the Major, either PHYS 2214 or a designated mathematics or science course.	
3. Chemistry	4–8
CHEM 2090. Majors in ChemE or those planning on a health-related career should take CHEM 2090 and then 2080. Students in EnvE, the Environmental Engineering Option in BE, or the Environmental Engineering Concentration of CE should take CHEM 2090 and CHEM 1570/3570. SES Majors should take CHEM 2080/1570.	
4. First-year writing seminars (two courses)	6
5. Technical writing requirement (see page 14)	3
6. Computing (CS 1110, 1112, or 1114 followed by CS 1130 or CS 1132)	5
7. Engineering distribution	
a. one introduction to engineering (ENGRI) course	3
b. two distribution courses (ENGRD), one of which may be required by the Major	6–8
8. Liberal studies distribution (six courses)	≥18
9. Approved electives	6
10. Major program	
a. Major-required courses	≥30
b. Major-approved electives	9
c. Courses outside the Major	9
11. Two semesters of physical education and demonstration of proficiency in swimming (university requirement).	

From 124 to 134 credits are required for graduation. The exact number depends on the Major; the specific requirements for each Major are given on the following pages.

The Academic Program

College of Engineering Majors

In the first two years, students in the College of Engineering take a set of courses 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 second year, students affiliate with an undergraduate Major (see list below); thereafter, they take courses to satisfy the Bachelor of Science degree in that Major.

Biological Engineering (BE)

Chemical Engineering (ChemE)

Civil Engineering (CE)

Computer Science (CS)

Electrical and Computer Engineering (ECE)

Engineering Physics (EP)

Environmental Engineering (EnvE)

Independent Major (IM)

Information Science, Systems, and Technology (ISST)

Materials Science and Engineering (MSE)

Mechanical Engineering (ME)

Operations Research and Engineering (ORE)

Science of Earth Systems (SES)

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 10 categories.

Category 1. Mathematics

Students must earn at least C– in MATH 1910, 1920, 2930 or 2940, and a math course chosen by the Major. 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 result in withdrawal 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 1910 before taking PHYS 1112. Similarly, at least

C– is required in each subsequent math course before taking the physics course for which it is a prerequisite (MATH 1920 is a prerequisite for PHYS 2213; MATH 2930 is a prerequisite for PHYS 2214).

Category 3. Chemistry

Students who do not intend further study in chemistry should enroll in CHEM 2090 during either semester of the first year. Students are required to receive credit for CHEM 2090 either through AP credit or by successful completion of the course. Students choosing the CHEM 2090–2080 sequence must enroll in CHEM 2090 during the fall semester of the first year so that they may enroll in CHEM 2080 during the spring.

Category 4. Computing

Introduction to Computing (one of CS 1110, 1112, and 1114) is taken in the first year, followed by either CS 1130 or 1132, to fulfill the computing requirement. If the first course is Java-based, the second course is MATLAB-based, and vice versa. The second course should be completed by the end of the second year.

Before CS 111x, some students take CS 1109: Fundamental Programming Concepts, offered only in the summer. CS 1109 may not be used as credit toward graduation.

Category 5. First-Year Writing Seminars

During each semester of the first year, students must choose a first-year writing seminar from among more than 100 courses offered by more than 30 different departments throughout Cornell. These courses, which offer the benefits of small class size, provide an opportunity to practice writing English prose.

Category 6. Technical Writing

In addition to the first-year writing seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course. 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/.

1. ENGR 3350 or ENGR 3500, 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 may satisfy the college's technical-writing requirement.
3. An officially designated writing-intensive (W-I) engineering course:

AEP/ENGRD 2640: Computer-Instrumentation Design

BEE 4530: Computer-Aided Engineering: Applications to Biomedical Processes

BEE 4590: Biosensors and Bioanalytical Techniques

BEE 4730: Watershed Engineering

BEE 4890: Entrepreneurial Management for Engineers

CHEME 4320: Chemical Engineering Laboratory

CIS 3000: Introduction to Computer Game Design

MAE 4272: Fluids/Heat Transfer Laboratory

MSE 4030/4040 (both): Senior Materials Laboratory I and II

MSE 4050/4060 (both): Senior Thesis I and II

4. ENGRC 3020, a 1-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 students co-register in ENGRC 3020. (May be taken more than once, with different courses, by permission of engineering instructor.)
5. COMM 3030: Organizational Writing, taught by the Department of Communication (in the College of Agriculture and Life Sciences).
6. Petition. Occasionally, students will be doing a significant amount and variety of technical writing elsewhere in engineering. 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 7. Engineering Distribution

The Common Curriculum requires three distribution courses (9 credits). One intro-to-engineering course (with the course acronym ENGRI) is to be completed during the first year. The remaining two distribution courses (with the course acronym ENGRD) should be completed by the end of the fourth semester. Some Majors may require additional distribution courses, taken after a student affiliates with a Major. Common Curriculum distribution requirements must be fulfilled by the end of the second year.

The intro-to-engineering course introduces students to the engineering process and provides a substantive experience in open-ended problem-solving. The following courses fulfill this requirement:

ENGRI 1100: Lasers and Photonics

ENGRI 1101: Engineering Applications of Operations Research

ENGRI 1110: Nanotechnology

ENGRI 1120: Introduction to Chemical Engineering

ENGRI 1130: Sustainable Design for Appledore Island

ENGRI 1131: Water Treatment Design

ENGRI 1140: Materials: Enabling the Future of Energy

ENGRI 1160: Modern Structures

ENGRI 1170: Introduction to Mechanical Engineering

ENGRI 1190: Biomaterials for the Skeletal System

ENGRI 1200: Introduction to Nanoscience and Nanoengineering

ENGRI 1220: Earthquake!

ENGRI 1260: Introduction to Signals and Telecommunications

ENGRI 1270: Introduction to Entrepreneurship and Enterprise Engineering

ENGRI 1290: Energy: From Atoms to Zephyrs

ENGRI 1310: Introduction to Biomedical Engineering

ENGRI 1610: Computing in the Arts

ENGRI 1620: Visual Imaging in the Electronic Age

ENGRI 1810: Electronics for Human-Machine Interfaces

The two ENGRD courses (6–8 credits) must be selected from two different categories listed below. A student may use any one of the possible substitutions described.

1. Scientific Computing

ENGRD 2110: Object-Oriented Programming and Data Structures

ENGRD 3200: Engineering Computation

ENGRD 3220: Introduction to Scientific Computation

2. Materials Science

ENGRD 2610: Mechanical Properties of Materials; From Nanodevices to Superstructures

ENGRD 2620: Electronic Materials for the Information Age

3. Mechanics

ENGRD 2020: Statics and Mechanics of Solids

TAM 2030: Dynamics

Majors in Engineering Physics may substitute AEP 3330: Mechanics of Particles and Solid Bodies for TAM 2030.

4. Probability and Statistics

ENGRD 2700: Basic Engineering Probability and Statistics

Majors in Engineering Physics may substitute MATH 4710: Basic Probability for ENGRD 2700. Majors in Civil, Biological, or Environmental Engineering may substitute CEE 3040: Uncertainty Analysis in Engineering for ENGRD 2700.

ENGRD 3100: Introduction to Probability and Inference for Random Signals and Systems

5. Electrical Sciences

ENGRD 2100: Introduction to Circuits for Electrical and Computer Engineers

ENGRD 2300: Introduction to Digital Logic Design

ENGRD 2640: Computer-Instrumentation Design

6. Thermodynamics and Energy Balances

ENGRD 2190: Mass and Energy Balances

ENGRD 2210: Thermodynamics

7. Earth and Life Sciences

ENGRD 2200: The Earth System

ENGRD 2510: Engineering for a Sustainable Society

8. Biology and Chemistry

CHEM 3890: Honors Physical Chemistry I

ENGRD 2520: The Physics of Life

Category 8. Liberal Studies Distribution

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 communication skills. Cornell has a rich curriculum in the humanities, arts, and social sciences, enabling every engineering student to obtain a truly liberal education. At least six courses (totaling at least 18 credits) are required, and these 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 seven groups
- Only one course may be chosen from Group 7 (CE).
- At least two courses must be at the 2000 level or higher.

Students should utilize the current *Courses of Study* as the master list of approved liberal studies courses. Refer to the web page of Cornell Engineering Advising (www.engineering.cornell.edu/academics/undergraduate/curriculum/liberal_studies.cfm), for complete lists of additional approved courses and unacceptable courses. Please direct any questions to Engineering Advising, 167 Olin Hall.

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

Group 2. Historical Analysis (HA)

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

Group 3. Literature and the Arts (LA)

Courses in this area explore literature and the arts in two different but related ways. Some courses focus on the critical study of art works 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 art works (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)

Courses 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) (FL)

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

Group 7. Communications in Engineering (CE)

Courses in this area explore communication as a way of acting in the world. The primary aim is to provide students with the opportunity to practice performing a range of engineering-related communication skills within specific genres (e.g. proposals, reports, and journal articles, oral presentations, etc.). Each of these genres potentially engages a wide variety of audiences and, depending on the particulars of context, each may have multiple purposes. The secondary aim is to enable students to be aware of the choices they make as communicators and to be able to articulate a rationale for those choices. (Only one course will be allowed to be counted in this category.)

Category 9. Approved Electives

Six credits of approved electives are required and must be approved by the student's faculty advisor. (All students are strongly encouraged to officially document Approved-electives by completing a petition, available in Engineering Advising, 167 Olin Hall.) 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. (Note: up to 6 credits of advisor-approved electives will be allowed for ROTC courses at or above the 3000 level.)

Students are free to take as many courses as they wish, in addition to the minimum

engineering curriculum requirement, before meeting graduation requirements.

No course with a number <1100 can be applied toward graduation requirements.

Category 10. Major Requirements

The requirements of the Majors are discussed on pages 28–84. They include:

1. Major-required courses, i.e. courses in the Major itself.
2. Major-approved electives (9 credits).
3. Courses outside the Major (9 credits). These courses 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, including at least three semesters affiliated with an Engineering Major.

Engineering students who are on leave may not take Cornell extramural courses. Exceptions are granted in extraordinary circumstances with permission from Engineering Advising. At most, 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 international universities is available at the Cornell Abroad office, 300 Caldwell 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.

First-Year Requirements

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

- MATH 1910 and MATH 1920;
- Two of the following: CHEM 2090, CHEM 2080 (if required for Major), PHYS 1112, 2213, 2214 (depending on Major);
- One of CS 1110, CS 1112, and CS 1114;
- Two first-year writing seminars;
- One intro-to-engineering course (ENGRI designation);
- Two physical education courses and the university swim test.

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 on pages 26–27 of this handbook and in *Courses of Study*.

Academic Advising and Student Services

Engineering Advising Office

From the time students enter the college until they become affiliated with a Major, they are under the administration of Engineering Advising, which implements the academic policies of the College Curriculum Governing Board (CCGB). Engineering Advising provides a variety of advising services to help first- and second-year students with academic and personal matters. Students can make an appointment by calling 255.7414 or may stop in to 167 Olin Hall to inquire about seeing an advisor on a walk-in basis.

Engineering Advising is responsible for a variety of programs and services that assist in the development of successful engineering students. These include publishing *The Sundial*, a weekly email newsletter for students that provides information about upcoming deadlines and special programs; organizing the Major Information Fair and other events to help students choose a Major; coordinating the Peer Advisor Program; sending early-intervention communications to students who may need additional support in specific courses; and providing information on tutoring and academic support services available on campus.

Faculty Advising

Students are assigned a faculty advisor when they begin their course of study in the College of Engineering. They usually keep that advisor until they affiliate with a Major, even though the advisor may not be in the Major in which they intend to specialize. Once students choose a Major, they are assigned a faculty advisor from that Major.

Faculty advisors help students translate their interests into an appropriate course of study, evaluate their curriculum and workload, monitor their progress toward a degree, and take advantage of the diverse opportunities available at Cornell. Students should consult their faculty advisor when they have questions about the academic requirements of the university, the college, or the schools and departments. Faculty advisors evaluate each semester's program, approve course changes, and approve courses to be used as approved electives. Students must see their faculty advisor whenever they consider adding or dropping a course. Students who wish to petition for an exception to college rules should discuss the matter first with their advisor, who must sign any petition before it can be considered.

To be effective, a faculty advisor must be aware of a student's academic and personal goals. Students should make appointments to see their advisors as soon as they return to campus after intersession or summer vacation. This is an opportunity for the student and advisor to discuss the student's goals, reevaluate academic plans, and make necessary changes in course enrollment. Students should also consult with their faculty advisors during the pre-registration period to receive approval of their course selections for the following semester.

Students are responsible for staying in contact with their faculty advisor and ensuring that the advisor is aware of their goals and progress. Academic difficulties may be avoided if the advisor is able to recognize problems early. Students often form strong intellectual bonds with their faculty advisors, and this is more apt to happen if the student takes the initiative. Another benefit of developing a relationship with the faculty advisor (and faculty members

in general) is that students may wish to ask the advisor for a letter of recommendation at some point in their career. Such letters are most useful when they come from people who know the student well enough to accurately assess their capabilities.

What to Expect from an Advisor

- *Advice.* Students should use their advisors as resources for planning their academic program and identifying academic and career goals. The advisor will be able to explain college degree requirements, scheduling/registration procedures, and other academic regulations. While it is not the function of advisors to help students find employment, they should be able to give broad advice on careers in engineering and science and the academic background necessary for such careers. Advisors can also provide information on postgraduate education and general requirements for admission to graduate programs. A faculty advisor may refer a student to other faculty members or offices that are better able to serve the student's needs.
- *Assistance.* Advisors can help students explore special programs, such as cooperative education, international study, dual-degree, and double-Major programs. They may also be helpful in obtaining tutorial assistance or transfer/advanced placement credit, as appropriate. Students often ask their advisors to provide letters of recommendation for scholarships, study abroad, employment, or graduate school.
- *Availability.* Students should expect to have ready access to their advisors. Most advisors set aside several hours each week for advising and will usually make appointments outside those hours if necessary. Advisors who are out of town for more than a week will usually designate an alternative advisor to handle urgent problems.
- *Personal Contact.* Students should expect to have personal relationships with their advisors, through which the advisors will become familiar with the students' backgrounds, academic records, and career plans.

What Not to Expect from an Advisor

- *Assessment of Effort Required for Specific Courses.* Advisors can determine the appropriateness of a given course in a student's program, but they cannot predict how difficult the course will be or how much effort it will require.
- *Help with Personal Problems.* Students should make their advisors aware of problems that interfere with academic progress, but advisors are not trained to provide counseling for personal problems, nor should they be expected to resolve housing or financial issues. However, they will refer students to the appropriate university office or program.
- *Job Search Assistance.* While students should be able to discuss career options with their advisors, it is not the advisor's responsibility to provide assistance in a job search. Students should contact Cornell Career Services in Barnes Hall or the Engineering Cooperative Education and Career Services office in Carpenter Hall for help in finding employment.
- *Tutoring/Study Skills.* Advisors are often able to identify the need for tutoring, remedial course work, or improved study skills but should not be expected to provide the necessary assistance. Students in need of such assistance are generally referred to other resources, such as the Learning Strategies Center.

Student Responsibilities in the Student-Advisor Relationship

- *Accept Referrals.* Students should be willing to accept referrals from their advisors and should review the results of such referrals with their advisors after the fact.
- *Initiate Contact.* Students are expected to initiate contact with their advisors for scheduling, course changes, and other matters in a timely fashion. Because of teaching commitments, research, and travel obligations, advisors may not be available on short notice. Students are urged to plan ahead and initiate contact with their advisors well in advance of specific deadlines.
- *Keep Advisors Informed.* Advisors can provide better advice if they are kept informed of their advisees' academic progress and career goals. Students should feel free to share this information with their advisors and can expect that their advisors will ask questions and provide appropriate guidance based on the dialogue.
- *Work to Develop Rapport.* The rapport necessary for good advising can occur only if both advisor and student make an active effort to develop it. Recognizing that individual advisors have their own styles and personalities, students should respond to the efforts of their advisors to get to know them and their academic interests.

Peer Advising

Each ENGRG 1050 (Engineering Seminar) section has one or two peer advisors: second-, third-, or fourth-year students who have volunteered to help new students understand the course selection process, meet other engineering students, and adjust to life at Cornell. Incoming first-year students meet their peer advisors during orientation week and as part of ENGRG 1050. Subsequent meetings are arranged as needed. Students should feel free to email their peer advisors when they have questions.

Preprofessional Advising

Students who intend to do graduate study in medicine, law, or business have access to resources and services designed specifically to support their professional aspirations. Students should make an appointment with Engineering Advising for general guidance and then, depending on their interests, consult the specific offices and web sites listed below.

Premedical

Students interested in medicine or other health-related careers must plan their courses early to meet both the requirements of the Common Curriculum and the prerequisites of the intended professional course of study. Engineering Advising helps students understand how professional course requirements fit into the Engineering curriculum. The university health career advisor (103 Barnes Hall) assists students in navigating the examination and application processes related to health careers. For additional information, please see: <http://www.career.cornell.edu>.

Prelaw

Prelaw advising is provided by Cornell Career Services, 103 Barnes Hall. For complete information, please visit www.career.cornell.edu.

Prebusiness

Students interested in business may wish to consider the minor in Business (specifically for Engineering students) offered by the Department of Applied Economics and Management (AEM) in the College of Agriculture and Life Sciences (CALS). Information about this minor can be obtained by visiting Engineering Advising.

Students may also wish to consider special cooperative programs between the College of Engineering and the Johnson Graduate School of Management, which allow students to work on degrees in both areas at the same time. For more information, contact the Engineering Research and Graduate Office, 222 Carpenter Hall, and the admissions office of the Johnson Graduate School of Management, 112 Sage Hall.

Diversity Programs in Engineering

The Diversity Programs in Engineering (DPE) office operates programs at the undergraduate, graduate, and faculty levels to facilitate the outreach, recruitment, retention, and overall success of underrepresented minorities, women, and other underrepresented groups in Engineering. DPE is responsible for fostering a vision of diversity appreciation reflective of the College of Engineering's strategic plan, which enables students from all backgrounds and cultures to thrive and succeed at Cornell. DPE coordinates and plans educational, professional development, and networking opportunities that enhance interaction and learning across groups. For further information, please contact DPE at 255.6403 or stop by 146 Olin Hall.

Engineering Learning Initiatives

Engineering Learning Initiatives, 167 Olin Hall, facilitates academic opportunities for engineering students that enhance the learning environment, support teaching excellence, and cultivate professional development. The programs are outlined below. For more information call 255.9622, send email to eng-learning@cornell.edu, or visit www.engineering.cornell.edu/learning.

Academic Excellence Workshops (AEW)

AEWs are optional, 1-credit, collaborative, problem-solving workshops that complement the core engineering courses, including the core MATH, CHEM, and CS courses. The weekly two-hour workshops, led by trained peer facilitators, offer a cooperative environment where students work together to enhance understanding of course material. Research shows that such cooperative methods promote higher grades, deeper comprehension, more enjoyment in learning, and more positive attitudes toward academic work. For more information on AEWs, visit www.engineering.cornell.edu/aew.

Tutors-on-Call

Peer tutors are available free of charge for many first- and second-year core engineering courses, including MATH, CHEM, PHYS, CS, and some distribution courses. Peer tutors, who must have a 3.0 GPA and have earned at least B in the course they tutor, earn an hourly wage and are trained to help their peers master course content and improve learning skills. The one-on-one tutoring is tailored to the individual needs of the student. To request a tutor, go to www.engineering.cornell.edu/tutoring to complete the online

Tutor Request Form, or visit the Engineering Learning Initiatives office in 167 Olin Hall to submit a paper copy.

Cornell LeaderShape® Institute

The Cornell LeaderShape® Institute is a dynamic, interactive, six-day residential retreat emphasizing vision planning and leadership development. The curriculum is provided by LeaderShape®, Inc., a not-for-profit organization that has been helping young adults learn to “lead with integrity” since 1988. For more information, visit www.engineering.cornell.edu/leadershape.

Engineering Registrar

The Engineering Registrar’s office, located in 158 Olin Hall, is the main repository of all engineering student records. This office is distinct from the University Registrar’s office located in B7 Day Hall.

The Engineering Registrar’s office oversees course enrollment, grading, course scheduling, room assignments, and examination scheduling for the College of Engineering. It is responsible for maintaining the Student Information System, and it processes all grade and course updates. Official documents relating to academic matters are filed as part of each student’s permanent record and held there. It produces reports regarding course, enrollment, and student data.

Students who need an official transcript may request one online at www.transcript.cornell.edu, or go to the University Registrar’s office in B7 Day Hall. The University Registrar is also responsible for issuing certifications of enrollment.

University Student Records Policy

The university regards a student’s enrollment status (e.g. registered, on leave, withdrawn) as directory information that may be released unless a student submits a “no-release” request to the University Registrar. Additionally, where the university believes that it is in a dependent student’s best interest, information from the student’s educational records may, at the university’s discretion, be released to the parents or legal guardians of a dependent student. Such disclosure will generally be limited to information about a student’s official status at the university, but parents or legal guardians of a dependent student may also be notified when a student has voluntarily withdrawn from the university or has been required to withdraw; when a student has been placed on academic warning; when the student’s academic good standing or promotion is at issue; when a student has been placed on disciplinary probation or restriction; or when a student otherwise engages in behavior calling into question the appropriateness of the student’s continued enrollment in the university. Unless otherwise indicated in writing by the student at the time of registration, or thereafter, the university will presume that a full-time undergraduate student is a dependent as that term is defined in the Internal Revenue Code.

Applying for Major Affiliation

Students apply for affiliation with a Major during the first semester of their second 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) >2.0 ; and (2) have satisfied the Major's course and grade requirements (see list below).

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.

Students who are not affiliated or conditionally affiliated with a Major by the end of the fourth semester will be withdrawn from the College of Engineering. Continued enrollment in the college is dependent on affiliation or participation in a terminal semester.

Major Descriptions, Flow Charts, and Check Lists

Each Major program is described in detail in *Courses of Study*. The descriptions of these programs begin on page 28. 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 courses 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 courses that constitute the Major; they must earn grades that are adequate to remain in good standing (see page 125 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 their Major. Specific Major requirements are set forth later in this handbook and in *Courses of Study*. Students should consult their undergraduate Major consultants (listed on pages 10-11) and their faculty advisors if they have questions regarding the requirements.

Requirements for Major Affiliation

Biological Engineering (BE)

Minimum GPA of ≥ 2.5 and at most one grade below C- in math, science, and engineering courses. Completion of BEE/ENGRD 2600 or 2510 with at least C-, and one year of Introductory Biology with grades of at least C-. Completion of all College of Engineering core requirements by the end of the sophomore year (also applies to transfer students).

Chemical Engineering (ChemE)

At most one grade below C- in chemistry, math, physics, and chemical engineering courses and a GPA ≥ 2.2 in math, science, and chemical engineering courses.

Civil Engineering (CE)

GPA ≥ 2.0 for all engineering and science courses. At least C in ENGRD 2020.

Computer Science (CS)

At least C in all completed CS and math courses. GPA ≥ 2.5 in CS 2110 (or CS 2112) and 2800. GPA ≥ 2.5 in MATH 1920 and CS 2800. Visit the CS undergraduate web site to learn about alternative criteria for affiliation.

Electrical and Computer Engineering (ECE)

At least C+ in MATH 2930, PHYS 2213, and one of ECE/ENGRD 2100, ECE 2200, and ECE/ENGRD 2300. GPA ≥ 2.5 in the following courses if completed: MATH 1920, 2930, 2940; PHYS 2213; ECE/ENGRD 2100; ECE 2200; ENGRD/CS 2110, ECE/ENGRD 2300.

Engineering Physics (EP)

At least B- in all required math and physics courses (MATH 1910, MATH 1920, MATH 2930, MATH 2940, PHYS 1112/1116, PHYS 2213/2217, PHYS 2214/2218).

Environmental Engineering (EnvE)

GPA ≥ 2.0 for all engineering and science courses. At least C- in BEE/ENGRD 2510.

Independent Major (IM)

Cumulative GPA ≥ 2.0 .

Information Science, Systems, Technology (ISST)

At least C in two of MATH 2940, CS 2110, and ENGRD 2700. GPA ≥ 2.3 in completed math, ENGRD, and ISST Major courses. Qualifying courses must be taken at Cornell, and for a letter grade. For a repeated course, the most recent grade is used.

Materials Science and Engineering (MSE)

Cumulative GPA ≥ 2.0 in the required math, physics, and chemistry courses and at least C in ENGRD 2610 or 2620. Alternatively, at least B- in the following: MATH 2930, PHYS 2213, CHEM 2090, and ENGRD 2610 or 2620.

Mechanical Engineering (ME)

At least C- in ENGRD 2020, ENGRD 2210 (if taken), and all completed required math, science, and computer science courses. GPA ≥ 2.5 in these courses: MATH 2930, PHYS 2213, ENGRD 2020, and ENGRD 2210 (if taken).

Operations Research and Engineering (ORE)

At least C in ENGRD 2700 and MATH 2940. GPA ≥ 2.2 in math, science, and engineering courses (both overall and in the term immediately before affiliation). At least C- in all completed ORIE courses. Good academic standing in the college.

Science of Earth Systems (SES)

At least C- in all completed Major required courses. GPA ≥ 2.0 in all math, science, and engineering courses. Good academic standing in the college.

Major Programs

Each Major program is described using a chart that depicts when courses are usually taken: The charts do not include liberal studies and Physical Education requirements.

Major: Biological Engineering (BE)

Accredited by ABET (see inside front cover)

Offered by: Department of Biological and Environmental Engineering
207 Riley-Robb Hall, 255.2173, www.bee.cornell.edu

Our Commitment

The educational objectives of the Biological Engineering program are consistent with those of the College of Engineering and Cornell University. We are committed to providing an excellent undergraduate engineering program in a nurturing learning environment where our graduates acquire knowledge and develop skills for professional success. Graduates of our program include a diverse group of leaders and problem solvers who contribute technically, professionally, and personally to our society.

Program Objectives

- Produce graduates who pursue careers related to Biological Engineering based on a solid educational background in appropriate mathematics, physical and life sciences, liberal studies, and engineering.
- Produce graduates who pursue advanced degrees in engineering and related professional fields.

Engineering Distributions

ENGRD 2020: Mechanics of Solids (required)

ENGRD 2XXX: ENGRD 2600: Principles of Biological Engineering *or*
ENGRD 2510: Engineering for a Sustainable Society (recommended)

Required Major Courses

Choose two of the three following:

BIOMG 1350: Principles of Cell and Developmental Biology

BIOG 1440: Introduction to Comparative Physiology

BIOEE 1610: Ecology and the Environment

plus

BIOG 1500: Investigative Biology Laboratory, *or*

BIOG 1105/1106: Introductory Biology

BIOMG 3300 or 3330: Principles of Biochemistry, *or*

BIOMG 3310 and BIOMG 3320: Principles of Biochemistry, *or*

BIOMI 2900: General Microbiology Lectures, *or*

CEE 4510: Microbiology for Environmental Engineering

BIO XXXX: Biological Science course(s) with a biology prerequisite

BEE 2600/ENGRD 2600: Principles of Biological Engineering, *or*

BEE 2510/ENGRD 2510: Engineering for a Sustainable Society

BEE 3500: Biological and Bioenvironmental Transport Processes

BEE 2220: Bioengineering Thermodynamics and Kinetics, *or*
ENGRD 2210: Thermodynamics

CEE 3040: Uncertainty Analysis in Engineering, *or*
ENGRD 2700: Basic Engineering Probability and Statistics

BEE 3310: Bio-Fluid Mechanics, *or*
CEE 3310: Fluid Mechanics

Concentration Electives: Three courses from approved list.

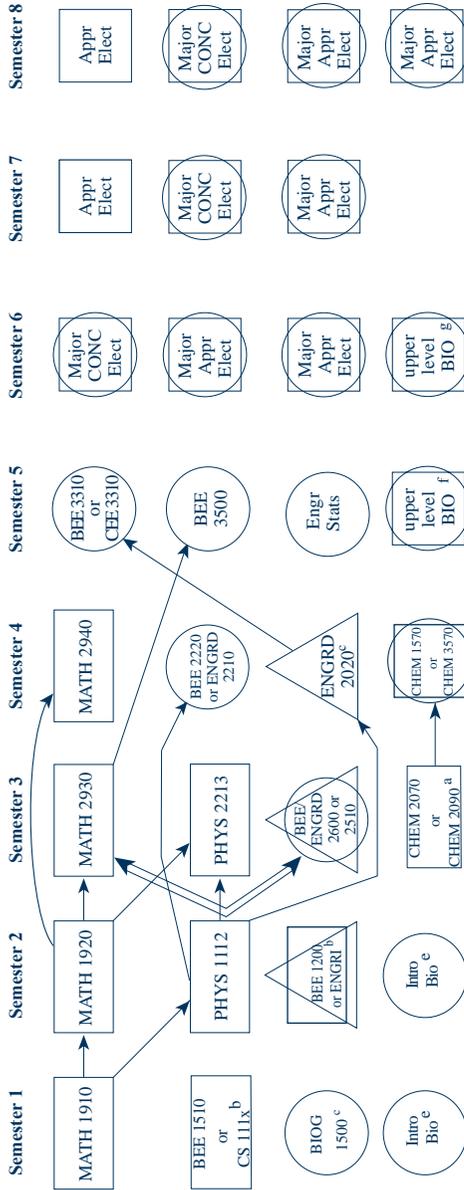
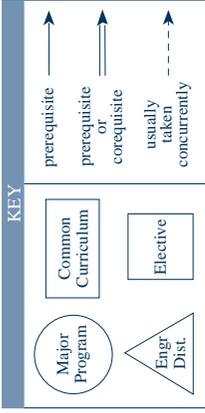
Major-approved electives to complete remaining credits.

Major-approved Engineering Electives and Concentration Courses

One course must be a BEE Capstone course and one must be a BEE Laboratory Experience course (see department web page for a current list of approved courses). BE Concentrations: Biomedical Engineering, Bioprocess Engineering, or Bioenvironmental Engineering (see department web page for a current list of approved concentration courses).

The requirements for premedical study can be met with an additional 6–9 credits if courses are carefully selected.

Biological Engineering Major (BE)



First-Year Writing Seminar

Intro Bio^c

CHEM 2070 or CHEM 2090^a

ENGRD 2020^c

CHEM 1570 or CHEM 3570

upper level BIO^f

Engr Stats

BEE 3500

BEE/ENGRD/2600 or ENGR 2510

PHYS 2213

BEE 2220 or ENGRD 2210

PHYS 1112

MATH 2930

MATH 2940

BEE 3310 or CEE 3310

Major CONC Elect

Major Appr Elect

Major Appr Elect

Appr Elect

Major CONC Elect

Major Appr Elect

Appr Elect

Major CONC Elect

Major Appr Elect

Major Appr Elect

Major CONC Elect

Major Appr Elect

Major Appr Elect

CS 1130 or 1132, pref. in sem. 2 but before sem. 5

Biological Engineering Major Check List

	Min. Cr. Hrs.	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 or CHEM 2070 (or 2150) ^a	4	<input type="checkbox"/>
CHEM 1570 (or 3570)	3	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
CS 1110, CS 1112, CS 1114, or BEE 1510 ^b	4	<input type="checkbox"/>
CS 1130 (or 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGRI 1XXX or BEE 1200 ^b	3/1	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2020	4	<input type="checkbox"/>
Engineering Distribution 2: BEE/ENGRD 2600, or BEE/ENGRD 2510 (recommended)	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^d	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum		
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum	3	<input type="checkbox"/>
Approved Elective 2	3	<input type="checkbox"/>
Physical Education: two semesters and swim test	0	<input type="checkbox"/>
Required Major Courses (46-credit minimum)		
Intro BIO ^e	3	<input type="checkbox"/>
Intro BIO	3	<input type="checkbox"/>
BIOG 1500 ^e	2	<input type="checkbox"/>
Upper-level Biology ^f	4/3	<input type="checkbox"/>
Upper-level Biology ^g	3/4	<input type="checkbox"/>
BEE 3500	3	<input type="checkbox"/>
BEE 2220 or ENGRD 2210	3	<input type="checkbox"/>
BEE 3310 or CEE 3310	4	<input type="checkbox"/>
Engineering Statistics: CEE 3040 or ENGRD 2700 ^c	4/3	<input type="checkbox"/>
Major Concentration Elective ^h	3	<input type="checkbox"/>
Major Concentration Elective	3	<input type="checkbox"/>
Major Concentration Elective	3	<input type="checkbox"/>
Major-approved Electives ^h	12–17	<input type="checkbox"/>
Total Required Credits	127 minimum	
Capstone Design Requirement		<input type="checkbox"/>
Laboratory Experience Requirement		<input type="checkbox"/>
Technical Writing Course ^d		<input type="checkbox"/>

Notes

- a. COE matriculates must enroll in CHEM 2090 (fall, spring); CALS matriculates must enroll in CHEM 2070 (fall). Students in either college may also substitute CHEM 2150 for either CHEM 2090 or 2070.
- b. CS 111X and ENGRI required of COE matriculates. BEE 1510 and BEE 1200 required of CALS matriculates.
- c. The Major program includes nine (9) credits of courses outside the Major. These are satisfied by ENGRD 2020, CEE 3040, or ENGRD 2700, and a non-BEE Major-approved elective.
- d. In addition to the First-year Writing Seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course.
- e. Choose two of the three following: BIOMG 1350, BIOG 1440, or BIOEE 1610, plus BIOG 1500. May substitute BIOG 1105/1106. All BIO courses must be taken for letter grade.
- f. Either biochemistry or microbiology is required: BIOMG 3300 or BIOMG 3330 or BIOMG 3310 or BIOMG 3320 or BIOMI 2900 or CEE 4510.
- g. Upper-level BIO: Any biology course that has a biology prerequisite.
- h. Electives must include a BEE capstone design course and a BEE laboratory experience course. See department web page for a current list of approved courses.

Major: Chemical Engineering (ChemE)

Accredited by ABET (see inside front cover)

Offered by: School of Chemical and Biomolecular Engineering
226 Olin Hall, 255.1489, www.cheme.cornell.edu

Program Objectives

Our objectives are designed to meet the needs of our constituents: our students, our graduates, the employers of our graduates, the graduate programs that our graduates enter, the chemical engineering professional community, and society in general.

Objective 1. To teach our students to analyze and design chemical processes that span molecular to macroscopic scales.

Objective 2. To teach our students interpersonal skills necessary in a professional environment.

Objective 3. To provide a liberal education in humanities and history.

Objective 4. To create scholars and professionals.

Engineering Distributions

ENGRD 2190: Mass and Energy Balances (required)

CHEM 3890: Honors Physical Chemistry I (recommended)^b

Required Major Courses

CHEM 2510: Introduction to Experimental Organic Chemistry

CHEM 2900: Introductory Physical Chemistry Laboratory

CHEM 3570: Organic Chemistry for the Life Sciences^e

CHEM 3900: Honors Physical Chemistry II

CHEME 3010: Career Perspectives

CHEME 3130: Chemical Engineering Thermodynamics

CHEME 3230: Fluid Mechanics

CHEME 3240: Heat and Mass Transfer

CHEME 3320: Analysis of Separation Processes

CHEME 3720: Introduction to Process Dynamics and Control

CHEME 3900: Chemical Kinetics and Reactor Design

CHEME 4320: Chemical Engineering Laboratory

CHEME 4620: Chemical Process Design

Electives

Two advanced chemical engineering electives chosen from:

CHEME 4010: Molecular Principles of Biomedical Engineering

CHEME 4020: Cellular Principles of Biomedical Engineering

CHEME 4130: Introduction to Nuclear Science and Engineering

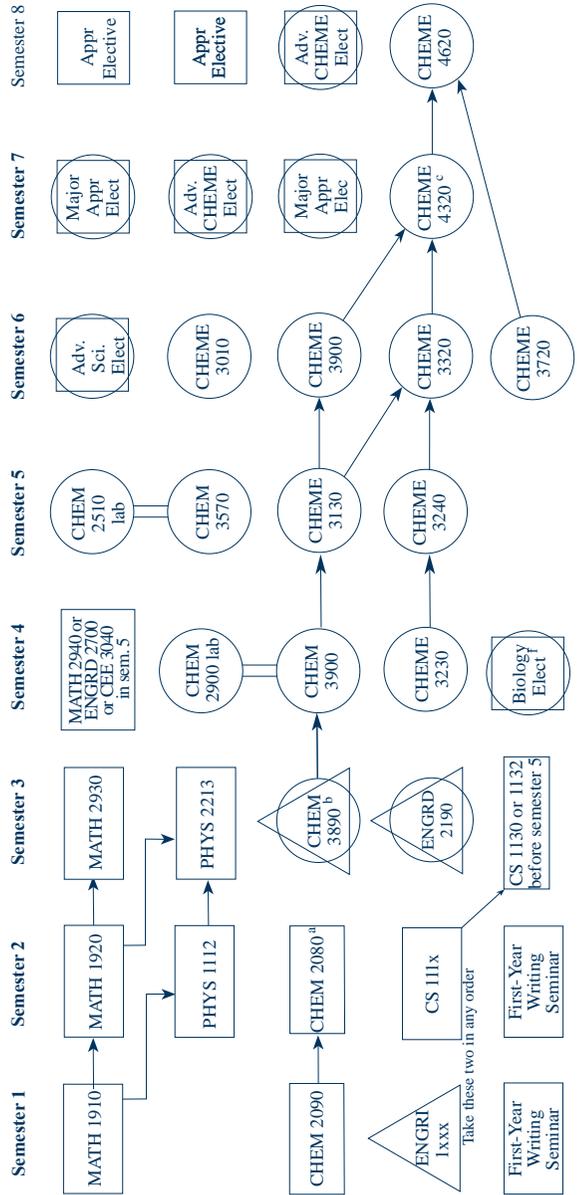
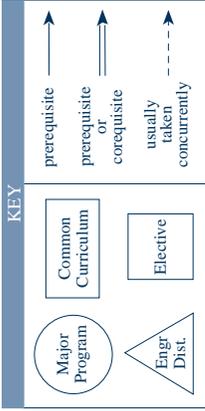
CHEME 4700: Process Control Strategies

CHEME 4720: Feedback Control Systems

CHEME 4800: Chemical Processing of Electronic Materials

CHEME 4810: Biomedical Engineering
CHEME 4840: Microchemical and Microfluidic Systems
CHEME 5200–9 Topic Modules
CHEME 5430: Biomolecular Engineering of Bioprocesses
CHEME 5440: Systems Biology in Biotechnology and Medicine
CHEME 6240/MAE 5240: Physics of Micro- and Nanoscale Fluid Mechanics and Heat Transfer
CHEME 6310: Engineering Principles for Drug Delivery
CHEME 6400: Polymeric Materials
CHEME 6440: Aerosols and Colloids
CHEME 6560: Membrane Separations
CHEME 6610: Air Pollution Control
CHEME 6640: Energy Economic
CHEME 6650: Energy Engineering
CHEME 6660: Analysis of Sustainable Energy Systems
CHEME 6661: Bioenergy and Biofuels Module
CHEME 6662: Solar Energy Module
CHEME 6663: Geothermal Energy Module
CHEME 6664: Wind Energy Module
CHEME 6665: Geological Carbon Sequestration Module
CHEME 6666: Unconventional Natural Gas Development from Shale Formations Module
Four Major-approved electives (includes the biology elective^f)

Chemical Engineering Major (ChemE)



Chemical Engineering Major Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940 (or CEE 3040 or ENGRD 2700)	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
CHEM 2080 (or 2160) ^a	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
CS 1110 (or 1112, or 1114)	4	<input type="checkbox"/>
CS 1130 (or 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGR1 1XXX	3	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2190	3	<input type="checkbox"/>
Engineering Distribution 2: CHEM 3890 (recommended) ^b	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^c	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum		
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1 ^a : two courses, 6-credit minimum		<input type="checkbox"/>
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (52-credit minimum)^d		
CHEME 3010	1	<input type="checkbox"/>
CHEME 3130	3	<input type="checkbox"/>
CHEME 3230	3	<input type="checkbox"/>
CHEME 3240	3	<input type="checkbox"/>
CHEME 3320	3	<input type="checkbox"/>
CHEME 3720	2	<input type="checkbox"/>
CHEME 3900	3	<input type="checkbox"/>
CHEME 4320 ^c	6	<input type="checkbox"/>
CHEME 4620	5	<input type="checkbox"/>
Advanced CHEME Elective 1 ^e	3	<input type="checkbox"/>
Advanced CHEME Elective 2	3	<input type="checkbox"/>
Major-approved Elective 1: Biology Elective ^f	3	<input type="checkbox"/>
Major-approved Elective 2: Advanced Science Elective ^e	3	<input type="checkbox"/>
Major-approved Elective 3 ^e	3	<input type="checkbox"/>
Major-approved Elective 4:	3	<input type="checkbox"/>
Courses outside the Major:		
CHEM 2510	2	<input type="checkbox"/>
CHEM 2900	2	<input type="checkbox"/>
CHEM 3570 ^g	3	<input type="checkbox"/>
CHEM 3900	4	<input type="checkbox"/>
Total Required Credits	131 minimum	
Technical Writing Course ^e : CHEM 4320		<input type="checkbox"/>

Notes

- a. CHEM 2080 (2160) usually fulfills one of the two approved electives.
- b. CHEM 3890 is required by the Major, and it is recommended that this course be counted as an engineering distribution course. In this case, the fourth credit may apply as an approved elective credit.
- c. In addition to the first-year writing seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course (CHEM 4320: Chemical Engineering Laboratory satisfies this requirement).
- d. The Major program includes nine (9) credits of courses outside the Major. These are satisfied by courses in chemistry.
- e. Electives can be taken in semester 7 or 8. Major-approved electives must be approved by your CHEME faculty advisor. Students with a biomolecular focus may use the following courses as electives: CHEM 4010 and CHEM 4020 as advanced CHEME Electives; BIOMG 3300 and CHEM 5430 or CHEM 4810 as a Major-approved elective.
- f. The biology elective can be taken in semester 4 or later. Each student must complete one of the seven following options for the biology elective:
 - Advanced Placement—a score of 5 on the CEEB AP exam or a score of 7 on the IB Higher Level exam.
 - CHEM 2880: Biomolecular Engineering: Fundamentals and Applications (fall, 3 credits).
 - Eight credits of a pre-med biology sequence; BIOG 1500: Investigative Laboratory (academic year, 2 credits) and BIOG 1350: Principles of Cell Developmental Biology (academic year, 3 credits) and BIOG 1440: Introduction to Comparative Physiology (academic year, 3 credits) or BIOG 1610: Ecology and the Environment (academic year, 3 credits), BIOG 1105: Introductory Biology (fall, 4 credits) and BIOG 1106: Introductory Biology (spring, 4 credits), BIOG 1107: General Biology (summer, first half of eight-week session, 4 credits) and BIOG 1108: General Biology (summer, second half of eight-week session, 4 credits).
 - Three credits of microbiology—BIOMI 2900: General Microbiology Lectures (fall, spring, or six-week summer session, 3 credits).
 - Four credits of biochemistry—BIOMG 3300: Principles of Biochemistry, Individualized Instruction (fall or spring, 4 credits) or BIOMG 3330: Principles of Biochemistry: Proteins, Metabolism, and Molecular Biology (six-week summer session, 4 credits) or BIOMG 3350: Principles of Biochemistry: Proteins, Metabolism, and Molecular Biology (spring, 4 credits).
 - Five credits of biochemistry—BIOMG 3310: Principles of Biochemistry: Proteins and Metabolism (fall, 3 credits) and BIOMG 3320: Principles of Biochemistry: Molecular Biology (spring, 2 credits).
 - CHEM 5430: Biomolecular Engineering of Bioprocesses (fall, 3 credits).
- g. Premed students need 8 credits of organic chemistry.

This engineering check list is formatted to conform to the general specifications of the College of Engineering. We strongly recommend that you visit 120 Olin Hall for an official Chemical and Biomolecular Engineering curriculum sheet and check list or visit www.cheme.cornell.edu/undergraduate/curriculum/.

Major: Civil Engineering (CE)

Accredited by ABET (see inside front cover)

Offered by: School of Civil and Environmental Engineering

221 Hollister Hall, 255.3412, www.cee.cornell.edu

Program Objectives

We are dedicated to providing the highest-quality broad-based technical, scientific, and liberal education. We create and maintain an outstanding educational program in a climate that fosters diverse skills designed for professional success. Our objectives are to prepare our students for:

- excellence in engineering decision-making and design,
- leadership careers in engineering practice,
- graduate professional engineering education,
- advanced study and research in engineering, and
- diverse, alternative career choices.

Engineering Distributions

ENGRD 2020: Mechanics of Solids (required)

Recommended Distributions

ENGRD 2110: Object-Oriented Programming and Data Structures (recommended for students interested in transportation systems engineering)

ENGRD 2210: Thermodynamics (recommended for students interested in fluid mechanics and hydraulics/hydrology)

ENGRD 2510: Engineering for a Sustainable Society (recommended for students interested in environmental engineering)

ENGRD 2610: Mechanical Properties of Materials: From Nanodevices to Superstructures (recommended for students interested in structural and geotechnical engineering)

ENGRD 3200^{d,f}: Engineering Computation (recommended for all students)

Required Major Courses

TAM 2030^d: Dynamics *or*

CEE 4780^e: Structural Dynamics and Earthquake Engineering

ENGRD 3200^f: Engineering Computation

CEE 3040^{d,g}: Uncertainty Analysis in Engineering

CEE 3230: Engineering Economics and Management

CEE 3310: Fluid Mechanics

CEE 3410: Introduction to Geotechnical Engineering

CEE 3510^{h,i}: Environmental Quality Engineering

CEE 3610^{h,i}: Introduction to Transportation Engineering

CEE 3710ⁱ: Structural Modeling and Behavior

Electives

Technical writing course (see listing of approved courses in *Courses of Study*)^j

One CEE Capstone Design Elective^k

Two CEE Design Electives^k

Two Major-approved electives^k

Two approved electives

One additional science course^m

Civil Engineering Major Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
PHYS 2214 (or 2218) ^a	4	<input type="checkbox"/>
CS 1110 (or 1112, or 1114)	4	<input type="checkbox"/>
CS 1130 (or 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGRI 1XXX	3	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2020 (required)	4	<input type="checkbox"/>
Engineering Distribution 2 ^b	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^c	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: 6 courses, 18-credit minimum	18	
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum	6	<input type="checkbox"/>
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (49-credit minimum)^l		
TAM 2030 ^d or CEE 4780 ^e	3	<input type="checkbox"/>
ENGRD 3200 ^{d,f}	3	<input type="checkbox"/>
CEE 3040 ^g	4	<input type="checkbox"/>
CEE 3230	3	<input type="checkbox"/>
CEE 3310	4	<input type="checkbox"/>
CEE 3410	4	<input type="checkbox"/>
CEE 3510 ^{h,i}	3	<input type="checkbox"/>
CEE 3610 ^{h,i}	3	<input type="checkbox"/>
CEE 3710 ⁱ	4	<input type="checkbox"/>
Technical Writing Course ^j	3	<input type="checkbox"/>
CEE Capstone Design Elective 1 ^k	3	<input type="checkbox"/>
CEE Design Elective 2 ^k	3	<input type="checkbox"/>
CEE Design Elective 3	3	<input type="checkbox"/>
Major-approved Elective 1 ^k	3	<input type="checkbox"/>
Major-approved Elective 2	3	<input type="checkbox"/>
Total Required Credits	126 minimum	
Additional Science Course ^m (0 credits minimum, no maximum)		<input type="checkbox"/>
Additional Elective Courses (0 credits minimum, no maximum)		<input type="checkbox"/>

Notes

- a. May substitute CHEM 2080 or CHEM 1570 for PHYS 2214.
- b. Recommended: ENGRD 2610 for civil infrastructure; ENGRD 2210 for hydraulics; ENGRD 2110 for transportation; ENGRD 2510 for environmental; ENGRD 3200 for all students.
- c. In addition to the first-year writing seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course. An approved COMM course, any ENGRC course, or BEE 4890: Entrepreneurial Management for Engineers will satisfy this requirement.
- d. Students using this course as a second engineering distribution must take an additional Major-approved elective.
- e. TAM 2030 may be taken in the second year, but CEE 4780 should not be taken until the third or fourth year.
- f. ENGRD 3200 may be taken in semester 4 or 6.
- g. ENGRD 2700: Basic Engineering Probability and Statistics may be accepted (by petition) as a substitute for CEE 3040 in the Major, but only if taken before affiliation, or in some special cases where co-op or study abroad programs necessitate such a substitution.
- h. Students interested in pursuing a concentration in civil infrastructure (geotechnical and structural engineering) may substitute either CEE 3720: Intermediate Solid Mechanics or CEE 4710: Fundamentals of Structural Mechanics for either CEE 3510 or CEE 3610, if they also complete either CEE 4730: Design of Concrete Structures or CEE 4740: Introduction to the Behavior of Metal Structures. However, CEE 3720 or CEE 4710 then counts as a core course only and not as a CEE Design Elective or Major-approved elective.
- i. Students may take CEE 3510, 3610, or 3710 in semester 4, depending on their interests.
- j. If the technical writing requirement is met with a course that fulfills another requirement (liberal studies, Major-approved elective, etc.), then the student must take an additional elective approved by their faculty advisor.
- k. To be chosen from lists available in the CE Undergraduate Office, 221 Hollister Hall. Lists of suggested courses are available for students interested in structural engineering, transportation engineering, fluid mechanics/hydrology, geotechnical engineering, water resources and environmental systems engineering, and environmental engineering.
- l. The Major program includes nine (9) credits of courses outside the Major. This group of courses may include ENGRD 2020, TAM 2030, one engineering distribution or elective, and/or a CE Major course outside the Major disciplinary area.
- m. Students must take one (1) additional basic science course in addition to the required physics and chemistry sequence. Courses meeting this requirement include: BIO 1440, BIOEE 1610, BIOMG 1610, and EAS 2200, 3030, 3050, 3410, 3420, and 3530. Students may petition to have other courses approved. (Note: This course may simultaneously satisfy another requirement, such as an approved elective.)

Major: Computer Science (CS)

Offered by: Department of Computer Science
303 Upson Hall, 255.0982, www.cs.cornell.edu/degreeprogs/ugrad/

Program Objectives

The CS curriculum covers both the theory of algorithms and computing and their applications in science, engineering, and business. Students learn algorithmic ways of thinking and how to bring them to bear on a wide range of problems. They also study the elements of computing and information technology such as system design, problem specification, programming, system analysis and evaluation, and complex modeling.

Engineering Distributions

ENGRD 2110: Object-Oriented Programming and Data Structures (required), *or*
ENGRD 2112: Object-Oriented Design and Data Structures-Honors

Required Major Courses

CS 2800: Discrete Structures

CS 3110: Data Structures and Functional Programming

CS 3410: Computer System Organization and Programming, *or*
CS 3420/ECE 3140: Computer Organization/Embedded Systems^d

CS 4410: Operating Systems

CS 4820: Introduction to Analysis of Algorithms

Electives

Three CS electives numbered ≥ 4000 ; 3-credit minimum per course; CS 4090 and CS 4999 not allowed

One CS project course; 2-credit minimum

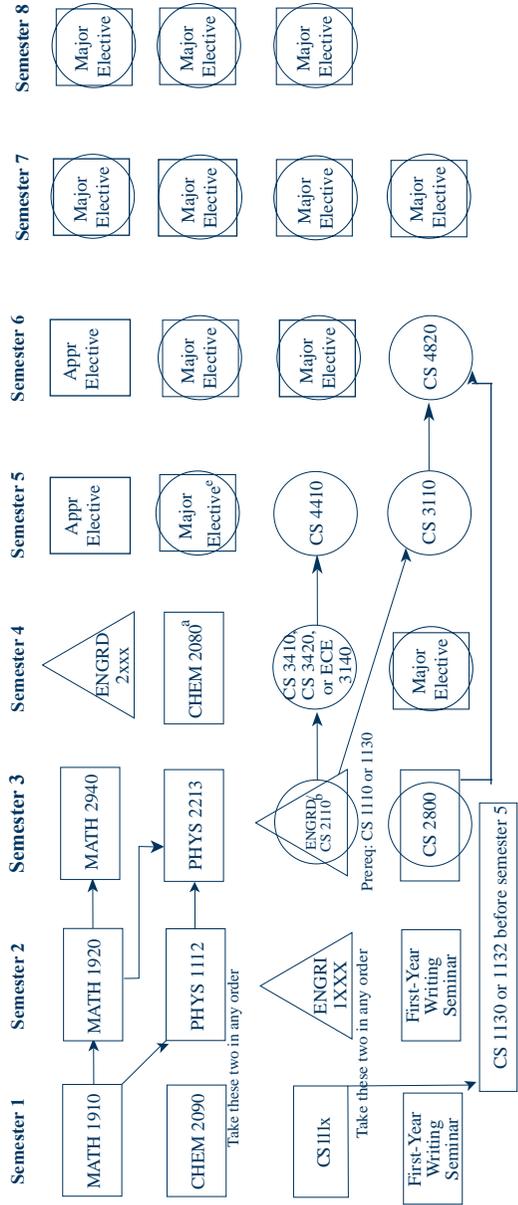
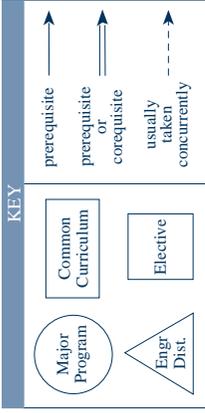
Three Major-Approved Technical Electives numbered ≥ 3000 ; 3-credit minimum per course; CS 4090 not allowed

Major-Approved Free Elective; totaling 3 credits

Two approved electives

Three related, upper-level elective courses numbered ≥ 3000 (External Specialization); 3-credit minimum per course; CS courses not allowed

Computer Science Major (CS)



Computer Science Major Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
CS 2800	3	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
CHEM 2080 ^a	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
CS 1110 (or 1112, or 1114)	4	<input type="checkbox"/>
CS 1130 (or 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGR1 1XXX	3	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2110 or ENGRD 2112 ^b	3	<input type="checkbox"/>
Engineering Distribution 2	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^c	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum		
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum		<input type="checkbox"/>
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (47-credit minimum)		
CS 3110	4	<input type="checkbox"/>
CS 3410 or CS 3420 or ECE 3140 ^d	4	<input type="checkbox"/>
CS 4410	3	<input type="checkbox"/>
CS 4820	4	<input type="checkbox"/>
Major Electives^e		
CS 4000 or above Elective 1 ^g	3	<input type="checkbox"/>
CS 4000 or above Elective 2	3	<input type="checkbox"/>
CS 4000 or above Elective 3	3	<input type="checkbox"/>
CS Project Course (4000 or above)	2	<input type="checkbox"/>
External Specialization Elective 1 ^h	3	<input type="checkbox"/>
External Specialization Elective 2	3	<input type="checkbox"/>
External Specialization Elective 3	3	<input type="checkbox"/>
Major-Approved Technical Elective 1 ⁱ	3	<input type="checkbox"/>
Major-Approved Technical Elective 2	3	<input type="checkbox"/>
Major-Approved Technical Elective 3	3	<input type="checkbox"/>
Major-Approved Free Elective ^j	3	<input type="checkbox"/>
Total Required Credits	122 minimum	
Technical Writing Course ^c <input type="checkbox"/> , Probability Requirement ^k <input type="checkbox"/> , Vector Requirement ^l <input type="checkbox"/>		

Notes

- a. May substitute BTRY 3080, ECON 3190, MATH 4710, PHYS 2214, or PHYS 2218 for CHEM 2080. MATH 2930 is a prerequisite for PHYS 2214.
- b. CS 2112 is an honors version of CS 2110.
- c. In addition to the first-year writing seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course.
- d. ECE/ENGRD 2300 is a prerequisite for ECE 3140.
- e. Major electives include CS 4000+ level electives, the CS 4000+ level project course, Technical Electives, the External Specialization, and the Major-approved elective. Courses for a CS vector and the probability requirement may also be included in these categories. All Major Electives must be courses of at least 3 credits with the exception of the CS project course, which is at least 2 credits, or the Major-approved elective, which must total 3 credits.
- f. This engineering checklist is formatted to conform to the general specifications of the College of Engineering. We strongly recommend that you visit 303 Upson Hall for an official Computer Science Major checklist. This information can also be obtained by visiting the Computer Science web site (www.cs.cornell.edu/ugrad).
- g. All CS 4000+ Electives must be taken under the CS rubric. CS/ENGRD 3220 also accepted unless CS 4210/MATH 4250 applied. CS 4090 and CS 4999 NOT allowed.
- h. The Major program includes nine (9) credits of courses outside the Major. These courses are satisfied by the External Specialization. The three courses must be related to each other (3000+ level and 3 credit minimum per course). Courses not allowed in the External Specialization are: any CS course, LING 4474, INFO 3300, INFO 4300, INFO 4302, and INFO 5300.
- i. Three 3000+ level courses of at least 3 credits each (including ENGRD 2700 or MATH 2930, but not both) that are technical in nature, as determined by the Major. CS 4090 is not allowed.
- j. An elective requirement consisting of a single 3+ credit course or a combination of courses coming to 3+ credits total. Roughly speaking, all academic courses (inside or outside of CS) count. No PE courses, courses numbered 10xx, or ROTC courses below the 3000 level are allowed.
- k. Students' course selections must also include one of BTRY 3080, CS 4850, ECE 3100, ECON 3190, ENGRD 2700, or MATH 4710. CS Majors can use ECE 3100 as a substitute for ENGRD 2700 in satisfying the engineering distribution requirements.
- l. Additionally, students' course selections must satisfy the requirements of at least one "vector", or CS-centric specialization, defined by the department. The set of vectors at the time of this writing include artificial intelligence, computational science and engineering, data-intensive computing, graphics, human-language technologies, network science, programming languages, security and trustworthy systems, software engineering/code warrior, systems, theory, and a broad "Renaissance" vector. See www.cs.cornell.edu/ugrad for the requirements of each vector.

Major: Electrical and Computer Engineering (ECE)

Accredited by ABET (see inside front cover)

Offered by: School of Electrical and Computer Engineering

222 Phillips Hall, 255.4309, www.ece.cornell.edu

Program Objectives

Our objectives are designed to serve the needs of our constituents: our graduates, the employers of our graduates, the graduate study programs that our graduates enter, and our society.

- To create leading scholars and professionals who are committed to excellence, integrity, lifelong learning, and professional citizenship.
- To enable our students to achieve engineering goals through problem solving, design, experimentation, teamwork, and effective communication.
- To endow our students with an appreciation of the impact of electrical and computer engineering on society and to encourage creative responses to the needs of society by our graduates.
- To provide our students with a broad education in the fundamentals of Electrical and Computer Engineering as well as advanced knowledge in one or more technical areas that lead to and sustain a productive engineering career.

Areas of Concentration

Computer architecture and organization, digital systems, and computer vision; power systems, and control; communications, networks, information theory and coding, signal processing, and optimization; electronic circuits, VLSI, solid state physics and devices, MEMs, nanotechnology, lasers and optoelectronics; electromagnetics, radiophysics, space sciences, and plasmas.

Engineering Distributions

ENGRD/ECE 2300: Introduction to Digital Logic Design (required)

ENGRD 2XXX^a

Required Major Courses

ECE/ENGRD 2100: Introduction to Circuits for Electrical and Computer Engineers

ECE 2200: Signals and Information

ECE 3400: Introduction to Design for Electrical and Computer Engineers

Further Major Requirements

At least three ECE foundation courses^c

At least one Culminating Design Experience course^d

At least three additional ECE courses at the 3000-level or above

At least three additional ECE courses numbered ≥ 4000 ^f

At least nine credits of Outside-ECE Technical Electives

Culminating Design Experience (CDE)^d

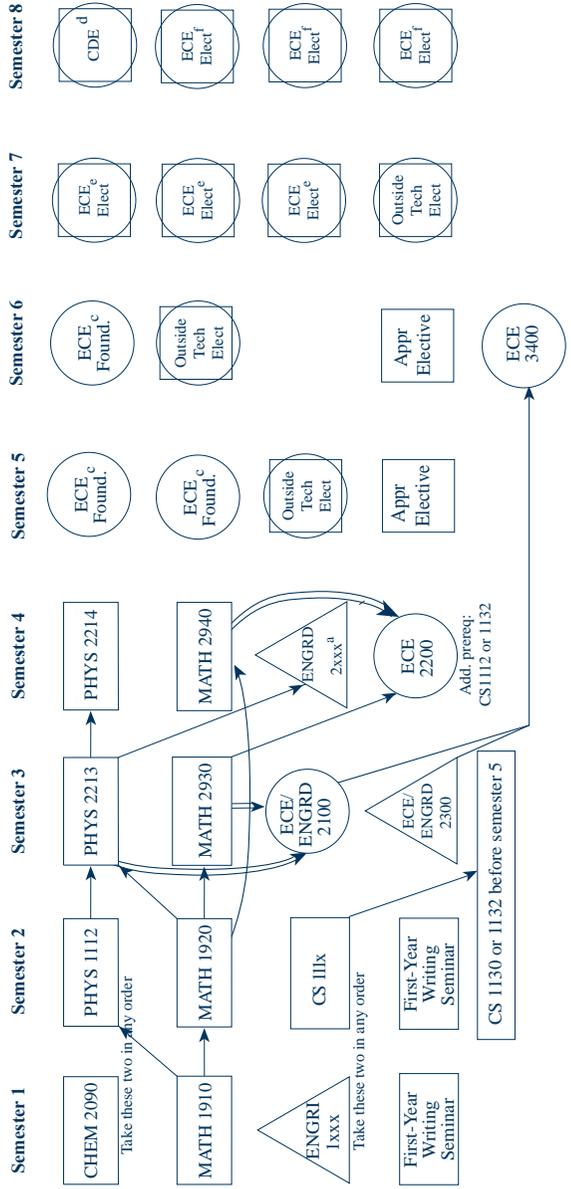
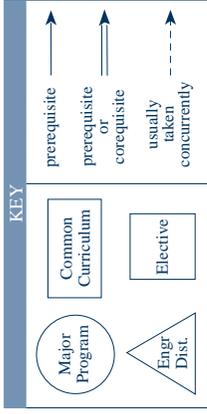
A Culminating Design Experience (CDE) course includes a significant and open-ended engineering design assignment with realistic constraints. The principal goal of a CDE

course is to help students develop the ability to design a component, system, or process to meet desired needs taking into account some or all of the following: economics, the environment, sustainability, manufacturability, ethics, health and safety, society, and politics. Consult the ECE Undergraduate Office for current options.

Projects

Students may count up to three credits of work on approved large-group interdisciplinary project teams in the Outside-ECE Technical Electives category. A current list of approved project teams appears on the ECE Undergraduate Handbook site (www.ece.cornell.edu/ugradhndbk). Students may also petition to count up to three independent-study credits (ECE 4999) in the Outside-ECE Technical Elective category. See the ECE Undergraduate Handbook site for rules governing such work.

Electrical and Computer Engineering Major (ECE)



Electrical and Computer Engineering Major Check List^h

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
PHYS 2214 (or 2218)	4	<input type="checkbox"/>
CS 1110 (or 1112 or 1114)	4	<input type="checkbox"/>
CS 1130 (or 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGRI 1XXX	3	<input type="checkbox"/>
Engineering Distribution 1: ECE/ENGRD 2300 (required)	4	<input type="checkbox"/>
Engineering Distribution 2 ^a :	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^b	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum		
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum		<input type="checkbox"/>
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (55 credits)		
ECE 2100	4	<input type="checkbox"/>
ECE 2200	4	<input type="checkbox"/>
ECE 3400	4	<input type="checkbox"/>
ECE Foundation Course ^c	4	<input type="checkbox"/>
ECE Foundation Course	4	<input type="checkbox"/>
ECE Foundation Course	4	<input type="checkbox"/>
CDE ^d	4	<input type="checkbox"/>
ECE 3000 + elective ^e	3	<input type="checkbox"/>
ECE 3000 + elective	3	<input type="checkbox"/>
ECE 3000 + elective	3	<input type="checkbox"/>
ECE 4000 + breadth/depth course ^f	3	<input type="checkbox"/>
ECE 4000 + breadth/depth course	3	<input type="checkbox"/>
ECE 4000 + breadth/depth course	3	<input type="checkbox"/>
Outside–ECE Technical Elective	3	<input type="checkbox"/>
Outside–ECE Technical Elective	3	<input type="checkbox"/>
Outside–ECE Technical Elective	3	<input type="checkbox"/>
Total Required Credits	132 minimum	
Technical Writing Course ^b		<input type="checkbox"/>

Notes

- a. ENGRD 2110, Object Oriented Programming and Data Structures, is recommended (but not required) for those interested in the Computer Engineering specialty area.
- b. In addition to the first-year writing seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course.
- c. ECE Foundation Courses—At least three of the following: ECE 3030, ECE 3100, ECE 3140, ECE 3150, ECE 3250. (Must include one of ECE 3100 and ECE 3250, and at least one of ECE 3030 and ECE 3150.)
- d. Culminating Design Experience (CDE): Consult the ECE Undergraduate Office for current options.
- e. At least three additional ECE courses at the 3000-level or above.
- f. At least three additional ECE courses numbered 4000-level or above. Each of these breadth and depth courses must have at least one ECE foundation course as a prerequisite. The total list of prerequisites for the breadth and depth courses must include at least three ECE Foundation courses, including at least one of ECE 3100 and ECE 3250, and at least one of ECE 3030 and ECE 3150. Students must successfully complete the foundation courses before taking the breadth and depth courses for which they serve as prerequisites.
- g. The Major program includes nine (9) credits of courses outside the Major. These are satisfied by the outside-ECE Technical Electives.
- h. We recommend strongly that you obtain from 222 Phillips Hall or the ECE Undergraduate Handbook web site (www.ece.cornell.edu/ugradhndbk) an official ECE Graduation Check List appropriate for the Class of 2013 or later.

Major: Engineering Physics (EP)

Offered by: School of Applied and Engineering Physics

261 Clark Hall, 255.5198, www.aep.cornell.edu

Program Objectives

The objectives for the Major in Engineering Physics are to:

- Give our students an adequate education in mathematics and physics so that they have a basis for a complete understanding of current and future scientific and technological developments.
- Ensure, through a set of several elective courses, the necessary flexibility for various career objectives, i.e. (1) immediate employment with the B.S. degree; (2) background for entering professional graduate schools like law or medicine; and (3) the appropriate background for Ph.D. graduate work in science and/or engineering.
- Include throughout the undergraduate program hands-on experience in laboratory as well as design, computational, and research problems.
- Provide an environment characterized by the highest academic and ethical standards that instills pride in these standards and the program in general.

Introduction to Engineering Course

ENGR1 1XXX: Introduction to Engineering Course

Engineering Distributions (suggested)^{a,b}

ENGRD 2520: The Physics of Life

ENGRD 2640: Computer-Instrumentation Design

ENGRD XXXX: Choose from the list of engineering distribution courses;

AEP 3330: Mechanics of Particles and Solid Bodies may count as the second engineering distribution course for EP Majors.

Required Major Courses

AEP 4210–4220: Mathematical Physics I and II

AEP 3330^b: Mechanics of Particles and Solid Bodies (counts as an engineering distribution course)

AEP 3550: Intermediate Electromagnetism

AEP 3560: Intermediate Electrodynamics

AEP 3610: Introductory Quantum Mechanics

AEP 3620: Intermediate Quantum Mechanics

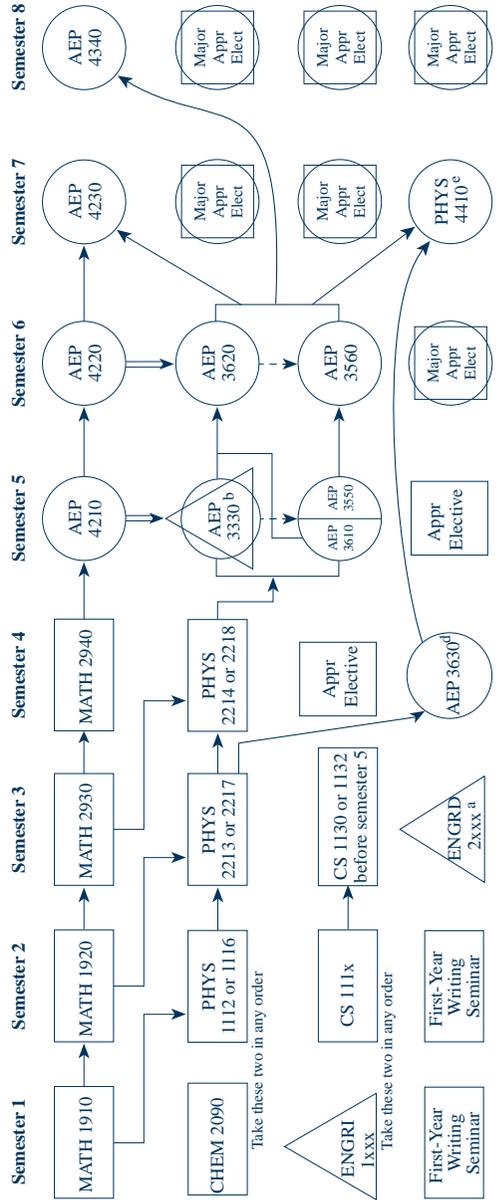
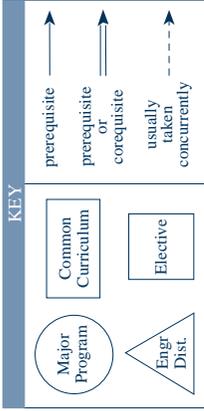
AEP 3630^d: Electronic Circuits (Laboratory)

AEP 4230: Statistical Thermodynamics

AEP 4340: Continuum Physics (Laboratory)

PHYS 4410^e: Advanced Experimental Physics (Laboratory)

Engineering Physics Major (EP)



Engineering Physics Major Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
PHYS 2214 (or 2218)	4	<input type="checkbox"/>
CS 1110 (or 1112, or 1114)	4	<input type="checkbox"/>
CS 1130 (or 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGR1 XXXX	3	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2640 or 2520 (recommended) ^a	3	<input type="checkbox"/>
Engineering Distribution 2: AEP 3330 (recommended) ^b	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^c	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum	18	
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum		<input type="checkbox"/>
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (58-credit minimum)		
AEP 4210	4	<input type="checkbox"/>
AEP 4220	4	<input type="checkbox"/>
AEP 3330	4	<input type="checkbox"/>
AEP 3550	2	<input type="checkbox"/>
AEP 3560	4	<input type="checkbox"/>
AEP 3610	2	<input type="checkbox"/>
AEP 3620	4	<input type="checkbox"/>
AEP 3630 ^d	4	<input type="checkbox"/>
AEP 4230	4	<input type="checkbox"/>
AEP 4340	4	<input type="checkbox"/>
PHYS 4410 ^e	4	<input type="checkbox"/>
Major-approved Elective ^f	3	<input type="checkbox"/>
Major-approved Elective	3	<input type="checkbox"/>
Major-approved Elective	3	<input type="checkbox"/>
Major-approved Elective	3	<input type="checkbox"/>
Major-approved Elective	3	<input type="checkbox"/>
Major-approved Elective	3	<input type="checkbox"/>
Total Required Credits	128 minimum	
Technical Writing Course ^c : ENGRD 2640 (recommended)		<input type="checkbox"/>

Notes

- a. EP offers two ENGRDs. ENGRD 2640 (recommended, but not required; satisfies the college technical writing requirement) offered in fall and spring, and ENGRD 2520, offered in spring.
- b. AEP 3330 may simultaneously satisfy major and distribution requirements. In this case, the total number of credits required for the degree is 130.
- c. In addition to the first-year writing seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course. (ENGRD 2640 satisfies this requirement.)
- d. AEP 3630 may be taken in either semester three or four. ECE 2100 and ECE 2300 can be substituted for AEP 3630.
- e. Two of the four credits of PHYS 4410 can be satisfied by successfully completing AEP 3300/PHYS 3330 or ASTRO 4410. The remaining two credits can be satisfied by taking PHYS 4400 for two credits, provided that the experiments in PHYS 4400 do not overlap with those in AEP 3300/PHYS 3330 or ASTRO 4410. (A list of experiments that are not appropriate will be prepared by AEP faculty and made available in the AEP office.) If a student chooses this option, AEP 3300/PHYS 3330 or ASTRO 4410 may also count as a technical elective, provided the remaining three technical electives are four credits each.
- f. Six Major-approved electives:
 - (1) Five of the six must be technical courses at or above the 3000-level.
 - (2) Nine credits of Major-approved electives must be outside of EP.
 - (3) Only three 4900 courses may be taken as Major-approved electives, and must be taken during the last four semesters.
 - (4) All Major-approved electives must be taken for a letter grade.

Major: Environmental Engineering (EnvE)

Accredited by ABET (see inside front cover)

Offered jointly by:

Department of Biological and Environmental Engineering

207 Riley-Robb Hall, 607.255.2173, www.bee.cornell.edu

and

School of Civil and Environmental Engineering

221 Hollister Hall, 607.255.3412, www.cee.cornell.edu/undergraduate-programs/

[environmental-engineering-major/v2/](#)

Program Objectives

We are committed to providing an excellent undergraduate engineering program in a nurturing learning environment so that our graduates acquire knowledge and develop the skills needed for successful professional careers. The educational program objectives are to:

- Produce graduates who pursue careers in Environmental Engineering based on a background in mathematics, physical and life sciences, liberal studies, and engineering.
- Produce graduates who pursue advanced degrees in engineering and related professional fields.
- Produce graduates who assume leadership positions and contribute to solution of societal problems involving environmental systems.

Civil Engineering also offers a focus in Environmental Engineering. Biological Engineering offers a concentration in Bioenvironmental Engineering.

Introduction to Engineering

BEE 1200: The BEE Experience (required for students matriculating in CALS)^c, *or*

ENGR1 IXXX: Introduction to Engineering

Engineering Distributions

BEE/ENGRD 2510: Engineering for a Sustainable Society (required)

ENGRD 2XXX: ENGRD 2020: Mechanics of Solids, *or*

ENGRD 2210: Thermodynamics, *or*

ENGRD 3200: Engineering Computation are recommended.^d

Required Major Courses

Introductory Biology (choose one):

BIOEE 1610: Ecology and the Environment, *or*

BIOMG 1350: Principles of Cell and Development Biology, *or*

BIOEE 1780: Evolutionary Biology and Diversity, *or*

BIOG 1440: Intro to Comparative Physiology, *or*

BIOG 1105: Introductory Biology, *or*

BIOG 1106: Introductory Biology

ENGRD 2020: Mechanics of Solids^d

ENGRD 3200: Engineering Computation^d, *or*

ENGRD 2210: Thermodynamics^d

CEE 3040: Uncertainty Analysis in Engineering^h

CEE 3230: Engineering Economics and Management, *or*
BEE 4890: Entrepreneurial Management for Engineers

CEE 3310: Fluid Mechanics

CEE 3510: Environmental Quality Engineering

CEE 4510: Microbiology for Environmental Engineeringⁱ

BEE 4750: Environmental Systems Analysis

Earth Science^j

Laboratory Course^j

Electivesⁱ

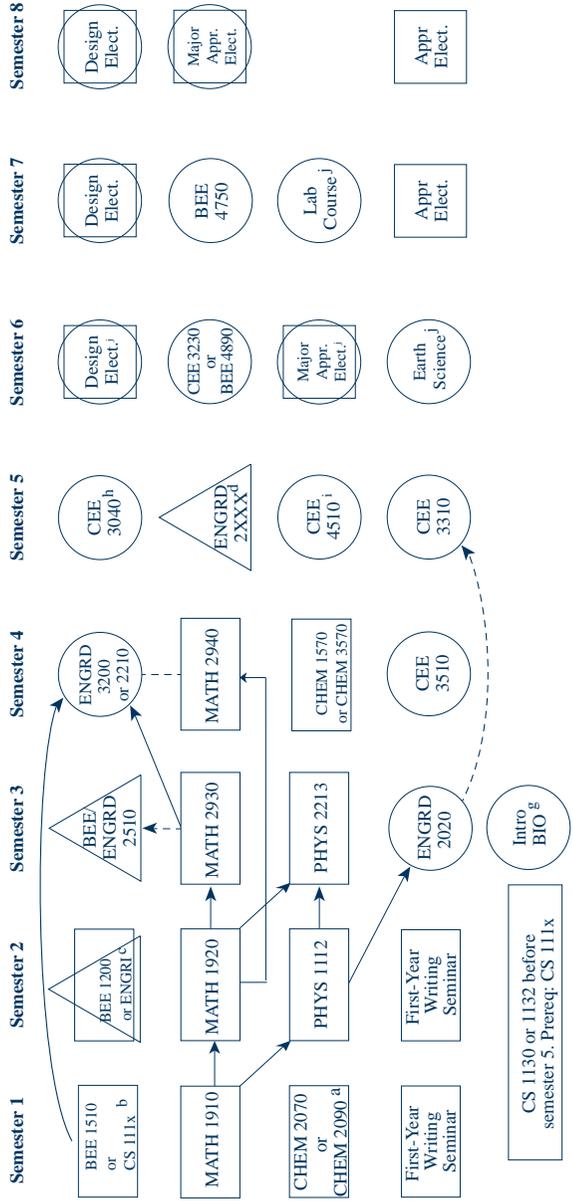
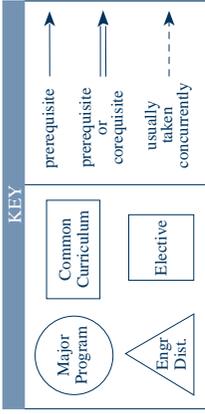
Technical writing course^e

Three Environmental Design electives, 9 credit minimum

Two Major-approved electives

Two approved electives

Environmental Engineering Major (EnvE)



Environmental Engineering Major Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 or CHEM 2070 (or 2150) ^a	4	<input type="checkbox"/>
CHEM 1570 or 3570	3	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
CS 1110 (1112 or 1114) or BEE 1510 ^b	4	<input type="checkbox"/>
CS 1130 (or 1132) ^b	1	<input type="checkbox"/>
Introduction to Engineering: ENGRI 1XXX or BEE 1200 ^c	3/1	<input type="checkbox"/>
Engineering Distribution 1: BEE/ENGRD 2510 (required)	3	<input type="checkbox"/>
Engineering Distribution 2: ENGRD XXXX ^d	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^e	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum	18	
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum	6	
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (57-credit minimum)^f		
Intro BIO 1XXX ^g	3/4	<input type="checkbox"/>
ENGRD 2020		
ENGRD 3200 or 2210	3	<input type="checkbox"/>
CEE 3040 ^h	4	<input type="checkbox"/>
CEE 3230 or BEE 4890	3/4	<input type="checkbox"/>
CEE 3310	4	<input type="checkbox"/>
CEE 3510	3	<input type="checkbox"/>
CEE 4510 ⁱ	3	<input type="checkbox"/>
BEE 4750	3	<input type="checkbox"/>
Earth Science ^j	3	<input type="checkbox"/>
Laboratory Course ^j	3	<input type="checkbox"/>
Design Elective 1 (Approved Capstone) ^j	3	<input type="checkbox"/>
Design Elective 2	3	<input type="checkbox"/>
Design Elective 3	3	<input type="checkbox"/>
Major-approved Elective 1 ^j	3	<input type="checkbox"/>
Major-approved Elective 2	3	<input type="checkbox"/>
Engineering electives to meet 57 credits	0-3	<input type="checkbox"/>
Total Required Credits	126 minimum	
Technical Writing Course ^e		<input type="checkbox"/>

Notes

- a. COE matriculates must enroll in CHEM 2090 (fall, spring); CALS matriculates must enroll in CHEM 2070 (fall). Students in either college may also substitute CHEM 2150 for CHEM 2090 or CHEM 2070.
- b. Students matriculated in CALS may take BEE 1510 followed by CS 1130 for the computing requirement. COE students take CS 1110, 1112, or 1114 followed by CS 1130 or 1132.
- c. BEE 1200 combined with BEE 1510: Introduction to Computer Programming (5 credits total) satisfies the ENGRI requirement for CALS matriculated students. Students using BEE 1200 and BEE 1510 to satisfy the ENGRI requirement must make up the 2-credit difference with engineering course work.
- d. ENGRD 2020 and 2210 or 3200 are recommended. Students electing to use one of these courses as a second engineering distribution must take an additional Major-approved elective.
- e. In addition to the First-Year Writing Seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective or Major course. An approved COMM or ENGRC course, or BEE 4730, or BEE 4890, will satisfy this requirement. Students meeting the technical communications requirement with a course that fulfills another requirement (e.g. liberal studies, Lab, Design) can use that one course to satisfy both requirements.
- f. The Major program includes nine (9) credits of courses outside the Major.
- g. Choose one of the following: BIOEE 1610, BIOMG 1350, BIOEE 1780, BIOG 1440, BIOG 1105, or BIOG 1106.
- h. ENGRD 2700: Basic Engineering Probability and Statistics is accepted (by petition) to substitute for CEE 3040 if taken prior to affiliation with Environmental Engineering or if necessary because of scheduling conflicts caused by co-op or study abroad programs.
- i. Students may take BIOMI 2900: General Microbiology Lectures, in place of CEE 4510.
- j. The lists of suggested courses are published in the *Undergraduate Handbook for Environmental Engineering*. At least one design elective must be chosen from the list of Capstone design courses. The handbook is available online or in 207 Riley-Robb Hall or 221 Hollister Hall.

Major: Information Science, Systems, and Technology (ISST)

Offered by:

Department of Information Science
303 Upson Hall, 255.9837, www.infosci.cornell.edu/ugrad
and
School of Operations Research and Information Engineering
(Management Science Option)
202 Rhodes Hall, 255.5088, www.infosci.cornell.edu/ugrad

Program Objectives

The ISST Major studies the design and management of complex information systems. Rather than focusing on the computing and communication technologies that underlie digital information systems, the ISST Major emphasizes information systems engineering in broad application contexts, where issues at the confluence of information science, technology, and management are the primary concerns. The core courses in the field provide students with grounding in operations research modeling techniques of probability, statistics, and optimization; computer science; economics; and the social and organizational contexts in which transformative information systems exist. Students then choose one of two options: Management Science (MS) or Information Science (IS).

The Management Science option educates students in methods for quantitative decision-making and their application to information technology, as well as the broader role that information technology plays in making these methods effective. Management Science students take advanced courses in mathematical models in management science, information systems, mathematical modeling in IT, and information technology management solutions.

The Information Science option educates students in methods for the creation, representation, organization, access, and analysis of information in digital form. Students who choose the Information Science option take classes in information systems, mathematical modeling in IT, human-centered systems, and social systems.

Note: All courses used toward the ISST Major must be taken for a letter grade.

The Major requires ENGRD 2700: Basic Engineering Probability and Statistics as an engineering distribution course. CS 2110 is required by the Major and it is recommended that it be taken as an engineering distribution course.

The Major has seven (7) additional required courses in three areas: probability, statistics, optimization (two courses); information systems (three courses); and economic, organizational, and social context (two courses).

Students then complete the Major by specializing in either the Management Science option or the Information Science option (seven advanced courses); and by taking two Major-approved electives. The set of Major-approved elective courses is the same for both specialization options, and it contains all the courses listed at www.infosci.cornell.edu/ugrad. In addition, students may choose to take INFO 4900: Independent Reading and Research, as one of their Major-approved elective courses, as discussed at www.infosci.cornell.edu/ugrad.

Engineering Distributions

ENGRD 2110: Object-Oriented Programming and Data Structures (required by the Major; recommended as a distribution course)

ENGRD 2700: Basic Engineering Probability and Statistics (required)

Required Major Courses

INFO 2040: Networks

ENGRD 3350: Communications for Engineering Managers *or*

ILROB 1750: Behavior, Values, and Performance *or*

INFO 2450: Communication and Technology

INFO 2300: Intermediate Design and Programming for the Web

INFO 3300: Data-Driven Web Applications *or*

INFO 4300: Information Retrieval *or*

INFO 4302: Web Information Systems

ORIE 3300: Optimization I

ORIE 3500: Engineering Probability and Statistics II

ORIE 3800: Information Systems and Analysis

Information Science Option

Three courses from Area II: Information Systems

One course from Area III: Mathematical Modeling in Information Technology

Three elective courses: Students must choose either Area V: Human-Centered Systems or Area VI: Social Systems and take all elective courses from that area.

Management Science Option

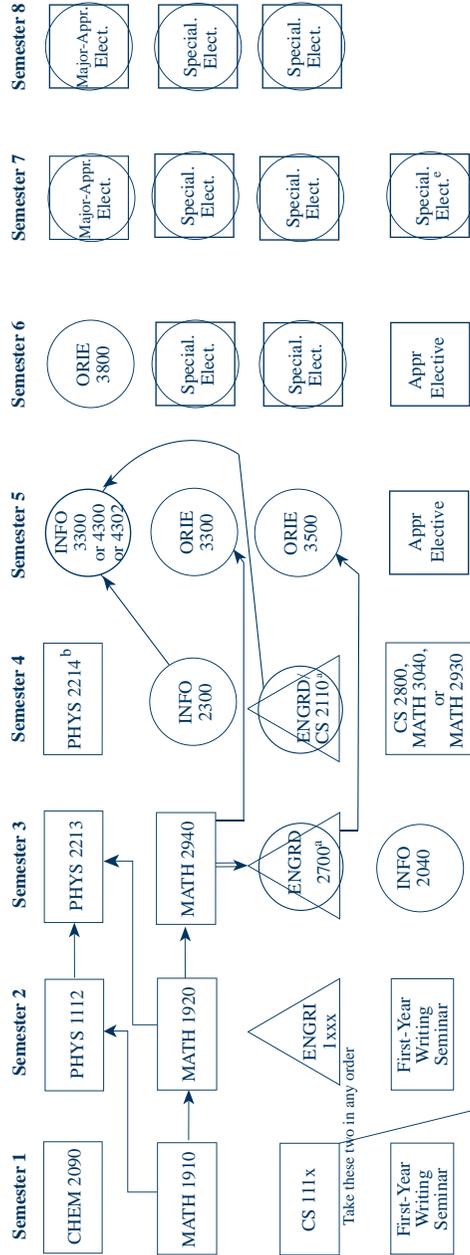
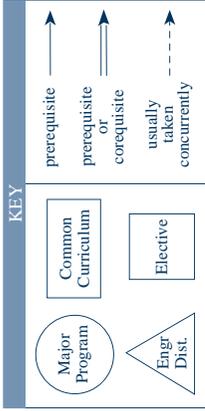
The four courses in Area I: Mathematical Models in Management Science

Three elective courses:

- one from Area II: Information Systems
- two from the union of Area III: Mathematical Modeling in Information Technology and Area IV: Information Technology Management Solutions

For a complete listing of course options for Areas I-VI, visit www.infosci.cornell.edu/ugrad.

Information Science, Systems, and Technology Major (ISST)



Information Science, Systems, and Technology Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930 (or 3040 or CS 2800)	3/4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
PHYS 2214 ^b	3/4	<input type="checkbox"/>
CS 1110 (or 1112, or 1114)	5	<input type="checkbox"/>
CS 1130 (or 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGRI 1XXX	3	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2700 ^a	3	<input type="checkbox"/>
Engineering Distribution 2: CS/ENGRD 2110 ^a	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^c	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum		
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum		<input type="checkbox"/>
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (52-credit minimum)^d		
INFO 2040	4	<input type="checkbox"/>
INFO 2300	3	<input type="checkbox"/>
INFO 2450 or ILROB 1750 or ENGRC 3350 ^c	3	<input type="checkbox"/>
INFO 3300 or INFO 4300 or INFO 4302	3	<input type="checkbox"/>
ORIE 3300	4	<input type="checkbox"/>
ORIE 3500	4	<input type="checkbox"/>
ORIE 3800	4	<input type="checkbox"/>
Information Science/Management Science Option (nine course, 27-credit minimum)^e		
Specialization Elective	3/4	<input type="checkbox"/>
Specialization Elective	3/4	<input type="checkbox"/>
Specialization Elective	3/4	<input type="checkbox"/>
Specialization Elective	3/4	<input type="checkbox"/>
Specialization Elective	3/4	<input type="checkbox"/>
Specialization Elective	3/4	<input type="checkbox"/>
Specialization Elective	3/4	<input type="checkbox"/>
Major-approved Elective	3/4	<input type="checkbox"/>
Major-approved Elective	3/4	<input type="checkbox"/>
Total Required Credits	127 minimum	
Technical Writing Course ^c : ENGRC 3350 (recommended)		<input type="checkbox"/>

Notes

- a. CS/ENGRD 2110 and ENGRD 2700 are required by the Major, and it is recommended that these courses be used as engineering distribution courses.
- b. The following courses may be substituted for PHYS 2214, if not used to meet other requirements: PHYS 2218, CHEM 2080, CHEM 2160, MATH 2930, MATH 3040, or CS 2800.
- c. In addition to the first-year writing seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course. ENGRC 3350 is recommended as a technical writing course for ISST Majors.
- d. The program includes nine (9) credits of courses outside the Major department. This is satisfied by the interdisciplinary nature of the ISST Major.
- e. Major electives include seven (7) Specialization courses in either Information Science or Management Science, and two Major-approved electives chosen from Areas I-VI of the Major. Please see www.infosci.cornell.edu/ugrad/ for more information.

This engineering check list is formatted to conform to the general specifications of the College of Engineering. We strongly recommend that you visit 303 Upson Hall for an official ISST Major check list. This information can also be obtained by visiting the Information Science web site (www.infosci.cornell.edu/ugrad/).

Major: Materials Science and Engineering (MSE)

Accredited by ABET (see inside front cover)

Offered by: Department of Materials Science and Engineering

214 Bard Hall, 255.9159, www.mse.cornell.edu

Program Objectives

The MSE undergraduate Major is based on the following educational objectives:

- **Preparation:** To prepare students to excel in graduate school or technical careers through a world-class, rigorous, and competitive program.
- **Core Competence:** To train students across the spectrum of basic and applied materials science, recognizing and exploiting common descriptions in disparate systems.
- **Breadth:** To train students with sufficient scientific and engineering breadth to design and create novel solutions to materials problems in engineering systems.
- **Professionalism:** To develop in students professional and ethical attitudes, effective communication and teamwork skills, and an ability to place science and engineering issues and solutions within the broader societal context.
- **Learning Environment:** To provide students with an academic environment committed to excellence and innovation that contributes to developing leadership, professionalism, and life-long learning for their professional careers.

Common Curriculum Recommendations

CHEM 2090: Engineering General Chemistry

Engineering Distributions

ENGRD 2610: Mechanical Properties of Materials: From Nanodevices to Superstructures

ENGRD 2620: Electronic Materials for the Information Age

Either course (ENGRD 2610 or 2620) satisfies the Major entry requirement.

Other Relevant Engineering Distributions

ENGRD 2020: Mechanics of Solids

ENGRD 2100: Introduction to Circuits for Electrical and Computer Engineers

ENGRD 2190: Mass and Energy Balances

ENGRD 2520: The Physics of Life

ENGRD 2600: Principles of Biological Engineering

ENGRD 2640: Computer-Instrumentation Design

ENGRD 2700: Basic Engineering Probability and Statistics

ENGRD 3200: Engineering Computation

Required Major Courses

MSE 2060: Atomic and Molecular Structure of Matter

MSE 2610: Mechanical Properties of Materials: From Nanodevices to Superstructures
(required unless used as Engineering Distribution)

MSE 2620: Electronic Materials for the Information Age (unless used as engineering distribution)

MSE 3010: Materials Chemistry

MSE 3030: Thermodynamics of Condensed Systems

MSE 3040: Kinetics, Diffusion, and Phased Transformations

MSE 3050: Electronic, Magnetic, and Dielectric Properties of Materials

MSE 3070: Materials Design Concepts I^c

MSE 3110–3120: Junior Laboratory I and II

MSE 4020: Mechanical Properties of Materials, Processing, and Design

MSE 4030–4040: Senior Materials Laboratory I and II^d

MSE 4070: Materials Design Concepts II

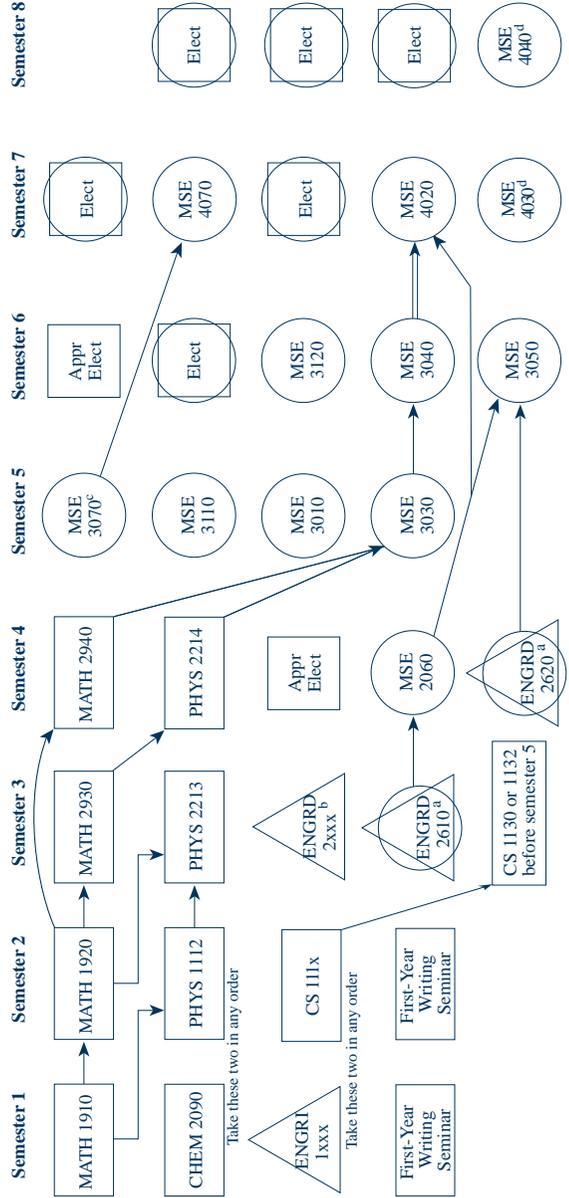
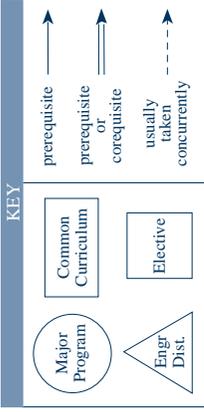
Electives^g

Two materials-related electives covering two groups of different materials.^{b,e}

Three materials application-related electives in at least two different types of applications. Two of the materials application-related electives must be taken from outside MSE.^{b,e}

One additional technical elective must be taken from outside MSE.^f

Materials Science and Engineering Major (MSE)



Materials Science and Engineering Major Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
PHYS 2214 (or 2218)	4	<input type="checkbox"/>
CS 1110 (or 1112, or 1114)	4	<input type="checkbox"/>
CS 1130 (or 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGRI 1XXX	3	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2610 or 2620 ^a	3	<input type="checkbox"/>
Engineering Distribution 2: ENGRD 2XXX ^b	3	<input type="checkbox"/>
First Year Writing Seminar 1 ^c	3	<input type="checkbox"/>
First Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum		
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum		<input type="checkbox"/>
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (53-credit minimum)^g		
MSE 2610 or MSE 2620	3	<input type="checkbox"/>
MSE 2060	4	<input type="checkbox"/>
MSE 3010	3	<input type="checkbox"/>
MSE 3030	4	<input type="checkbox"/>
MSE 3040	4	<input type="checkbox"/>
MSE 3050	3	<input type="checkbox"/>
MSE 3070	2	<input type="checkbox"/>
MSE 3110	1	<input type="checkbox"/>
MSE 3120	1	<input type="checkbox"/>
MSE 4020	3	<input type="checkbox"/>
MSE 4030 ^d	3/4	<input type="checkbox"/>
MSE 4040 ^d	3/4	<input type="checkbox"/>
MSE 4070	2	<input type="checkbox"/>
Materials-related Elective I ^e	3	<input type="checkbox"/>
Materials-related Elective II	3	<input type="checkbox"/>
Materials Application-related MSE Elective I ^e	3	<input type="checkbox"/>
Materials Application-related non-MSE Elective II	3	<input type="checkbox"/>
Materials Application-related non-MSE Elective III	3	<input type="checkbox"/>
Non-MSE Technical Elective III ^f	3	<input type="checkbox"/>
Total Required Credits	132 minimum	
Technical Writing Course ^c		<input type="checkbox"/>

Notes

- a. ENGRD 2610 or 2620 satisfies the Major entry requirement.
- b. In addition to Major requirements, a course involving significant computational or mathematical modeling or advanced mathematics is required. This requirement is typically fulfilled by one of the Engineering Distribution, approved elective, Materials-related Elective, or outside Technical Elective courses. Courses satisfying this requirement will generally have MATH 2930, MATH 2940, or equivalent courses as a pre- or co-requisite. A list of courses meeting this requirement is available in the MSE office and online at www.mse.cornell.edu.
- c. In addition to the first-year writing seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course. The combination of MSE 3070/4070 with MSE 4030/4060 satisfies this requirement.
- d. Research-oriented students may replace MSE 4030 and 4040 (senior lab) with MSE 4050 and 4060 (senior thesis).
- e. A list of approved materials-related and materials application-related courses is available in the MSE office and online at www.mse.cornell.edu.
- f. The non-MSE Technical Elective must be an upper level (2000+) technical course and may be selected from engineering or other colleges subject to advisor approval.
- g. The Major program includes nine (9) credits of courses outside the Major. These are satisfied by the non-MSE Technical Elective and by six (6) credits of the materials application-related electives.

Major: Mechanical Engineering (ME)

Accredited by ABET (see inside front cover)

Offered by: The Sibley School of Mechanical and Aerospace Engineering
108 Upson Hall, 255.3573, www.mae.cornell.edu

Program Objectives

Cornell University is a learning community that seeks to serve society by educating the leaders of tomorrow and extending the frontiers of knowledge. The faculty and staff of the Sibley School of Mechanical and Aerospace Engineering, as members of this community, affirm these objectives. Specifically, the Sibley School is committed to excellence and seeks to graduate mechanical engineers who, collectively:

- assume leadership positions in technology-based industries;
- conceive, design, and realize useful products, systems, and services, properly respecting economic, environmental, cultural, life-safety, and ethical standards or constraints;
- discover and apply new knowledge and develop new tools for the practice of engineering;
- complete programs of graduate and/or professional studies and continue to learn throughout their lives;
- are valued in their careers, whether for mastery of the disciplines central to mechanical engineering or for the broader analytical or creative abilities fostered by their engineering education; and
- engage with their communities, profession, and the world.

These Program Educational Objectives describe long-term accomplishments for which we seek to prepare our graduates. Progress toward these objectives is expected to be measurable within three to five years of graduation.

Engineering Distributions

ENGRD 2020: Statics and Mechanics of Solids (required)^b

Required Major Courses

ENGRD 2210: Thermodynamics^b

TAM 2030: Dynamics

MAE 2120: Mechanical Properties and Selection of Engineering Materials

MAE 2250: Mechanical Synthesis

MAE 3230: Introductory Fluid Mechanics

MAE 3240: Heat Transfer

MAE 3250: Analysis of Mechanical and Aerospace Structures

MAE 3260: System Dynamics

MAE 3272: Mechanical Property and Performance Laboratory

MAE 3780: Mechatronics (recommended) *or*

ENGRD 2100: Introduction to Circuits for Electrical and Computer Engineers *or*

PHYS 3360: Electronic Circuits

MAE 4272: Fluids/Heat Transfer Laboratory^{c,f}

MAE 4300: Professional Practice in Mechanical Engineering^f

Major-approved Electives

MAE 4291: Supervised Senior Design Experience^{g,f}

Mathematics Elective: TAM 3100: Introduction to Applied Mathematics I; or ENGRD 2700: Basic Engineering Probability and Statistics; or CEE 3040: Uncertainty Analysis in Engineering; or ENGRD 3200: Engineering Computation^{h,a}

Technical Elective^{i,a}

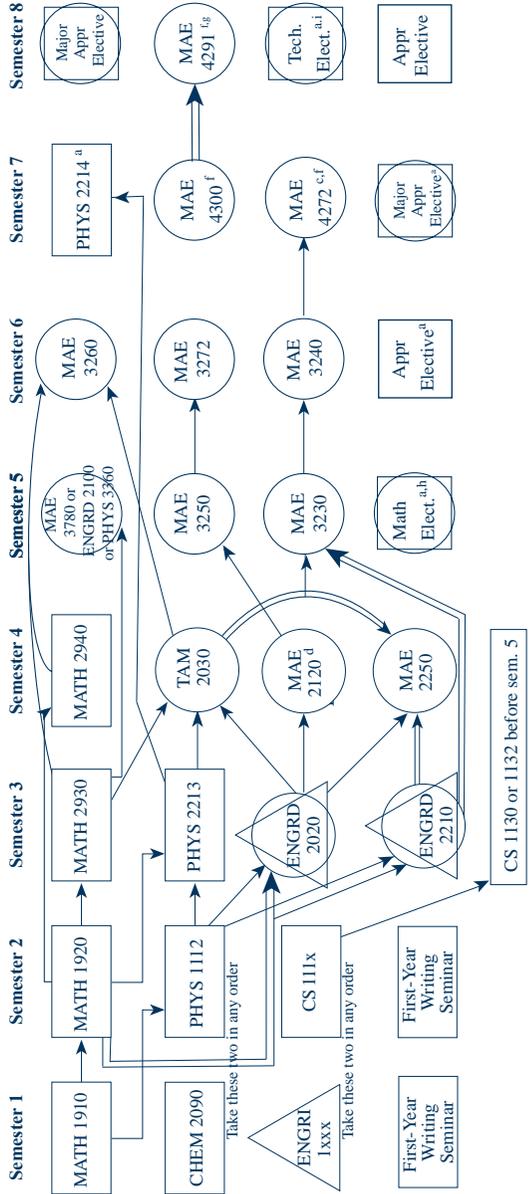
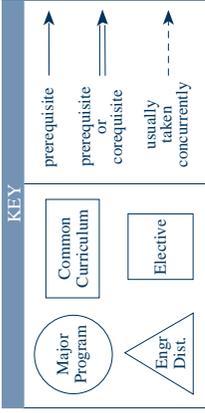
Major-approved electives (two courses)^e

The upper-level common curriculum (approved electives) and the Major-approved electives can be used to build a program with particular emphasis for individual students, appropriate for a wide range of career objectives, including supervised engineering practice, advanced professional engineering education, and other professional education (business, medicine, law).^a

For a complete list of designated senior design courses and guidelines for electives, consult: www.mae.cornell.edu.

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Mechanical Engineering Major (ME)



Mechanical Engineering Major Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
PHYS 2214 (or 2218) ^a	4	<input type="checkbox"/>
CS 1110 (or 1112, or 1114)	4	<input type="checkbox"/>
CS 1130 (or CS 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGRI 1XXX ^b	3	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2020 (required) ^b	3	<input type="checkbox"/>
Engineering Distribution 2: ENGRD 2210 (recommended)	3	<input type="checkbox"/>
First Year Writing Seminar 1 ^c	3	<input type="checkbox"/>
First Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum		
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum		<input type="checkbox"/>
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (52-credit minimum)		
ENGRD 2210 ^b	3	<input type="checkbox"/>
TAM 2030	3	<input type="checkbox"/>
MAE 3780 (or ENGRD 2100 or PHYS 3360)	4	<input type="checkbox"/>
MAE 2120 ^d	3	<input type="checkbox"/>
MAE 2250	4	<input type="checkbox"/>
MAE 3230	4	<input type="checkbox"/>
MAE 3240	3	<input type="checkbox"/>
MAE 3250	3	<input type="checkbox"/>
MAE 3260	4	<input type="checkbox"/>
MAE 3272	2	<input type="checkbox"/>
MAE 4272 ^{c,f}	3	<input type="checkbox"/>
MAE 4300 ^f	2	<input type="checkbox"/>
M.E. Major Electives^{e,a}		
MAE 4291: Supervised Senior Design Experience ^{g,f}	3	<input type="checkbox"/>
Mathematics Elective: TAM 3100 or ENGRD 2700 <i>or</i> CEE 3040 or ENGRD 3200 ^{a,h}	3	<input type="checkbox"/>
Technical Elective ^{a,i}	3	<input type="checkbox"/>
Major-approved Elective 1 ^{a,e}	3	<input type="checkbox"/>
Major-approved Elective 2	3	<input type="checkbox"/>
Total Required Credits	127 minimum	
Technical Writing Course ^c : MAE 4272		<input type="checkbox"/>

Notes

- a. May be taken any time in junior or senior year.
- b. Introduction to Engineering (ENGRI 1XXX), ENGRD 2020, and ENGRD 2210, satisfy the Common Curriculum distribution requirement. ENGRD 2020 satisfies the major entry requirement.
- c. In addition to the first-year writing seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course. MAE 4272 satisfies this requirement.
- d. Requires MATLAB programming at the level of CS 1112 or CS 1132.
- e. A list of approved Major-approved electives is available online at www.mae.cornell.edu
- f. To be taken in fourth year.
- g. The Supervised Senior Design Experience is to be taken concurrently with or after MAE 4300. A list of design electives is available online at www.mae.cornell.edu
- h. Must be an upper-level mathematics course, which includes statistics, taken after Math 2940. A list of approved math electives is available online at www.mae.cornell.edu
- i. Generally any course at a level beyond the required courses of the college curriculum in engineering, mathematics, or science (chemical, physical, or biological). Business or organization courses excluded, except MAE 4610: Entrepreneurship for Engineers.

This engineering check list is formatted to conform to the general specifications of the College of Engineering. We strongly recommend you consult www.mae.cornell.edu for complete Mechanical Engineering academic program information or visit 108 Upson Hall for additional information.

Major: Operations Research and Engineering (ORE)

Offered by: School of Operations Research and Information Engineering
206 Rhodes Hall, 255.4856, www.orie.cornell.edu

Engineering Distributions

ENGRD 2110^c: Objected-Oriented Programming and Data Structures (recommended)

ENGRD 2700: Basic Engineering Probability and Statistics (required)

Required Major Courses

ORIE 3120: Industrial Data and Systems Analysis

ORIE 3150: Financial and Managerial Accounting

ORIE 3300: Optimization I

ORIE 3310: Optimization II

ORIE 3500: Engineering Probability and Statistics II

ORIE 3510: Introductory Engineering Stochastic Processes I

ORIE 4580: Simulation Modeling and Analysis

Electives

A behavioral science (organizational behavior) course

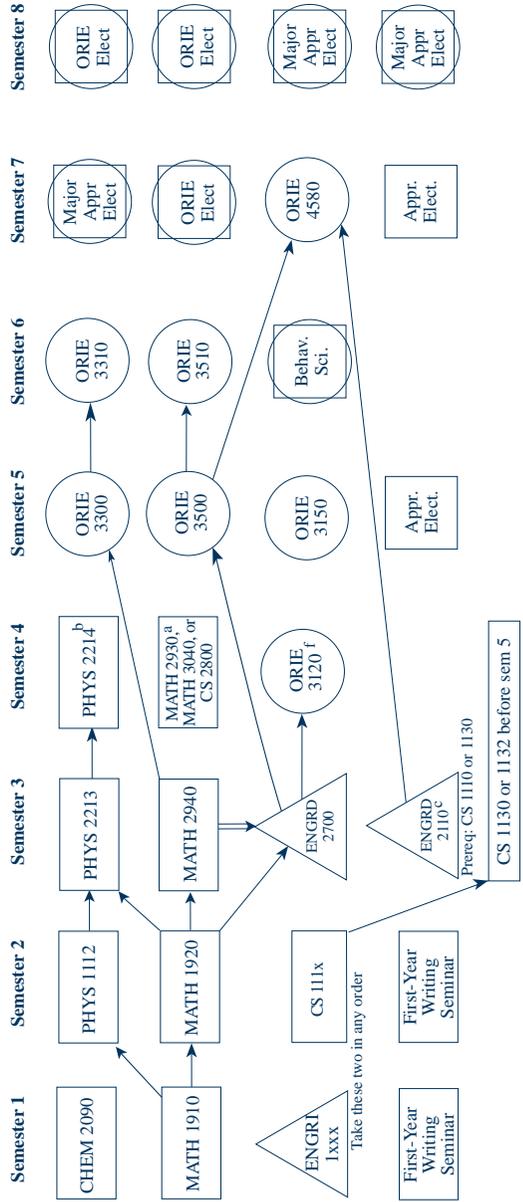
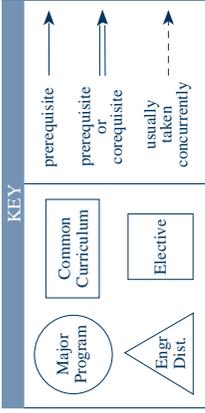
At least 9 credits of ORIE electives

At least 9 credits of Major-approved electives, with at least 3 credits from outside ORIE

At least 6 credits of approved electives

At least one of the courses taken must satisfy the technical writing requirement.

Operations Research and Engineering Major (ORE)



Operations Research and Engineering Major Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930 ^a	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
PHYS 2214 ^b	4	<input type="checkbox"/>
CS 1110 (or 1112, or 1114)	4	<input type="checkbox"/>
CS 1130 (or CS 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGRI 1XXX	3	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2700	3	<input type="checkbox"/>
Engineering Distribution 2: ENGRD 2110 ^c (recommended)	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^d	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum	18	
Liberal Studies 1		<input type="checkbox"/>
Liberal Studies 2		<input type="checkbox"/>
Liberal Studies 3		<input type="checkbox"/>
Liberal Studies 4		<input type="checkbox"/>
Liberal Studies 5		<input type="checkbox"/>
Liberal Studies 6		<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum		<input type="checkbox"/>
Approved Elective 2		<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (49-credit minimum)^e		
ORIE 3120 ^f	4	<input type="checkbox"/>
ORIE 3150	4	<input type="checkbox"/>
ORIE 3300	4	<input type="checkbox"/>
ORIE 3310	4	<input type="checkbox"/>
ORIE 3500	4	<input type="checkbox"/>
ORIE 3510	4	<input type="checkbox"/>
ORIE 4580	4	<input type="checkbox"/>
Behavioral Science (organizational behavior)	3	<input type="checkbox"/>
ORIE Elective	3	<input type="checkbox"/>
ORIE Elective	3	<input type="checkbox"/>
ORIE Elective	3	<input type="checkbox"/>
Major-approved Electives—Non-ORIE ^e	3	<input type="checkbox"/>
Major-approved Elective	3	<input type="checkbox"/>
Major-approved Elective	3	<input type="checkbox"/>
Total Required Credits	125 minimum	
Technical Writing Course ^d		<input type="checkbox"/>

Notes

- a. ORE affiliates are required to complete MATH 1910: Calculus for Engineers, MATH 1920: Multivariable Calculus for Engineers, and MATH 2940: Linear Algebra for Engineers (or their subject matter equivalents). Either MATH 2930: Differential Equations for Engineers, CS 2800: Discrete Structures, or MATH 3040: Prove It! can be used to satisfy the fourth semester mathematics requirement. Students should discuss with their advisor which of these three courses is most appropriate to their future program of study in ORE. The following should be considered:

MATH 2930 is essential for advanced study in financial engineering. Also, MATH 2930 is a pre-requisite for PHYS 2214: Physics III: Optics, Waves, and Particles, thus students who do not take MATH 2930 must plan to take CHEM 2080.

CS 2800 provides an introduction to discrete structures and algorithms of broad applicability in the field of operations research, particularly for fundamental models in the areas of optimization, production scheduling, inventory management, and information technology; it is also a pre-requisite for certain upper-class computer science courses in the areas of information technology and algorithmic analysis.

MATH 3040 covers fundamentals of formal proof techniques. Students considering Ph.D.-level study in Operations Research are encouraged to see the Associate Director for advice regarding the fourth math course.

- b. The following courses may be substituted for PHYS 2214, if not used to meet other requirements: CHEM 2080, MATH 2930, CS 2800, MATH 3040, MATH 3110: Introduction to Analysis, or MATH 3360: Applicable Algebra. Students who prefer PHYS 2214 must take MATH 2930 in Semester 3.
- c. ENGRD 2110 is required by the Major. It is recommended that this course be counted as an engineering distribution.
- d. In addition to the First-year Writing Seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course.
- e. The Major program includes nine (9) credits of courses outside the Major. These are satisfied by ENGRD 2110, the behavioral science course, and one Major-approved elective.
- f. It is recommended that ORIE 3120 be taken in semester 4. However, if a student's schedule does not permit it, the course can be taken in semester 6 or 8.

This engineering check list is formatted to conform to the general specifications of the College of Engineering. We strongly recommend that you visit 203 Rhodes Hall for an official Operations Research and Engineering check list.

Major: Science of Earth Systems (SES)

Offered by: Department of Earth and Atmospheric Sciences
2124 Snee Hall, 255.5466, www.eas.cornell.edu

Program Objectives

The SES program is intrinsically interdisciplinary, involving many branches of science and engineering. It is unique in that it incorporates the fundamentals of Earth Science with the emergence of a new and more complete approach that encompasses all components of the earth system—*air, life, rock, and water*—to gain a new and more comprehensive understanding of the world as we know it. By analyzing the complex relations between the ocean, solid earth, atmosphere and biosphere, students can help meet society's growing demand for energy, minerals, and clean water, as well as contribute to mitigating the negative impacts related to global warming, rising sea level, natural hazards, and decreasing biodiversity.

Common Curriculum

CHEM 2090: Engineering General Chemistry
CHEM 2080: General Chemistry^a

Engineering Distributions

ENGRD 2XXX^c
ENGRD 2XXX

Required Major Courses

EAS 2200: The Earth System^c

One biology course selected from the following:

BIOG 1140: Foundations of Biology
BIOEE 1610: Ecology and the Environment
BIOEE 1780: Evolutionary Biology and Diversity
BIOSM 1610: Ecology and the Marine Environment

One Advisor-approved course in statistics, computer science, math, or natural science^{b,f}

Three courses selected from the following core courses:

EAS 3010: Evolution of the Earth System
EAS 3030: Introduction to Biogeochemistry
EAS 3040: Interior of the Earth
EAS 3050: Climate Dynamics

Field Course (at least 3 credits):

Examples include:

EAS 2500: Meteorological Observations and Instruments
EAS 3400: Field Study of the Earth System (given as part of the Cornell University Earth and Environmental Systems Field Program in Hawaii)
EAS 4170: Field Mapping in Argentina
A course at Shoals Marine Laboratory

Concentration Courses

The concentration courses build depth and provide the student with a specific expertise in some facet of earth system science. Four concentrations are defined for the Major: atmospheric sciences, biogeochemistry, geological sciences, and ocean sciences. In concert with the student's advisor and upon approval of the SES curriculum committee, other concentrations can be tailored to a student's interest. Examples include mathematical geosciences, geohydrology, and planetary science. The concentration is achieved by completing four intermediate- to advanced-level courses (3000 level or above) that build on the core courses and have prerequisites in the required basic sciences and mathematics courses. These courses must be approved by the student's advisor and the director of undergraduate studies. Two of the concentration courses count as Major-required courses and two of the concentration courses count as Major-approved electives.

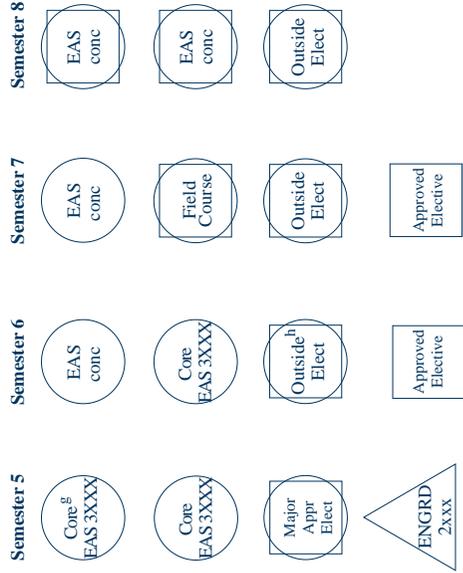
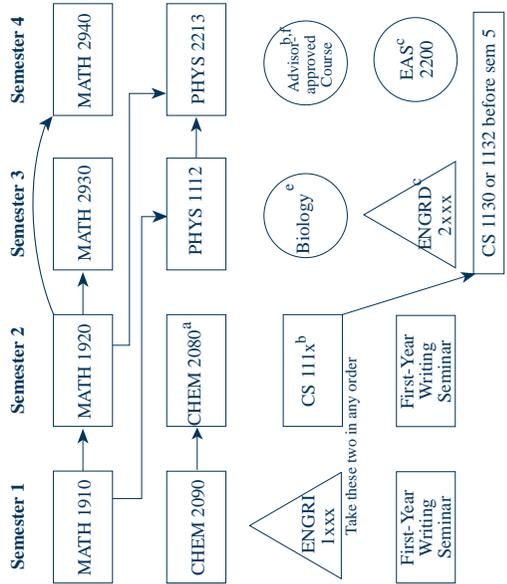
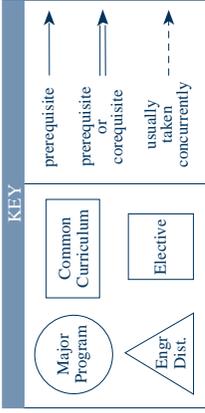
Electives

One Major-approved elective at the 3000 level or above. This course must be approved by the student's advisor.

Three outside Major Electives. These courses must be approved by the student's advisor.

Two approved electives.

Science of Earth Systems Major (SES)



Science of Earth Systems Major Check List

	Minimum Credit Hours	√ When Done
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (or 2150)	4	<input type="checkbox"/>
CHEM 2080 ^a	4	<input type="checkbox"/>
PHYS 1112 (or 1116)	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
CS 1110 (or 1112, or 1114) ^b	4	<input type="checkbox"/>
CS 1130 (or 1132)	1	<input type="checkbox"/>
Introduction to Engineering: ENGRI 1XXX	3	<input type="checkbox"/>
Engineering Distribution 1: ENGRD 2XXX ^c	3	<input type="checkbox"/>
Engineering Distribution 2: ENGRD 2XXX	3	<input type="checkbox"/>
First-Year Writing Seminar 1 ^d	3	<input type="checkbox"/>
First-Year Writing Seminar 2	3	<input type="checkbox"/>
Liberal Studies Distribution: six courses, 18-credit minimum		
Liberal Studies 1	3	<input type="checkbox"/>
Liberal Studies 2	3	<input type="checkbox"/>
Liberal Studies 3	3	<input type="checkbox"/>
Liberal Studies 4	3	<input type="checkbox"/>
Liberal Studies 5	3	<input type="checkbox"/>
Liberal Studies 6	3	<input type="checkbox"/>
Approved Elective 1: two courses, 6-credit minimum	3	<input type="checkbox"/>
Approved Elective 2	3	<input type="checkbox"/>
Physical Education: two semesters and swim test		<input type="checkbox"/>
Required Major Courses (48-credit minimum)		
EAS/ENGRD 2200 ^c	4	<input type="checkbox"/>
Biology ^e	3/4	<input type="checkbox"/>
Advisor-approved Course ^{b,f}	3/4	<input type="checkbox"/>
EAS 3XXX core ^g	4	<input type="checkbox"/>
EAS 3XXX core	3/4	<input type="checkbox"/>
EAS 3XXX core	3	<input type="checkbox"/>
Field Course	3/4	<input type="checkbox"/>
EAS Concentration (Major required)	3/4	<input type="checkbox"/>
EAS Concentration (Major-required)	3/4	<input type="checkbox"/>
EAS Concentration (Major-approved Elective)	3/4	<input type="checkbox"/>
EAS Concentration (Major-approved Elective)	3/4	<input type="checkbox"/>
Major-approved Elective (3XXX or higher)	3/4	<input type="checkbox"/>
Outside Major Elective ^h	3/4	<input type="checkbox"/>
Outside Major Elective	3/4	<input type="checkbox"/>
Outside Major Elective	3/4	<input type="checkbox"/>
Total Required Credits	123 minimum	
Technical Writing Course ^d		<input type="checkbox"/>

Notes

- a. Students may substitute CHEM 1570 or PHYS 2214 for CHEM 2080.
- b. If a student elects to count CS 1110 (or CS 1112, or CS 1114) as their Major-required, Advisor-approved course in statistics, computer science, math, or natural science, an additional Major-approved elective is required.
- c. If a student elects to count EAS/ENGRD 2200 as an ENGRD, an additional Major-approved elective is required.
- d. In addition to the First-year Writing Seminars, a technical writing Course must be taken as an engineering distribution, liberal studies, approved elective, or Major course.
- e. One of the following courses must be selected: BIOG 1140, BIOEE 1610, BIOEE 1780, or BIOSM 1610.
- f. An Advisor-approved course in statistics or computer science, or an additional Advisor-approved course in mathematics or natural science, including, but not limited to, a course in astronomy, a second course in biology, or an additional course in physics or chemistry is required.
- g. Three of the following core courses must be selected: EAS 3010, EAS 3030, EAS 3040, or EAS 3050
- h. The Major program includes nine (9) credits of courses outside the Major.

Minors

In an effort to encourage multi-disciplinary and cross-disciplinary study at Cornell, students enrolled in an undergraduate college may pursue minors offered by units in any college or division. A unit that offers a minor may place restrictions on who can pursue that minor (usually because of limited resources), and a Major may place restrictions on the minors that its students can pursue (usually because the Major and minor areas are too close).

Completion of a minor will be audited by the unit that offers it. The minor will be recorded on a student's official transcript by their home college after receiving verification by the unit offering the minor, usually after graduation. Students should inquire with individual units for application procedures and requirements.

Students undertaking a minor are normally expected to complete the requirements during the time of their continuous undergraduate enrollment at Cornell. Since courses for minor requirements may also satisfy other degree requirements (e.g. distribution courses, approved electives), the minor may sometimes be completed within the traditional eight semesters. However, more than eight semesters may be needed.

The rest of this section describes the Engineering minors—the minors offered by departments and schools of the Engineering College.

Courses required for a minor do not necessarily satisfy a Major requirement. For example, some minor courses may not be used as Major-approved electives. Check with your advisor.

To complete an Engineering minor, an engineering student must

- be enrolled in a Major that approves participation of its affiliates in the desired Engineering minor.
- successfully complete all the requirements for a Bachelor of Science degree in engineering.
- satisfactorily complete six courses (18-credit minimum) as stipulated in the Engineering minor offered by an engineering department/school other than that which offers the student's Major.

Each course used to satisfy an Engineering minor must be taken for a letter grade, if that option exists.

The College of Engineering currently offers minors in the following areas (offering units are indicated in parentheses):

Aerospace Engineering (MAE)

Applied Mathematics (TAM)

Biological Engineering (BEE)

Biomedical Engineering (BME)

Business (AEM) offered by the College of Agriculture and Life Sciences

Civil Infrastructure (CEE)

Computer Science (CS)
Electrical and Computer Engineering (ECE)
Engineering Management (CEE)
Engineering Statistics (ORIE)
Environmental Engineering (BEE/CEE)
Game Design (CS)
Industrial Systems and Information Science Technology (ORIE)
Information Science (CS)
Materials Science and Engineering (MSE)
Mechanical Engineering (MAE)
Operations Research and Management Science (ORIE)
Science of Earth Systems (EAS)
Sustainable Energy Systems (CBE/BEE/EAS/MAE)

Additional information on specific Engineering minors can be found in the Major office of the department/school offering the minor, in *Courses of Study*, in Engineering Advising, and on the pages that follow.

Minor: Aerospace Engineering

Offered by: Sibley School of Mechanical and Aerospace Engineering
Contact: MAE Undergraduate Coordinator, 108 Upson Hall, phone 255.3573, np18@cornell.edu.

Eligibility

All undergraduates. Pre-approval is required. Students intending to earn this minor should seek advice and pre-approval from the Associate Director for Undergraduate Affairs in MAE before taking courses toward the minor.

Educational Objectives

The Aerospace Engineering minor develops the engineering-analysis and design skills necessary for creating and understanding aerospace vehicles and their subsystems. The minor includes diverse topics relevant to applications both in the Earth's atmosphere (e.g. aerodynamics) and in space (e.g. spacecraft thermal systems or orbital mechanics). Students in this minor will take at least four core aerospace courses, along with up to two supporting courses in engineering fundamentals or courses with applicability to aeronautics and spacecraft.

Requirements

1. Six courses from the lists below, each worth at least 3 credits. No substitutions accepted from other departments at Cornell or elsewhere.
2. Rules for ME Majors:

- (a) Select at least four courses from group A, of which you must choose MAE 3050 or MAE 3060 (or both).
- (b) Select at most two courses from group B. No courses from group C may be used.
- (c) Two courses must be selected from the Aerospace Engineering subject field from Mechanical Engineering Major approved electives in Mechanical Engineering (for a complete listing, consult www.mae.cornell.edu). These two courses may not be used towards fulfilling the B.S., Mechanical Engineering degree requirements.

3. Rules for other Majors:

- (a) Select at least four courses from group A, of which you must choose MAE 3050 or MAE 3060 (or both).
- (b) Select a total of at most two courses from group B and group C.
- (c) You may not use any courses to satisfy requirements of both the Mechanical Engineering minor and the Aerospace Engineering minor.

Group A: Core Aerospace Engineering

MAE 3050: Introduction to Aeronautics

MAE 3060: Spacecraft Engineering

MAE/ECE 4150: GPS: Theory and Design

MAE 4291^a: Supervised Senior Design Experience (with Aerospace focus)
or MAE 4900^a: Individual and Group Projects in Mechanical Engineering (with Aerospace focus)

MAE 4230/5230: Intermediate Fluid Dynamics

MAE 5060: Aerospace Propulsion Systems

MAE 5070: Dynamics of Flight Vehicles

Group B: Courses Applicable to Aerospace Engineering

MAE 4550/CEE 4770/MSE 5550/TAM 4550: Introduction to Composite Materials

MAE 4700/5700: Finite Element Analysis for Mechanical and Aerospace Design
or CEE 4720: Introduction to the Finite Element Method

MAE 4770/5770: Engineering Vibrations

MAE 4780/MAE 5780/CHEM 4720/ECE 4720: Feedback Control Systems

MAE 5430: Combustion Processes

MAE 5710: Applied Dynamics
or TAM 5700: Intermediate Dynamics

Group C: Fundamentals

ENGRD 2020: Statics and Mechanics of Solids

TAM 2030: Dynamics

ENGRD/MAE 2210: Thermodynamics

MAE 2120: Mechanical Properties and Selection of Engineering Materials

MAE 3230: Introductory Fluid Mechanics

MAE 3240: Heat Transfer

MAE 3250: Analysis of Mechanical and Aerospace Structures

MAE 3260: System Dynamics

MAE 3780: Mechatronics

or

ECE/ENGRD 2100: Introduction to Circuits for Electrical and Computer Engineers or

PHYS 3360: Electronic Circuits

Academic Standards

At least C– in each course. In S/U only courses, S is acceptable

Note

- a. MAE 4291 and 4900 require a form signed by the project advisor, stating that the project focuses on Aerospace and is suitable as a core aerospace course for the minor. MAE 4291 or 4900 must be worth 3 credits or more. Students may count at most one MAE 4291 or one MAE 4900 toward the minor (i.e. they may not count both MAE 4291 and MAE 4900 toward the minor).

Minor: Applied Mathematics

Offered jointly by: Sibley School of Mechanical and Aerospace Engineering and the Department of Mathematics

Students intending to earn a minor in Applied Mathematics should seek advice and pre-approval of their minor academic program from Professor Richard Rand, RHR2@cornell.edu.

Eligibility

Engineering undergraduates affiliated with all Engineering Majors are eligible to participate in the Applied Mathematics minor.

Educational Objectives

This minor is aimed at providing a focus for students who are interested in applied mathematics.

Requirements

Students must take MATH 2930, MATH 2940, and at least six (6) courses beyond MATH 2940, to be chosen as follows:

- (a) At most one course may be chosen from any one of groups 1, 2, 3, or 4.
- (b) At least three courses must be chosen from groups 5 and 6.
- (c) At most one 2000-level course may be chosen.
- (d) At most one course may be chosen that is offered by the student's Major department.

Group 1. Analysis

AEP 3210: Mathematical Physics I

MATH 3230: Introduction to Differential Equations

MATH 4200: Differential Equations and Dynamical Systems

TAM 3100: Introduction to Applied Mathematics I

Group 2. Computational Methods

CS 4210: Numerical Analysis and Differential Equations

ENGRD 3200: Engineering Computation

ENGRD 3220: Introduction to Scientific Computation

ORIE 3300: Optimization I

Group 3. Probability and Statistics

CEE 3040: Uncertainty Analysis in Engineering

ECE 3100: Introduction to Probability and Inference for Random Signals and Systems

ENGRD 2700: Basic Engineering Probability and Statistics

MATH 4710: Basic Probability

ORIE 3500: Engineering Probability and Statistics II

Group 4. Applications

AEP 3330: Mechanics of Particles and Solid Bodies

CEE 3310: Fluid Mechanics

CEE 3710: Structural Modeling and Behavior

CHEME 3230: Fluid Mechanics

CS 2800: Discrete Structures

CS 2850: Networks

ECE 3200: Networks and Systems

ECE 4250: Digital Signal Processing

MAE 3230: Introductory Fluid Mechanics

MSE 3030: Thermodynamics of Condensed Systems

Group 5. Advanced Courses

Only one of the following two may be chosen:

AEP 3220: Mathematical Physics II

MATH 4220: Applied Complex Analysis

Only one of the following two may be chosen:

ECE 4110: Random Signals in Communications and Signal Processing

ORIE 3510: Introductory Engineering Stochastic Processes I

Also:

TAM 5700: Intermediate Dynamics

You may also choose from:

CS 3810: Introduction to Theory of Computing

CS 4820: Introduction to Analysis of Algorithms

ORIE 3310: Optimization II

ORIE 4330: Discrete Models

ORIE 4350: Introduction to Game Theory

ORIE 4520: Introductory Engineering Stochastic Processes II

ORIE 5600: Financial Engineering with Stochastic Calculus I

ORIE 5610: Financial Engineering with Stochastic Calculus II

TAM 5780: Nonlinear Dynamics and Chaos

TAM 6100: Methods of Applied Mathematics I

TAM 6110: Methods of Applied Mathematics II

Group 6. Mathematics Courses

Any 3000+ level course offered by the Mathematics Department in algebra, analysis, probability/statistics, geometry, or logic, with the following exceptions:

- (i) MATH 3230 or MATH 4200, if any course from group 1 is chosen.
- (ii) MATH 4710, if any course from group 3 is chosen.
- (iii) MATH 4220, if AEP 3220 is chosen from group 5.
- (iv) Only one of the following may be chosen:
 - MATH 3320: Introduction to Number Theory
 - MATH 3360: Applicable Algebra

Academic Standards

At least C in each course in the minor.

Minor: Biological Engineering

Offered by: Department of Biological and Environmental Engineering

Contact: BEE Major Coordinator, 207 Riley-Robb Hall

Eligibility

All undergraduates except Biological Engineering Majors.

Note: Students should meet with the BEE Major Coordinator when they decide to pursue the minor. At that time they will receive a BEE faculty advisor, who will guide them in completing the minor program.

Educational Objectives

Biological engineering is the application of engineering to living systems. Examples of engineering efforts in this Major include the development of new biosensor technologies, study and control of biologically based matter-transformation systems, and development of engineered devices to study and regulate fundamental biological processes. This minor is an opportunity for students to further their understanding of living systems and to increase their knowledge of the basic transport processes that occur within these systems. Courses in the minor provide opportunities to analyze, design, and manipulate living systems at the molecular, cellular, and system levels.

Requirements

At least six (6) courses (minimum of 18 credits), with at least three courses and 9 credits taught in BEE, chosen as follows:

I. Biology Foundation (at least one but no more than two courses)

BIOMG 3300 or 3310–3320: Principles of Biochemistry

BIOMI 2900: General Microbiology Lectures

BIONB 2220: Neurobiology and Behavior II: Introduction to Neurobiology

II. Biological Engineering Core (at least one but no more than two courses)

BEE 2600: Principles of Biological Engineering

BEE 3310: Bio-Fluid Mechanics

BEE 3500: Biological and Bioenvironmental Transport Processes

BEE 3600: Molecular and Cellular Bioengineering

III. Biological Engineering Concentration Electives (Minimum of three courses)

Choose any three courses from the concentration lists below. Courses appearing in more than one concentration do not double count. BEE 3600 may be taken as either a concentration elective or a core course.

Biomedical Engineering Concentration

AEP 4700: Biophysical Methods

BEE 3600: Molecular and Cellular Bioengineering

BEE 3650: Properties of Biological Materials

BEE 4500: Bioinstrumentation

BEE 4530: Computer-Aided Engineering: Applications to Biomedical Processes

BEE 4590: Biosensors and Bioanalytical Techniques

BME 3300: Introduction to Computational Neuroscience

BME 5020: Biomedical System Design

BME 5390: Biomedical Materials and Devices for Human Body Repair

BME 5650: Biomechanical Systems—Analysis and Design

CHEME 4810: Biomedical Engineering

ECE 5780: Computer Analysis of Biomed Images

MAE 4630: Neuromuscular Biomechanics

MAE 4640: Orthopaedic Tissue Mechanics

MSE 4610: Biomedical Materials and Their Applications

Bioprocess Engineering Concentration

BEE 3600: Molecular and Cellular Bioengineering

BEE 4500: Bioinstrumentation

BEE 4530: Computer-Aided Engineering: Applications to Biomedical Processes

BEE 4590: Biosensors and Bioanalytical Techniques
BEE 4640: Bioseparation Processes
BEE 4840: Metabolic Engineering
CHEM 3000: Quantitative Chemistry (does not count for Engineering credit)
CHEM 3320: Analysis of Separation Processes
CHEM 5430: Biomolecular Engineering of Bioprocesses

Bioenvironmental Engineering Concentration
BEE 3710: Physical Hydrology for Ecosystems
BEE 4010: Renewable Energy Systems
BEE 4350: Principles of Aquaculture
BEE 4710: Introduction to Groundwater
BEE 4730: Watershed Engineering
BEE 4870: Sustainable Bioenergy Systems
CEE 4510: Microbiology for Environmental Engineering
CEE 4520: Water Supply Engineering

Academic Standards

At least C– in each course in the minor and a GPA ≥ 2.0 in all courses in the minor.

Minor: Biomedical Engineering

Offered by: Department of Biomedical Engineering
Contact: Belinda Floyd, Graduate Field Assistant, 109 Weill Hall, minor_bme-mailbox@cornell.edu, 255.2573

Eligibility

All undergraduates are eligible. Students may participate in either the Biological Engineering minor or the Biomedical Engineering minor, but not both.

Educational Objectives

Biomedical engineering is the application of engineering principles and methods to a wide array of problems associated with human health. The discipline includes the design of bio-compatible materials, prostheses, surgical implants, artificial organs, controlled drug-delivery systems, and wound-closure devices. Diagnosing diseases and determining their biological origins depend on increasingly sophisticated instrumentation and the use of mathematical models. This minor allows students to gain exposure to the breadth and depth of biomedical engineering offerings at Cornell, to prepare for advanced studies in biomedical engineering, and to obtain recognition for their interest and capability in this rapidly growing area.

Requirements

- Bioengineering Seminar (1 credit, one semester) and at least six (6) courses

(minimum of 18 credits) from the five categories listed below.

- Two courses need to be in Category 1 (Introductory Biology) and/or Category 2 (Advanced Biology) with no more than one listing from Category 1.
- Four courses must come from Category 3 (Molecular and Cellular Biomedical Engineering); Category 4 (Biomedical Engineering Analysis of Physiological Systems); and Category 5 (Biomedical Engineering Applications), with courses from at least two of these categories represented.
- At least four of the six courses must not be specifically required Major degree courses or cross-listings. A course chosen from a list of major electives is acceptable.

Students are asked to join the bmeundergrads-L@cornell.edu listserve to receive biomedical information updates. Consult the web site www.bme.cornell.edu/academics/undergraduate/biomedminor.cfm for instructions.

Category 1. Introductory Biology (maximum of 4 credits; 3-8 credits count as one course toward this category.)

A score of 5 on (CEEB) Advanced Placement Biology

ENGR1 1310: Introduction to Biomedical Engineering

BIOG/BIOGM 1350: Principles of Cell and Developmental Biology

BIOG/BIOGM 1440: Introduction to Comparative Biology

BIOG 1105 and 1106: Introductory Biology

BIOG 1107 and 1108: General Biology

BIOG 1140: Foundations of Biology

Pre-med introductory biology requirements as outlined by the Health Careers Program Advisory Board of Cornell University.

Category 2. Advanced Biology

BIOAP 3110/VTBMS 3460: Introductory Animal Physiology, Lectures

BIOGM 3300: Principles of Biochemistry, Individualized Instruction

BIOGM 3310: Principles of Biochemistry, Proteins and Metabolism

BIOGM 3320: Principles of Biochemistry: Molecular Biology

BIOGM 3330: Principles of Biochemistry, Proteins, Metabolism, and Molecular Biology

BIOGM 2810: Genetics and Genomics

BIOMI 2900: General Microbiology Lectures

BIONB 2220: Neurobiology and Behavior II: Introduction to Neurobiology

Category 3. Molecular and Cellular Biomedical Engineering

AEP/ENGRD 2520: The Physics of Life

BEE/BME 3600: Molecular and Cellular Bioengineering

BME 3010/CHEME 4010^a: Molecular Principles of Biomedical Engineering

BME 3020/CHEME 4020^a: Cellular Principles of Biomedical Engineering

Category 4. Biomedical Engineering Analysis of Physiological Systems

BIONB/BME/COGST/PSYCH 3300: Introduction to Computational Neuroscience

BIONB/BME 4910: Principles of Neurophysiology

BME 4010/MAE 4660^a: Biomedical Engineering Analysis of Metabolic and Structural Systems

BME 4020^a: Electrical and Chemical Physiology

CHEME/BME 4810: Biomedical Engineering

MAE/BME 4640: Orthopaedic Tissue Mechanics

Category 5. Biomedical Engineering Applications

AEP 4700/BIONB 4700/BME 5700: Biophysical Methods

BEE 3650: Properties of Biological Materials

BEE 4500: Bioinstrumentation

BEE/MAE 4530: Computer-Aided Engineering: Applications to Biomedical Processes

BEE 4590: Biosensors and Bioanalytical Techniques

BME 4110: Science and Technology Approaches to Problems in Human Health

BME 5400: Biomedical Computation

BME 5600: Biotransport and Drug Delivery

BME 5810/MAE 5680: Soft Tissue Biomechanics

BME 5830: Cell-Biomaterials Interactions

CS/BIOMG/ENGRD 3510: Numerical Methods in Computational Molecular Biology

DEA/BME 4520: Inside-Out Ergonomics II

ECE/BME 4980: Special Topic: Introduction to Systems and Synthetic Biology

ECE 5020/BME 5020: Biomedical System Design

ECE 5780: Computer Analysis of Biomed Images

MSE 4610: Biomedical Materials and their Applications

MSE/BME 5620: Biomineralization: The Formation and Properties of Inorganic Biomaterials

FSAD 4390/BME 5390: Biomedical Materials and Devices for Human Body Repair

Required

BME/BEE 5010: Bioengineering Seminar

Academic Standards

At least C– in each course in the minor. GPA ≥ 2.0 for all courses in the minor.

Note

- a. Students interested in professional practice as biomedical engineers should consider the M.Eng. degree in BME. The recommended sequence for admission is as follows, two courses from category I and category II, BME 3010, 3020, 4010, and 4020. The program requires that students have knowledge of molecular and cellular biomedical engineering and of biomedical engineering analysis of physiological systems.

Minor: Business for Engineering Students

Offered by: College of Agriculture and Life Sciences

Contact: AEM Undergraduate Program, 146 Warren Hall

Eligibility

All Engineering undergraduates, except those majoring in Operations Research and Engineering, are eligible to apply beginning the first semester of their second year. Students planning to major in Chemical Engineering should meet with a member of the Engineering Advising staff during their first or second year to discuss requirements and possible courses of study to complete the minor. Acceptance into the minor is selective. An application form is available to students on the Engineering college web site, and in 167 Olin Hall and 146 Warren Hall. A deadline for applications that falls before pre-enrollment will be established each semester.

Educational Objectives

This minor provides a focus for Engineering students interested in business.

Requirements

ECON 1110: Introductory Microeconomics or equivalent (including AP credit as equivalent)

AEM 2100: Introductory Statistics

or

ILRST 2100: Introductory Statistics

or

PAM 2100: Introduction to Statistics

or

ENGRD 2700: Basic Engineering Probability and Statistics^a

or

CEE 3040: Uncertainty Analysis in Engineering or equivalent (including AP credit as equivalent)

or

MATH 1710: Statistical Theory and Application in the Real World

AEM 2210: Financial Accounting

or

ORIE 3150: Financial and Managerial Accounting^b

AEM 1200: Introduction to Business Management

AEM 2400: Marketing

AEM 3240: Finance

or

AEM 2240: Principles of Finance

Academic Standards

At least C– in all courses counting toward the minor.

Notes

The College of Engineering does not award AP credit for statistics, but AP statistics credit is awarded if it is used to fulfill AEM's requirement for the Business minor.

- a. ECE 3100, which is allowed as a substitute for ENGRD 2700 in some Majors in Engineering, is not allowed as a substitute in the minor in Business for Engineering Students.
- b. This course will not satisfy the two-semester sequence in financial and managerial accounting needed for AEM Majors. Any Engineering student contemplating a transfer to AEM as a Major should be aware that AEM 2210: Financial Accounting and AEM 3240: Finance will still be required for the AEM Major.

Minor: Civil Infrastructure

Offered by: School of Civil and Environmental Engineering

Contact: CEE Undergraduate Major Coordinator, 221 Hollister Hall, 607.255.3412, www.cee.cornell.edu

Eligibility

All undergraduates except Civil Engineering Majors.

Educational Objectives

The Civil Infrastructure minor is intended to introduce engineering undergraduates to the engineering methodologies of mechanics, materials, analysis, design, and construction and to show how these are brought to bear in solving problems in the development, maintenance, and operation of the built environment that is vital for any modern economy.

Requirements

At least six (6) courses (minimum of 18 credits), chosen as follows:

Required Course

ENGRD 2020: Mechanics of Solids

Additional Courses: Choose any five (groupings are for information only)^a

Geotechnical Engineering

CEE 3410: Introduction to Geotechnical Engineering

CEE 4400: Foundation Engineering

CEE 4410: Retaining Structures and Slopes

CEE 4440: Environmental Site and Remediation Engineering

Structural Engineering

CEE 3710: Structural Modeling and Behavior

CEE 3720: Intermediate Solid Mechanics

CEE 4710: Fundamentals of Structural Mechanics

CEE 4720: Introduction to the Finite Element Method

CEE 4730: Design of Concrete Structures

CEE 4740: Introduction to the Behavior of Metal Structures

CEE 4780: Structural Dynamics and Earthquake Engineering

Other Related Courses

CEE 5950: Construction Planning and Operations

Academic Standards

At least C in each course in the minor.

Note

a. Other CEE courses approved by petition in advance.

Minor: Computer Science

Offered by: Department of Computer Science

Contact: Nicole Roy, 303 Upson Hall, 255.0982, nicole@cs.cornell.edu

Eligibility

All undergraduates except Computer Science Majors and Information Science, Systems, and Technology Majors.

Educational Objectives

This minor is for students who anticipate that computer science will have a prominent role to play in their academic and professional career.

Requirements

At least six (6) courses (minimum of 18 credits) chosen as follows:

Required Courses

CS/ENGRD 2110: Object-Oriented Programming and Data Structures, *or*
CS/ENGRD 2112: Object-Oriented Programming and Data Structures—Honors

CS 3410: Computer System Organization and Programming, *or*
CS 3420/ECE 3140: Computer Organization

Additional Courses

Four (4) CS courses numbered 3000 or higher, with the following exceptions:

CS 4090, CS 4999, and seminars are excluded.

CS 2800 is allowed.

Academic Standards

At least C in each course in the minor.

Note

Cross-listed courses cannot be applied to the minor unless taken under the rubric CS (e.g. CS 4300 counts, but INFO 4300 does not), with the sole exceptions of ECE 3140 and CS courses also listed as ENGRD. All qualifying courses must be taken at Cornell for a letter grade. No substitutions allowed.

Minor: Electrical and Computer Engineering

Offered by: School of Electrical and Computer Engineering

Contact: ECE Undergraduate Major Coordinator, 222 Phillips Hall

Eligibility

All undergraduates except Electrical and Computer Engineering Majors.

Educational Objectives

The School of Electrical and Computer Engineering offers a minor to students who wish to complement their Major with a background in electrical and computer engineering. The minor offers the opportunity to study analog and digital circuits, signals and systems, electromagnetic fields, and to specialize at higher levels in one of several different areas such as circuit design and electronic devices, communications and signal processing, computer engineering and networks, or electromagnetic and space engineering.

Requirements

At least six (6) courses (minimum of 18 credits), chosen as follows:

Two (2) of the following:

ENGRD/ECE 2100: Introduction to Circuits for Electrical and Computer Engineers

ECE 2200: Signals and Information

ENGRD/ECE 2300: Introduction to Digital Logic Design

Two (2) of the following

ECE 3030: Electromagnetic Fields and Waves

ENGRD/ECE 3100: Introduction to Probability and Random Signals

ECE 3140/CS 3420: Embedded Systems

ECE 3150: Introduction to Microelectronics

ECE 3250: Mathematics of Signal and Systems Analysis

One (1) other technical ECE lecture course at the 3000 level or above (3-credit minimum)

One (1) other technical ECE lecture course at the 4000 level or above (3-credit minimum)

Academic Standards

At least C– for every course in the minor and a GPA ≥ 2.3 for all courses in the minor.

Minor: Engineering Management

Offered by: School of Civil and Environmental Engineering

Contact: CE Undergraduate Major Coordinator, 221 Hollister Hall, 607.255.3412, www.cee.cornell.edu

Eligibility

All undergraduates. (CE Majors may not use courses to fulfill the minor requirement and simultaneously as a Major-approved elective or as a Design course.) ORE Majors have

restrictions and requirements as noted below. Students pursuing the Independent Major should obtain approval from CEE for the proposed minor courses, as they may relate to approved primary and secondary area programs.

Educational Objectives

This minor focuses on giving engineering students a basic understanding of engineering economics, accounting, statistics, project-management methods, and analysis tools necessary to manage technical operations and projects effectively. The minor provides an important set of collateral skills for students in any engineering discipline.

Requirements

At least six (6) courses (minimum of 18 credits), chosen as follows:

Required Courses (3)

CEE 3230: Engineering Economics and Management

or

ORIE 4150: Economic Analysis of Engineering Systems

ORIE 3150^a: Financial and Managerial Accounting

CEE 3040^b: Uncertainty Analysis in Engineering

or

ENGRD 2700: Basic Engineering Probability and Statistics

or

ECE 3100: Introduction to Probability and Random Signals

Additional Courses (choose any three)^c

CEE 5930^d: Engineering Management Methods:

CEE 5950: Construction Planning and Operations

CEE 5970: Risk Analysis and Management

ENGRG 3600: Ethical Issues in Engineering Practice

NBA 5070: Entrepreneurship for Scientists and Engineers

or

MAE 4610/ENGRG 4610/ORIE 4152: Entrepreneurship for Engineers

or

BEE 4890: Entrepreneurial Management for Engineers

Academic Standards

At least C in each course in the minor.

Notes

- a. ORE Majors must substitute NCC 5560: Managerial Finance or NBA 5000: Intermediate Accounting for ORIE 3150.
- b. TAM 3100: Introduction to Applied Mathematics I cannot be substituted for CEE 3040.
- c. Other courses approved by petition in advance.
- d. This course is not accepted for ORE Majors.

Minor: Engineering Statistics

Offered by: Department of Statistical Science and School of Operations Research and Information Engineering

Contact: ORE Undergraduate Major Consultant, 203 Rhodes Hall, 255.5088.

Eligibility

All undergraduates except Operations Research and Engineering Majors. A student may not receive credit for more than one minor offered by ORIE.

Educational Objectives

This minor requires the student to develop expertise in engineering statistics. The goal of the program is to provide a firm understanding of statistical principles and engineering applications and the ability to apply this knowledge in real-world situations.

Requirements

At least six (6) courses (minimum of 18 credits), chosen as follows:

Required Courses

ENGRD 2700: Basic Engineering Probability and Statistics

ORIE 3500: Engineering Probability and Statistics II

or

ECE 3100: Introduction to Probability and Random Signals

Four courses (11 credits minimum) taken from the following list^a

ORIE 3510: Introductory Engineering Stochastic Processes I

or

ECE 4110: Random Signals in Communications and Signal Processing

ORIE 4580: Simulation Modeling and Analysis

ORIE 4710: Applied Linear Statistical Models

ORIE 4711: Experimental Design

ORIE 4712: Regression

ORIE 5550: Applied Time-Series Analysis

ORIE 5770: Quality Control

MATH 4720: Statistics or BTRY 4090: Theory of Statistics

BTRY 6020: Statistical Methods II

BTRY 6030: Statistical Methods III

or

ILRST 4110: Statistical Analysis of Qualitative Data

or

ILRST 3100: Statistical Sampling

ILRST 4100: Techniques of Multivariate Analysis

Academic Standards

At least C– in each course in the minor and a GPA ≥ 2.0 in all courses in the minor.

Note

a. Other course options approved by petition in advance. The student should be aware that some of these courses require others as prerequisites. All these courses are cross-listed under the Dept. of Statistical Science.

Minor: Environmental Engineering

Offered by: Department of Biological and Environmental Engineering and School of Civil and Environmental Engineering

Contact: BE Undergraduate Major Coordinator, 207 Riley-Robb Hall, or CE Undergraduate Major Coordinator, 221 Hollister Hall

Eligibility

All undergraduates except Environmental Engineering Majors.

Educational Objectives

A fundamental challenge for the engineering profession is development of a sustainable society and environmentally responsible industry and agriculture reflecting an integration of economic and environmental objectives. We are called upon to be trustees and managers of our nation's resources, the air in our cities, and water in our aquifers, streams, estuaries, and coastal areas. This minor encourages engineering students to learn about the scientific, engineering, and economic foundations of environmental engineering so that they are better able to address environmental management issues.

Requirements

At least six (6) courses (minimum of 18 credits), chosen as follows:

Students must select courses from the following group listings, with at least one (1) course from each group.

Group A. Environmental Engineering Processes

BEE/ENGRD 2510: Engineering for a Sustainable Society

CEE 3510: Environmental Quality Engineering

CEE 4510: Microbiology for Environmental Engineering

CEE 4530: Laboratory Research in Environmental Engineering

CEE 4540: Sustainable Municipal Drinking Water Treatment

CEE 4550: AguaClara: Sustainable Water Supply Project

BEE 4760: Solid Waste Engineering

BEE/EAS 4800: Our Changing Atmosphere: Global Change and Atmospheric Chemistry

BEE 4870: Sustainable Bioenergy Systems

CEE 4920: Engineers for a Sustainable World: Engineering in International Development

CEE 6530: Water Chemistry for Environmental Engineering

CEE 6560: Physical/Chemical Process

CEE 6570: Biological Processes

CEE 6580: Biodegradation and Biocatalysis

Group B. Environmental Systems

ENGRI 1130: Sustainable Design for Appledore Island, *or*

ENGRI 1131: Water Treatment Design (may count only if taken before the third year)

BEE 4750: Environmental Systems Analysis

CEE 5970: Risk Analysis and Management

CEE 6230: Environmental Quality Systems Engineering

CEE 4650/6650: Transportation, Energy, and Environmental Systems for Sustainable Development

Group C. Hydraulics, Hydrology, and Environmental Fluid Mechanics

CEE 3310: Fluid Mechanics (CHEME 3230: Fluid Mechanics or MAE 3230: Introductory Fluid Mechanics may be substituted for CEE 3310)

BEE 3710: Physical Hydrology for Ecosystems

BEE/EAS 4710: Introduction to Groundwater

CEE 4320: Hydrology

CEE 4370: Experimental Methods in Fluid Dynamics

BEE 4730: Watershed Engineering

BEE 4740: Water and Landscape Engineering Applications

CEE 6550: Transport, Mixing, and Transformation in the Environment

Academic Standards

At least C– in each course in the minor and a GPA ≥ 2.0 in all courses in the minor.

Minor: Game Design

Offered by: Department of Computer Science

Contact: Nicole Roy, 303 Upson Hall, 255.0982, nicole@cs.cornell.edu

Eligibility

All undergraduates. CS Majors may not count courses from the CS-focused list toward completion of this minor.

Educational Objectives

This minor is for students who anticipate that game design will play a prominent role in their academic and professional career.

To apply for a Game Design minor:

- Complete course work required for the minor (see below).
- Obtain the form “Application to Certify Completion of an Engineering minor” from Engineering Advising in 167 Olin Hall.
- Obtain an official transcript from the University Registrar’s Office in B7 Day Hall.
- Complete the form and attach the copy of your transcript on which each course used for the minor is highlighted or underlined.
- Submit the form and the transcript to the Computer Science undergraduate office, 303 Upson Hall.

Requirements

At least six (6) courses (18 credit minimum) chosen as follows:

Required Courses: Complete the following two courses:

CIS 3000: Introduction to Computer Game Design

CIS 4002: Advanced Projects in Computer Game Design

Additional Courses: Choose four of the following 12 courses:

CS-Focused courses:

CS/ENGRD 2110: Object-Oriented Programming and Data Structures

CS/INFO 3300: Data-Driven Web Applications

CS 4620/ARCH 3704: Introduction to Computer Graphics

CS 4700: Foundations of Artificial Intelligence

CS 5620: Interactive Computer Graphics

CS 5643: Physically Based Animation for Computer Graphics

Other courses:

ART 1701: Introduction to Digital Media

ART 2704: Interactive Digital Media

COMM 4220: Psychology of Entertainment Media

ECE 4760: Digital Systems Design Using Microcontrollers

INFO/COMM 2450: Communication and Technology

INFO/COMM 3450: Human–Computer Interaction Design

INFO/COMM 4400: Advanced Human–Computer Interaction Design

MUSIC 2421: Computers in Music Performance

MUSIC 3421: Scoring the Moving Image

PSYCH 3420/COGST 3420/VISST 3342: Human Perception: Applications to Computer Graphics, Art, and Visual Display

SOC 4340: Online Social and Information Networks

Academic Standards

At least C for each course in the minor.

Minor: Industrial Systems and Information Technology

Offered by: School of Operations Research and Information Engineering

Contact: ORE Undergraduate Major Consultant, 203 Rhodes Hall, 255.5088.

Eligibility

All undergraduates except those majoring in Information Science; Information Science, Systems, and Technology; or Operations Research and Engineering. A student may not receive credit for more than one minor offered by ORIE.

Educational Objectives

The aim of this minor is to provide an in-depth education in issues central to the design

and analysis of operational systems and the tools from information technology that have become an integral part of the manufacturing, finance, service, and public-health industries. Students will become familiar with the problems, perspectives, and methods found in these fields and be prepared to work with professionals in designing and managing them. That is, rather than providing a comprehensive view of the range of methodological foundations of operations research, this minor is designed to give the student a focused education in application areas closely associated with these techniques.

Requirements

At least six (6) courses (minimum of 18 credits), chosen as follows:

Required courses:

ENGRD 2700: Basic Engineering Probability and Statistics

ORIE 3120: Industrial Data and Systems Analysis

ORIE 4800: Information Technology

The remaining courses/credit hours from the following:

ORIE 3150: Financial and Managerial Accounting

ORIE 3300: Optimization I

ORIE 4150: Economic Analysis of Engineering Systems

ORIE 4580: Simulation Modeling and Analysis

ORIE 4810: Delivering OR Solutions with Information Technology

ORIE 4850: Applications of Operations Research and Game Theory to Information Technology

ORIE 5100: Design of Manufacturing Systems

ORIE 5120: Production Planning and Scheduling Theory and Practice

ORIE 5770: Quality Control

Academic Standards

At least C– in each course in the minor and a GPA ≥ 2.0 in all courses in the minor.

Minor: Information Science

Offered by: Department of Computer Science

Contact: Christine Stenglein, 303 Upson Hall, 255.9837, minor@infosci.cornell.edu

Eligibility

All students except those majoring in Information Science, Systems, and Technology are eligible. Students interested in pursuing the Information Science minor must initiate the process by sending an email message with their name, college, year of study (e.g. second-semester second-year student), expected graduation date, and (intended) Major to minor@infosci.cornell.edu.

Educational Objectives

The program has three main areas: Information Systems, Human-Centered Systems, and Social Systems. The minor has been designed to ensure that students have substantial grounding in all three areas in addition to having a working knowledge of basic probability

and statistics necessary for analyzing data occurring in the real world.

Requirements

At least six (6) courses (minimum of 18 credits) chosen as follows:

Statistics: one course, either CEE 3040 or ENGRD 2700

Information Systems: two courses

Human-Centered Systems: one course

Social Systems: one course

Elective: one additional course from either Human-Centered Systems or Social Systems

Academic Standards

At least C in each course in the minor. All courses for the minor must be taken at Cornell.

For a complete listing of course options and restrictions, visit www.infosci.cornell.edu/ugrad/concentrations.html.

Minor: Materials Science and Engineering

Offered by: Department of Materials Science and Engineering

Contact: MSE Undergraduate Program Coordinator, 214 Bard Hall, 255.9159

Eligibility

All undergraduates except those majoring in Materials Science and Engineering.

Educational Objectives

Materials form the core basis of many engineering disciplines including mechanical, civil, chemical, and electrical engineering. This minor provides engineers in related Majors with the fundamental understanding of mechanisms that determine the performance, properties, and processing of modern materials.

Requirements

At least six (6) courses (≥ 18 credits), chosen as follows:

Required

MSE 2610: Mechanical Properties of Materials: From Nanodevices to Superstructures
or

MSE 2620: Electronic Materials for the Information Age

Two of the following:

MSE 2060: Atomic and Molecular Structure of Matter

MSE 3010: Materials Chemistry

MSE 3030: Thermodynamics of Condensed Systems

MSE 3040: Kinetics, Diffusion, and Phase Transformation

MSE 3050: Electronic, Magnetic, and Dielectric Properties of Materials

MSE 4020: Mechanical Properties of Materials, Processing, and Design

Three electives chosen from the following:

- MSE 2610, MSE 2620, and any MSE course at the 3000 level or above
- Selected courses in materials properties and processing (at the 3000 level or above) from AEP, CHEME, CEE, ECE, MAE, PHYS, and CHEM, as approved by the MSE undergraduate coordinator. (Courses listed as “Materials Applications Electives” on the MSE web site meet this requirement.)

Academic Standards

At least C in each course in the minor.

Minor: Mechanical Engineering

Offered by: Sibley School of Mechanical and Aerospace Engineering

Contact: MAE Undergraduate Coordinator: 108 Upson Hall, 255.3573, np18@cornell.edu

Eligibility

All undergraduates except those majoring in Mechanical Engineering.

Students intending to earn this minor should seek advice and pre-approval from the Associate Director for Undergraduate Affairs in Mechanical Engineering. Contact np18@cornell.edu, 108 Upson Hall before taking courses toward the minor.

Educational Objectives

The primary educational objective of this minor is to give students from outside MAE the necessary skills and tools to interact technically with mechanical engineers on various multidisciplinary fronts. This minor has the appearance of being very broad since it encompasses nearly all of the MAE upper-division courses. However, the prerequisites of the upper-division courses may dictate that a student concentrate in a subarea of mechanical engineering. A recommended strategy for designing a minor is to select a few upper-level courses of interest and work backward from them to determine what courses will be needed as prerequisites or prerequisites of prerequisites. (Note: Instructors may waive certain prerequisites in some circumstances.) The prerequisite structure dictates that most curricula will focus either on fluids/thermal systems or mechanical systems/design courses.

Requirements

At least six (6) courses (≥ 18 credits) from among the following: MAE courses at the 2000+ level; ENGRD 2020: Mechanics of Solids; and TAM 2030: Dynamics.

Rules for Selecting Courses

The selection of courses must satisfy the following three requirements.

- At least two courses must be numbered above 3000.
- At least one course must be either (i) numbered above 5000 or (ii) numbered above 3260 and have as its prerequisite ENGRD 2020, TAM 2030, or an MAE course.
- Each course must be worth at least 3 credits.

All courses used to satisfy the ME minor must be MAE courses, ENGRD 2020, or TAM

2030. No substitutions will be accepted from other departments at Cornell or elsewhere. Transfer credit cannot be used to satisfy the ME minor. MAE 1110: Naval Ship Systems, or MAE 4980: Teaching Experience in Mechanical Engineering, may not be used to satisfy the ME minor. Applications for the ME minor may be obtained in 108 Upson Hall. Credits from MAE 4900 or 4291 may be used for at most one course in the minor.

Academic Standards

At least C– in each course in the minor

Minor: Operations Research and Management Science

Offered by: School of Operations Research and Information Engineering

Contact: ORE Undergraduate Major Consultant, 203 Rhodes Hall, 255.5088

Eligibility

All undergraduates except those majoring in ORE or ISST. A student may receive credit for at most one minor offered by ORIE.

Educational Objectives

Operations Research and Management Science (OR&MS) aims to support decision-making through modeling and analysis of complex systems. This understanding is used to predict system behavior and improve system performance. This minor gives the student the opportunity to obtain a wide exposure to the core methodological tools for OR&MS, including mathematical programming, stochastic and statistical models, and simulation. The intent of this minor is to provide a broad knowledge of the fundamentals, rather than training the student in a particular application domain. With this preparation, students can adjust their advanced courses and pursue either methodological or application-oriented areas most relevant to their educational goals.

Requirements

At least six (6) courses (≥ 18 credits), chosen as follows:

Choose three courses from the following list:

ENGRD 2700: Basic Engineering Probability and Statistics

ORIE 3300: Optimization I

ORIE 3310: Optimization II

ORIE 3500: Engineering Probability and Statistics II

ORIE 3510: Introduction Engineering Stochastic Processes I

ORIE 4580: Simulation Modeling and Analysis

Any ORIE courses at the 3000 level or higher (including those above)

Academic Standards

At least C– in each course in the minor and a GPA ≥ 2.0 in all courses in the minor.

Minor: Science of Earth Systems

Offered by: Department of Earth and Atmospheric Sciences

Contact: SES Undergraduate Major Coordinator, 2124 Snee Hall, 255.5466, www.eas.cornell.edu

Eligibility

All undergraduates except those majoring in Science of Earth Systems.

Educational Objectives

Some of the major problems facing mankind in this century involve earth science, and the engineering workforce will be challenged to solve these problems. This minor will prepare engineering students to understand the natural operating systems of Earth and the tools and techniques used by earth scientists to understand and monitor these solid and fluid systems.

Requirements

There are two options for satisfying the minor requirements:

Option 1:

At least six (6) courses (≥ 18 credits), chosen as follows:

1. Required introductory course:

EAS 2200: The Earth System

2. At least two selections from the following core courses:

EAS 3010: Evolution of the Earth System

EAS 3030: Introduction to Biogeochemistry

EAS 3040: Interior of the Earth

EAS 3050: Climate Dynamics

3. Additional EAS courses at the 3000 level or higher.

These may include additional courses from the above list, undergraduate research courses, and outdoor field courses.

Option 2:

At least six (6) courses (≥ 18 credits), chosen as follows:

1. Required introductory course:

EAS 2200: The Earth System

2. The Earth and Environmental Systems Semester in Hawaii Program

3. One additional EAS course at the 3000 level or higher.

Academic Standards

At least C- in each course in the minor and an average GPA ≥ 2.0 in all courses in the minor.

Minor: Sustainable Energy Systems

Offered collaboratively by: Biological and Environmental Engineering, Chemical and Biomolecular Engineering, Earth and Atmospheric Sciences, and Mechanical and Aerospace Engineering. Administered by the Department of Chemical and Biomolecular Engineering.

Contacts: Curricular topics: Jeff Tester, Director, Cornell Energy Institute, jwt45@cornell.edu; Administrative or registrar topics: Carol Casler, undergraduate programs office of the School of Chemical and Biomolecular Engineering, 607-255-1489

Eligibility

All undergraduates at Cornell.

Educational Objectives

Providing affordable energy to meet the demands of both developed and developing nations without further damaging the natural environment and the Earth's climate system is a grand challenge for the 21st century. Our quality of life and the stability of nations ultimately depend on having accessible energy resources and an equitable and sustainable energy supply and distribution system. Achievement of these goals requires the participation, ingenuity, and hard work of people with a range of specialized backgrounds, working collaboratively. The minor is intended to emphasize the importance of viewing the challenge of meeting the world's energy needs as a *system* of interacting themes. The requirements of the minor are designed to provide breadth across a range of energy resource types and conversion, transmission, and storage technologies along with coverage of the environmental, economic, political, and social consequences of various options.

Requirements

- Six courses and a minimum of 18 credits; at least 3 credits in each category
- At least two courses in category 2: Energy Sources and Technologies for a Transition to Sustainability
- At most two courses may be specific requirements in the student's Major
- At least one course from each of four breadth categories

Four Breadth Categories

- (1) Energy Systems Analysis
- (2) Energy Sources and Technologies for a Transition to Sustainability
- (3) Natural Systems Impacted by Energy Production and Use
- (4) Social Impact: Policy, Economics, Business, History, Ethics, and Risk Analysis

Courses satisfying each of the breadth categories:

- (1) Energy Systems Analysis

BEE 4010: Renewable Energy Systems

BEE 4870: Sustainable Bioenergy Systems

CHEME 6660: Analysis of Sustainable Energy Systems

MAE 5010: Future Energy Systems

(2) Energy Sources and Technologies for a Transition to Sustainability

(a) Fossil and Nuclear Energy

CHEME 5204/5207: Turbomachinery Applications/Petroleum Product Refining
(series of two 1-2 credit hour courses)

CHEME 6666: Unconventional Natural Gas Development from Shale Formations
Module

EAS 4010: Fundamentals of Earth and Minerals Resources

EAS 4340: Exploration Geophysics

EAS 4370: Geophysical Field Methods

MAE 4590: Nuclear Fusion (also NSE 4840)

MAE 4590/NSE/AEP/NSE 4840: Introduction to Controlled Fusion: Principles and
Technology

TAM/AEP/CHEME/ECE/MAE/NSE 4130: Introduction to Nuclear Science and
Engineering

(b) Renewable Energy

CHEME 6661: Bioenergy and Biofuels Module

CHEME 6662: Solar Energy Module

CHEME 6664: Wind Energy Module

MAE 4020: Wind Power

(c) Energy Conversion, Distribution, and Storage

ECE 4510: Electric Power Systems I

ECE 4520: Electric Power Systems II

MAE 5430: Combustion Processes

MAE 4490: Combustion Engines and Fuel Cells

MSE 4330: Materials for Energy Production, Storage and Conversion

ORIE 5142: Systems Analysis Architecture, Behavior and Optimization

ORIE/CEE 5140/CIS 5040, ECE 5120, MAE 5910 5140: Applied System
Engineering

(3) Natural Systems Impacted by Energy Production and Use

BEE 3710: Physical Hydrology for Ecosystems

BEE 4800: Our Changing Atmosphere: Global Geophysics and Atmospheric
Chemistry

BEE 6740: Ecohydrology

BIOEE/EAS 3500: Dynamics of Marine Ecosystems

BIOEE/NTRES 4560: Stream Ecology

CEE 4320: Hydrology

CHEME 6610: Air Pollution Control

CHEME 6663: Geothermal Energy Module
CHEME 6665: Geological Carbon Sequestration Module
EAS/NTRES 3030: Introduction to Biogeochemistry
EAS 3050: Climate Dynamics
EAS 3530: Physical Oceanography
EAS 4400: Seminar: Climate Science, Impacts, and Mitigation
EAS 4570: Atmospheric Air Pollution
EAS 4850: Climate Information and Management (energy-related project required)
Laboratory and NTRES 4220: Wetland Ecology Lecture
MAE/EAS 6480 Air Quality and Atmospheric Chemistry
NTRES 4201: Forest Ecology Laboratory and NTRES 4200: Forest Ecology

(4) Policy/Economics/Business/History/Ethics/Risk Analysis

AEM 4510/ECON 4090: Environmental Economics
BSOC/STS 2061/PHIL 2460: Ethics and the Environment
BSOC/STS 3181: Living in an Uncertain World: Science, Technology and Risk
CEE/TOX 5970: Risk Analysis and Management
CHEME 6640: Energy Economics
DSOC 3240/STS 3241/SOC 3240: Environment and Society
ENGRG/ECE/HIST 2500/STS 2501: Technology in Society
ENGRG/ECE 3600/STS 3601: Ethical Issues
MAE/STS 4000: Components and Systems: Engineering in a Social Context
NTRES 3320: Introduction to Ethics and the Environment
ORIE 4150: Economic Analysis of Engineering Systems

Consult www.sustainablefuture.cornell.edu/education/, the web site of the Atkinson Center for a Sustainable Future, for updates regarding requirements and acceptable courses.

Academic Standards

At least C- in each course, or, for S/U Only courses, S.

Special Programs

Dual-Degree Option

The dual-degree program is intended for superior students. Students can earn both a Bachelor of Science and either a Bachelor of Arts or a Bachelor of Fine Arts degree in about five years (ten semesters). After acceptance of their application, engineering students begin the dual-degree program in their second or third year. For more information about this option, students should attend a Dual Degree Information Meeting, held approximately once a month (www.arts.cornell.edu/programs/dualdeg.php).

Exceptional students may be able to arrange (by petition) an accelerated program and finish in less than 10 semesters. Such a program may not rely on summer work or credits earned at community colleges. Students in the program may decide to complete only one degree, but it may be difficult to complete the requirements for either degree in four years because of the way their curriculum has been structured.

Double Majors

The double Major makes it possible to study two allied engineering disciplines. A double Major generally requires nine semesters. (Students dependent on financial aid who spend more than eight semesters as an undergraduate will need to change their financial-aid package.)

To embark on a double Major, a student must complete the entry requirements for both Majors and have a cumulative GPA ≥ 3.0 after the first four semesters. Affiliation with the first Major proceeds as usual. Before the end of the third year, the student presents an application for Double Major to enter the second Major. The application must be approved by the faculty in both Majors. The second Major may set its own requirements, and admission is not guaranteed. Obtain application forms from Engineering Advising and submit completed forms to the Engineering Registrar, 158 Olin Hall.

Double-Major students have a faculty advisor in each Major. Both Majors maintain records, approve course changes, and eventually certify to the registrar that all requirements for the B.S. degree have been met.

The standards for academic performance of both Majors must be met, although the consequences for failing to do so for one or the other will differ. For example, deficient performance in the primary area may result in a required leave of absence or withdrawal from the Major (resulting perhaps in withdrawal from the college), but deficient performance in the secondary Major simply terminates the double Major. For more information, contact Engineering Advising, 167 Olin Hall, and the individual Major consultant offices.

The Independent Major (IM)

The IM is an opportunity for students whose educational objectives cannot be met by any of the regular Majors. It allows students to create specially tailored, interdisciplinary courses of study. The student develops the program in consultation with faculty advisors; it is approved by the Independent Major Committee, which is responsible for overseeing the student's work.

The IM includes a primary engineering area of ≥ 32 credits and an educationally related secondary area of ≥ 16 credits. The primary area may be any subject area offered by the engineering schools or departments; the secondary area is a logically connected area taught anywhere at Cornell. The program must constitute an engineering education in scope and substance, and all requirements of the Common Curriculum must be met.

Students should apply by the end of the first semester of the second year and must be in good academic standing. They should seek assistance in developing a coherent program from professors in the proposed primary and secondary subject areas. If approved, the program becomes a curricular contract to which the student must adhere. For more information, contact Engineering Advising, 167 Olin Hall.

Note: Because no single standardized curriculum exists, the IM is not accredited. IM students who intend to seek legal licensing as Professional Engineers should be aware that this non-accredited degree program will require additional education, work, and/or experience to be eligible to take the Fundamentals of Engineering examination.

International Engineering Programs

An international perspective, sensitivity to other cultures, and the ability to speak a second language are increasingly important to today's engineer. The College of Engineering encourages students to study or work abroad during their undergraduate years to prepare for participation in the global marketplace.

Because most engineering curricula are highly structured with many sequential courses, students who wish to pursue this option must decide early and plan carefully. Advisors and faculty in the college can suggest a variety of ways for students to study abroad and still meet graduation requirements. Students interested in studying or working abroad should begin gathering information early in the first year. These programs may fit some students' curriculum plans better than others', depending on a variety of factors, including Advanced Placement credit, completed prerequisites, and Major affiliation requirements.

On campus, there are several sources of specific information on study abroad:

- Cornell Abroad office, 300 Caldwell Hall
- Engineering Advising, 167 Olin Hall
- the associate director of undergraduate studies in the student's Major

Engineering Communications Program (ECP)

The ECP provides instruction in technical writing, oral presentation, and the use of graphics in both. ECP courses are like writing seminars elsewhere at Cornell. Students' work receives abundant written comments and conferences are frequent.

Members of the ECP are available to help engineering faculty members develop materials for their own writing and oral-presentation assignments.

For more information, call 255.7199, visit the Director's office at 465 Hollister Hall, or go to www.engineering.cornell.edu/ECP/.

Engineering Cooperative Education Program (Co-op)

The Co-op program provides an opportunity to gain 28 weeks of career-related practical work experience but still graduate in four years. By supplementing course work with carefully monitored, paid positions, co-op students can explore their interests and acquire a better understanding of engineering as a profession.

To be eligible, students must be enrolled in the College of Engineering an equivalent of five semesters before starting their first work term. Exceptions may be made for transfer students and others pursuing an accelerated curriculum. Students majoring in computer science or biological engineering, but not registered in the College of Engineering, are also eligible. In most cases, a GPA > 2.7 is required.

Applicants interview with employers in February of the sophomore year and, if an offer is received, usually complete their fifth-semester course work on campus during the summer after sophomore year. They begin the first co-op work term the following fall, complete the sixth semester on campus, and return to their co-op employer the following summer for their second work term. Students spend the senior year on campus, graduating on schedule with their class. Students with flexible course curriculums may prefer to complete one spring/summer or summer/fall co-op work term during the junior year.

Obtain more information at www.engineering.cornell.edu/coop or at the Engineering Cooperative Education and Career Services office, 201 Carpenter Hall, 255.3512.

Undergraduate Research

Engineering Learning Initiatives (ELI) is committed to facilitating connections and providing funding support for undergraduate students who are motivated to pursue research opportunities during their time at Cornell. Research enhances the undergraduate experience by allowing students to apply the skills and knowledge learned in the classroom to real engineering problems and to contribute to the advancement of knowledge in their fields. Research gives students the opportunity to interact closely with faculty mentors and, in many instances, to develop valuable industry connections. Engineering students and faculty members may apply for funding awards to support undergraduate research projects for the fall, spring, and summer terms. Funds may be used to provide a student stipend or to cover project expenses. Projects usually involve one student and one professor, although some projects may involve student teams. Student researchers submit a report and present their work in a public poster session at the end of the term. For more information on tips for locating a faculty mentor, suggested research topics, application information, selection criteria, and funding sources, visit Engineering Learning Initiatives on the web at www.engineering.cornell.edu/learning/.

Cooperative Programs with The Samuel Curtis Johnson Graduate School of Management

For information about program options at Johnson, stop by the admissions office in 111 Sage Hall or visit the web site www.johnson.cornell.edu/prospectivestudents/.

Course Registration

Registration

Being registered with the university and the College of Engineering and completing course enrollment are two different things. To be registered with both the university and the College of Engineering, new students must have

- obtained their ID card,
- paid their bursar bill,
- submitted all required health forms to Gannett Health Services, and
- attended a first-year or transfer briefing.

Students who have not followed this procedure must register with both the University Registrar (B7 Day Hall) and the Engineering Registrar (158 Olin Hall) and then meet with an advisor in Engineering Advising (167 Olin Hall) to receive and discuss course registration materials.

Continuing students are automatically registered after the due date of the tuition fee payment, provided the above criteria have been met and no academic or judicial holds prevent registration. *The Student Center*, an online student service, will provide students with information regarding their registration status at the beginning of each semester.

The Course Add/Drop Form

Early in the semester, students can use their Student Center online account to make most course-enrollment changes. Some “permission only” courses may require students to submit an add/drop form, obtainable at the Engineering Registrar’s office, 158 Olin Hall.

The add/drop form requires the following information:

- Student Identification Number, semester, and year of study, and full name.
- The four to five-digit course identification number (CID), the department/course name, and the number of credit hours for the course a student wishes to change. (This information can be found via the Student Center or in the Course and Time Roster, which is also available online.)
- Approval from the department offering the course. Because each department keeps a running tally of the numbers of students enrolled in each lecture, section, or laboratory, students must receive departmental approval before making formal changes to their schedule. (The location of departmental offices can be found in the campus directory or *Courses of Study*.)
- The student’s signature and the date.

Submit the completed add/drop form in person to the Engineering Registrar’s office, 158 Olin Hall. There, a staff member will process the changes and return one copy of the form. It is important that students keep this record of the change and check their schedules on *Student Center* periodically during the semester for accuracy.

Adding a Course

Students may add courses to their schedule at any time before the end of the third week of

classes, using Cornell's electronic add/drop system or an add/drop form mentioned in the previous section for "permission only" courses.

To add a course after the third week of classes, a petition (available in the Engineering Registrar's office, 158 Olin Hall) is required in addition to the add/drop form. Like the add/drop form, the petition must be endorsed by the student's advisor. Submit the completed petition and add/drop form to Engineering Advising, 167 Olin Hall.

Dropping a Course

Students may drop a course any time before the end of the seventh week of classes, using Cornell's electronic add/drop system or an add/drop form mentioned earlier for "permission only" courses.

Dropping a course during weeks 8 to 12 requires a petition (available in the Engineering Registrar's office, 158 Olin Hall) in addition to the add/drop form. The petition must be signed by the student's academic advisor. Submit the completed petition and add/drop form to Engineering Advising, 167 Olin Hall.

Courses dropped after the seventh week are marked with a grade of "W" (for withdrawal) on the official transcript. "W" is a matter of record: its removal cannot be petitioned.

No course may be dropped after the twelfth week of classes, even with a petition.

Changing a Grade Option

During weeks one to seven of the semester, change a grade option (on courses where a choice between letter or S/U grade is offered) using the online add/drop system, or with an add/drop form for "permission only" courses. If an add/drop form is used, permission of the faculty advisor and course instructor or departmental representative must be obtained. Submit the completed add/drop form to the Engineering Registrar's office, 158 Olin Hall, by the end of the third week of classes.

Important: After the third week of classes, the grading option may not be changed, nor will students be permitted to add a course in which they were previously enrolled (in the current semester) under a different grade option. This deadline is strictly enforced. (For more information on the S/U Grading Option, see "Grades and Credits" in this handbook.)

Changing Credit Hours

Certain upper-level courses in the Engineering curriculum are offered with "variable" credit hours. Students decide the number of credits they wish to register for when they enroll, in consultation with the instructor and their faculty advisor. (For example, a course listed as "variable to 5 credits" can be taken for 1, 2, 3, 4, or 5 credits.)

During weeks one to three of the semester, change credit hours (on courses that offer variable credit) using the online add/drop system, or with an add/drop form for "permission only" courses. If an add/drop form is used, permission of the faculty advisor and course instructor or departmental representative must be obtained. Submit the completed add/drop form to the Engineering Registrar's office, 158 Olin Hall, by the end of the third week of classes.

After the third week of classes, variable credit hours may not be changed except by petition (see previous section on “adding a course after week three” for instructions).

Course Pre-Enrollment through CoursEnroll

Each semester, there is a period (usually near the middle of the semester) during which students electronically request courses they plan to take during the next semester, using the online service *CoursEnroll*. It provides the most accurate, up-to-date listings of course offerings for the coming semester and is available at <http://studentcenter.cornell.edu>.

Each semester, the University Registrar’s office assigns each class (first- through fourth-year) a designated time period during which *CoursEnroll* will be accessible through *the Student Center*. This access schedule is published in written form by the University Registrar’s office and in the weekly email newsletter, *The Sundial*.

To request courses through *CoursEnroll*:

- Determine your pre-enrollment access period by reading *The Sundial*, by contacting the Engineering Registrar’s office, 158 Olin Hall, or by checking your *Student Center* account.
- Check the online Course and Time Roster or view classes via *the Student Center*.
- Decide which courses you want to take the next semester, keeping in mind the requirements for the Common Curriculum and your intended Major program.
- Meet with your faculty advisor prior to the pre-enrollment period to discuss the proposed course schedule and make changes as necessary.
- Use *CoursEnroll* to enter your course choices.

This completes the pre-enrollment process.

Maximum Number of Credits per Semester

The college permits (but does not encourage) students to take up to 23 credits per semester—excluding physical education courses, supplementary courses, and other courses that do not count toward the degree. Those who wish to take more than 23 credits must complete the appropriate petition. Add/drop forms that result in a schedule of more than 23 credits will not be processed without a petition endorsed by the student’s faculty advisor and approved by a representative of ASPAC in Engineering Advising.

ROTC Courses

ROTC courses may be used to satisfy engineering degree requirements as follows:

1. Up to 6 credits of ROTC courses numbered ≥ 3000 may be used as approved electives;
2. Selected ROTC courses may be used to satisfy the liberal studies requirement. (For details, see: www.cs.cornell.edu/gries/ccgb/);
3. ROTC courses that are co-listed by another department (e.g. NAVS 3050: Principles of Navigation). Some Majors further restrict the use of particular courses co-listed with Military Science. Check with the undergraduate coordinator office to find out whether such courses will count toward graduation.

Grades and Credit

Grades

The grading system used at the university is shown below.

Letter	Grade Point Value	Description
A+	4.3	Excellent to Very Good: comprehensive knowledge and understanding of subject matter; marked perception and/or originality
A	4.0	
A–	3.7	
B+	3.3	Good: moderately broad knowledge and understanding of subject matter; noticeable perception and/or originality
B	3.0	
B–	2.7	
C+	2.3	Satisfactory: reasonable knowledge and understanding of subject matter; some perception and/or originality.
C	2.0	
C–	1.7	
D+	1.3	Marginal: minimum knowledge and understanding of subject matter; limited perception and/or originality.
D	1.0	
D–	0.7	
F	0.0	Failing: unacceptably low knowledge and understanding of subject matter; severely limited perception and/or originality.
S	–	“Satisfactory” equivalent to C– or above
U	–	“Unsatisfactory” equivalent to below C–

Symbols Used in Lieu of Grades

INC	The student has substantial passing-level equity in the course but is unable to complete it because of circumstances beyond their control.
R (Registered)	This grade substitute is given after the first semester of a full-year course that does not require a grade until the end.
W (Withdrew)	The student withdrew from the course (with college permission) after the seventh week (or beyond three-fifths of the duration of shorter courses).

S/U Grading Option

In some courses students have the option of receiving a grade of satisfactory or unsatisfactory (S or U) instead of a letter grade. Students may pre-register for such a course under the S/U option or change the grading option during the first seven weeks of the semester. Changing a grade option is accomplished by completing the “Changes to Grade Option or Credit Hours” section of an add/drop form; this requires permission of the student’s faculty advisor and the course instructor or departmental representative. A grade of S is equivalent to a letter grade of A+ through C–; U is equivalent to a grade of D+ or less.)

Important: After the seventh week of classes, the grading option may not be changed, nor will students be permitted to add a course in which they were previously enrolled (in the current semester) under a different grade option.

Engineering students may choose to receive an S/U grade option under the following conditions:

- The course is offered with an S/U option.

- The student has completed at least one full semester of study at Cornell. First-year students may not take any courses on an S/U basis during their first semester except for courses that are graded “S/U Only”.
- The S/U course must be used as either a liberal-studies distribution or an approved elective in the Engineering curriculum.
- Students may enroll S/U in only one (1) course each semester in which the choice between letter grade and S/U is an option. (Additional courses offered “S/U only” may be taken in the same semester as the “elected S/U” course.)

Note: S/U courses do not count toward eligibility for the Dean’s List and may weaken chances for acceptance into graduate school. Address questions regarding the S/U option to Engineering Advising.

Incomplete Grades

There are many legitimate reasons for delaying completion of a course beyond the time allotted. An extended illness or serious injury, for example, might make it impossible to finish by the end of the semester. In such situations, it is desirable to receive a temporary grade of incomplete and finish the course work at a later time.

To receive an incomplete, students must:

- Have an extenuating reason that prevents them from completing the course in the time allotted; and
- Have passing equity in the course at the time of the request. (This is generally defined as completion of at least half the course work at a passing level.)

Incomplete grades are granted at the discretion of the course instructor. If you think an incomplete is appropriate, discuss it with the instructor, making sure to arrange specific conditions under which the missing work is to be completed and set a deadline for submission. Having this “contract” in writing is desirable.

Evidence of an incomplete remains permanently on the transcript. When the course has been completed, a grade is entered with an asterisk, indicating that it was not completed during the regular semester. Students should weigh the cost of taking an incomplete against the reasons for doing so. It may be helpful to discuss the matter with a faculty advisor or a staff member in Engineering Advising.

Advanced Placement and Transfer Credit

Many students come to Cornell with advanced placement credit for courses taken in high school or with courses taken at an accredited college that are similar to courses offered here. Students who think they are already competent in the subject matter of a course offered at the introductory level can demonstrate their proficiency and receive credit for the course without actually taking it.

There is a difference between advanced placement credit and transfer credit. Advanced placement credit is awarded when a student shows competence in a subject by doing well on an approved exam. Transfer credit is awarded for a course that has been satisfactorily completed at another college and that has not been used to meet high school graduation requirements.

The only courses for which students may obtain advanced placement or transfer credit are those that fit degree requirements in the undergraduate engineering program. The College of Engineering decides whether credit should be awarded for particular courses, and in all cases this decision is final.

Advanced Placement Credit

Students may become eligible for advanced placement credit in four ways:

- By taking a College Entrance Examination Board (CEEB) examination,
- By successfully completing a General Certificate of Education (GCE) Advanced (A-Level) examination,
- By successfully completing an International Baccalaureate (IB) Higher Level examination, or
- By taking a Cornell departmental examination, given during Orientation Week prior to the beginning of the fall term.

If a student's performance on one of these exams is satisfactory, college credit will be offered.

Advanced placement credit need not be accepted. Choosing to accept credit will depend, in part, on whether a course is a technical course that will be a prerequisite for other courses in a student's academic program. If it is not a technical prerequisite, there is no reason not to accept it. If it is a technical prerequisite, students should make certain that they are really prepared to take the next course in the sequence.

Departmental examinations test technical preparedness, and in this sense, they are better than CEEB AP exams, which may not test for what Cornell expects a student to know. The departmental exam is designed to test the depth of knowledge in the entire range of material customarily covered in a particular course offered at Cornell. Satisfactory performance on such an exam indicates that students already know what they would have learned if they had taken the Cornell course. Satisfactory performance on the CEEB AP exam is not as good an indication that a student knows the entire range of material. When in doubt, students should feel free to take a departmental exam, even if they have already passed the CEEB AP exam.

Since the amount of advanced placement or transfer credit awarded can affect the degree of difficulty of the first year and subsequent success as an engineering student, students should consider the options carefully, seeking advice from their faculty advisors during Orientation Week and talking with the undergraduate coordinator (see pages 10–11) for the primary Major of interest. The first year at Cornell is crucial to the development of an undergraduate program; wise use of advanced placement and transfer credit can make a positive difference.

Acceptable Subjects and Scores

A table showing the most common subjects for which advanced placement credit is awarded in the College of Engineering, and the scores needed on qualifying tests, follows. In mathematics, physics, chemistry, and computer science, advanced placement credit is awarded only for courses required in the engineering curriculum. (The College of Engineering does not award advanced placement credit for statistics.)

Modern Languages

Students can earn advanced placement credit for competence in a foreign language by taking the CEEB AP test or by taking the Cornell Advanced Standing Examination (CASE). Those with a score of 4 or 5 on the CEEB AP test in French, German, Italian, or Spanish will be awarded 3 credits. Qualification for the CASE (in any language) requires at least a 65 on a college placement test (taken either in high school or at Cornell during Orientation Week). Students achieving a passing score on the CASE will be awarded 3 credits. Modern language credits, earned via AP or CASE, may be used to satisfy part of the liberal studies distribution requirement (in the foreign language category) or the approved elective requirement, contingent on discussion with the faculty advisor.

Other Subjects

Advanced placement credit is granted for many subjects not discussed here. If guidelines for a subject area are not spelled out below, the College of Engineering follows the AP guidelines found in the “General Information” section of *Courses of Study* or online at http://courses.cornell.edu/content.php?catoid=12&navoid=2158#CEEB_AP_Exams

General Policies for Advanced Placement Credit

The general policies in the College of Engineering governing awards of advanced placement credit are as follows.

1. Advanced placement credit will not be offered in any subject area without a documented examination.
2. All advanced placement examinations are normally taken and scored before fall-term classes begin. Students who take CEEB AP tests in high school should have an official report of their scores sent directly to Cornell as soon as possible. Students who have completed either GCE A-level or IB Higher Level examinations must present the original or a certified copy of their examination certificate to Engineering Advising, 167 Olin Hall. Those who wish to take departmental examinations must do so during Orientation Week.

Advanced Placement Credit Table

Requirements	CEEB AP Exams	GCE A-Level	IB Higher Level
Mathematics 1910 required 1920 required	4 or 5 on BC Cornell Departmental Exam	A, B, or C on Math or Pure Math exams (1910 only)	No credit ^a
Physics 1112 required 2213 required 1112 and 2213	4 or 5 on mechanics portion of C; 5 on B with successful completion of a high school level calculus course 5 on electricity and magnetism portion of C	A or B A or B plus credit for MATH 1910	6 or 7
Chemistry 2090 ^b 2090 and 2080	5	B A	6 or 7
Computing CS 1110	5 on A, or 4 or 5 on AB		6 or 7
Biology 4 credits 8 credits	4 5	A or B	6 7
First-Year Writing Seminar (two required) One seminar	5 (English) ^c	A	7

For all other subjects, see *Courses of Study* or visit: www.admissions.cornell.edu/pdf/advance-placement-and-international-credentials

Notes

- Students are encouraged to take the Cornell departmental examination during orientation.
- Students who obtain advanced placement credit for CHEM 2090 and are thinking of majoring in ChemE or MSE should consider enrolling in CHEM 2150. Those who are offered credit for CHEM 2090 and then elect to take CHEM 2150 will also receive academic credit for CHEM 2090. You may want to discuss this option with your faculty advisor.
- Students receiving a 4 on the CEEB AP English Literature and Composition exam or the CEEB AP English Language and Composition exam, a 6 on the IB Higher Level English exam, or a B on the GCE A-level English exam will be eligible for 3 credits, which may be applied toward the Literature and the Arts category in the liberal studies distribution requirement.

Transfer Credit

General Policies for Transfer Credit

- Only courses that meet degree requirements for the undergraduate engineering program and are deemed equivalent in scope and rigor to courses offered at Cornell will be considered for transfer credit.
- Transfer credit will only be awarded for courses taken at regionally accredited, degree-granting, postsecondary institutions.
- A grade of at least C (not C-) must have been earned in the course being transferred; schools and departments may stipulate a higher minimum grade.
- At most, 18 transfer or Cornell extramural study credits may be applied to engineering degree requirements after a student matriculates at Cornell. (Credit for summer session courses taken at Cornell is not considered transfer credit.)
- Transfer credit will not be awarded for courses taken during a semester in which a student is enrolled at Cornell.
- Transfer credit will not be awarded for cooperative courses taken while in high school, technical skills, or general knowledge acquired through personal experience, employment, or military training.
- Transfer credit will only awarded if/when the student has submitted a detailed course syllabus or outline, and a certified copy of the student's official transcript from the host institution (photocopies are not acceptable). Current students must also submit a completed Transfer Credit Form. Incoming First-Year students submit a completed High School Credit Form.
- Credit in excess of that awarded by Cornell for the equivalent course is never granted, nor will Cornell award more than the number of credits completed at another institution. (Transfer credits from institutions on a trimester or quarter system are not directly comparable to semester credits, and will be reduced when converted to semester credits.)
- The final transfer credit award is recorded by the Engineering Registrar, 158 Olin Hall. Grades for courses taken at other institutions appear on the official Cornell transcript, but are not included in the Cornell cumulative grade point average.

Transfer Credit for Transfer Students

Transfer students entering as first-, second-, or third-year students may transfer up to 36 credits for each year spent in full-time study at another institution, provided that the courses are acceptable for meeting graduation requirements. No more than 72 total transfer credits (combination of those taken both before and after matriculation) may be used to meet graduation requirements. Transfer credits from institutions on the quarter system or trimester system are not directly comparable to semester credits. In general, the number of trimester credits or quarter credits will be reduced when converted to semester credits, and credit will not be given for more than 10 courses per year. Transfer credit awards for matriculating transfer students are evaluated and determined by the undergraduate Major representative in the student's intended Major of study in engineering.

Transfer students transferring 12 to 23 credits are exempt from one PE course.

Transfer students transferring 24 or more credits are exempt from two PE courses and the swim test.

Transfer Credit to Fulfill the Math Requirement

If transfer credit is given for one or more of the first three math courses (1910, 1920, and 2930 or 2940), the total number of credits for these three courses must be at least 11; otherwise, another math course is required. Transfer credit given for the fourth, Major-dependent, math course must be at least 3 credits.

Transfer Credit for First-Year Students

Students who have taken a course or courses at an accredited college or university may wish to transfer the credits and apply them toward course requirements at Cornell.

During the summer months prior to arriving on campus, Engineering Advising will work directly with students who indicate that they have taken college-level courses at another institution. These students will be provided additional information by email.

To be eligible to receive transfer credit the following must apply:

- Students must have received at least a grade of C (not C–) in the course, and the subject matter must be applicable to the Engineering curriculum at Cornell.
- Engineering Advising must possess a signed statement (High School Credit Form) from the high school guidance office certifying that the course was not used to fulfill high school graduation credit and that it was taught on a college campus by college faculty and attended by college students. Students who want credit for cooperative courses taken in high school must seek AP credit, not transfer credit
- An official transcript must be received.
- Transfer credit requests must be completed by the end of the first term of residence.

How to Use Advanced Placement or Transfer Credit

Advanced placement (or transfer) credit enables students to begin their college studies at an appropriate level in each subject. They generally profit from these options, but they must judge their own ability to handle a demanding academic program. The advisability of accepting credit depends on many personal factors, such as the extent of study skills, the activities students wish to engage in during their first year, and the thoroughness of their preparation. Whether to accept advanced placement—or take the corresponding course—is a decision for which the student, alone, is responsible.

AP or transfer credit can be used in at least three ways:

- Enrolling immediately in a more advanced course in the same subject area, for example, second-term mathematics in the first term.
- Substituting elective course work during the first year or subsequent year. However, students must meet the criteria for good academic standing.
- Enrolling in fewer courses, using the credit to fulfill basic requirements. (To be in good standing, enrollment in at least 12 credits each semester is required.)

Further Information

For further information about advanced placement or transfer credit, contact Engineering Advising, College of Engineering, Cornell University, 167 Olin Hall, Ithaca, NY 14853-5201; telephone: 255.7414, email: adv_engineering@cornell.edu.

Academic Standing

Full-time students are expected to remain in good academic standing. The criteria for good standing change somewhat as a student progresses through the four years of the engineering curriculum. At all times, the student must be making adequate progress toward a degree, but what this actually means varies from Major to Major.

Requirements for students not yet affiliated with a Major are listed below. Failure to meet the requirements will result in a review by the faculty committee on Academic Standards, Petitions, and Credit (ASPAC), which may issue a warning, may require a student to take a leave of absence, or may even require a student to withdraw from the college.

To be in good standing at the end of each semester, unaffiliated students must have:

- at least 12 credits, including at least two courses in mathematics, science, and engineering (PE courses, and courses below the 1100 level—except ENGRG 1050 and Academic Excellence Workshops (AEWs)—do not count. Military Science courses do not count, with the exception of courses listed under *ROTC Courses*, page 117);
- at least C– in the mathematics course;
- a semester GPA ≥ 2.0 ;
- no F, U, or INC grades.

Because mathematics is pivotal to the study and practice of engineering, students must earn at least C– in MATH 1910, 1920, 2930 or 2940, and a math course chosen by the Major. Students failing to meet this requirement must repeat the course immediately and receive a satisfactory grade before enrolling in the next course in the sequence. Failure to achieve at least C– the second time will result in dismissal from the college. Physics and advanced math courses often have math prerequisites, and having to repeat the prerequisite course may delay progress in the physics and math curricula. Students are expected to continue the sequence of core engineering math courses each semester until completed.

Some of the requirements for good standing in Majors are listed below; complete, up-to-date information is available from the undergraduate consultant for each Major.

The university requirement for full-time status (for financial aid) is a minimum of 12 credits, but students who believe they have a good reason to carry a lighter course load should see their faculty advisor and the undergraduate consultant for their Major or intended Major beforehand. Students may have to postpone graduation or attend summer classes as a result of reducing their course load.

Criteria for Good Standing in Major Programs

Affiliated students must continue to meet college requirements for good standing as described earlier in this section. In addition, they must meet the following criteria to remain in good standing in their Major:

Biological Engineering

(For all Biological Engineering Majors regardless of the college they are enrolled in)

- Semester GPA ≥ 2.0
- Cumulative GPA ≥ 2.0

- Semester GPA ≥ 2.0 in biological and environmental engineering courses and engineering distribution courses
- Passing grade in at least 12 credits each semester
- No failing grades

Chemical Engineering

- Semester GPA ≥ 2.0
- Cumulative GPA ≥ 2.2
- GPA ≥ 2.2 each semester in required chemical engineering courses
- At most one grade below C– in required chemical engineering courses during the undergraduate program
- No failing grades

Civil Engineering

- Semester GPA ≥ 2.0
- Cumulative GPA ≥ 2.0
- Semester GPA ≥ 2.0 in core courses, design courses, Major-approved electives, and engineering distribution courses.
- At most one grade below C– in required core courses, design courses, Major-approved electives, and engineering distribution courses.
- 12 credits hours each semester
- No failing grades

Computer Science

- Semester GPA ≥ 2.3
- Semester GPA ≥ 2.5 in courses required for the CS Major program, with no course grade less than C–
- No failing grades
- A passing grade in at least 14 credits each semester

Electrical and Computer Engineering

- Semester GPA ≥ 2.3
- No course with a grade less than C– may be used to satisfy degree requirements in the Major program or serve as a prerequisite for a subsequent ECE course.
- Students must satisfactorily complete the following requirements: (a) two of: ECE/ENGRD 2100, ECE 2200, or ECE/ENGRD 2300; (b) all mathematics and physics courses through MATH 2940 and PHYS 2214 by the end of the first semester in the Major (typically the second semester of the second year) and make adequate progress toward the degree in subsequent semesters.
- No failing or missing grades
- Passing grade in at least 12 credits each semester

Engineering Physics

- Semester GPA ≥ 2.3
- At least C– in all required courses
- No failing grades
- A minimum of 12 credit hours per semester

Environmental Engineering

(For all EnvE Majors regardless of the college in which they are enrolled)

- Semester GPA ≥ 2.0
- Cumulative GPA ≥ 2.0
- Semester GPA ≥ 2.0 in core courses, design courses, Major-approved electives, and engineering distribution courses.
- At most one grade below C– in required core courses, design courses, Major-approved electives, and engineering distribution courses.
- 12 credits hours each semester
- No failing grades

Independent Major

- Semester GPA ≥ 2.0
- Cumulative GPA ≥ 2.0
- A passing grade in at least 12 credits each semester
- No more than one grade below C– in the primary or secondary area during the undergraduate program

Information Science, Systems, and Technology

- Semester GPA ≥ 2.0
- Semester GPA ≥ 2.3 in courses used toward the ISST Major and all mathematics courses required by the Engineering college.
- At least C– in ENGRD 2110, ENGRD 2700, and all courses used toward the ISST Major. Note: For each such course, at least C– is required for the course to count toward graduation requirements. If a lower grade is received, the course must be retaken.
- Satisfactory progress (a minimum of 14 credits per semester)
- No failing grades

Materials Science and Engineering

- Semester GPA > 2.0
- Cumulative GPA > 2.3
- At most one grade as low as C– in the Major required courses, materials electives, materials applications electives, and the outside technical elective

Mechanical Engineering

- Cumulative GPA ≥ 2.0

- A passing grade in at least 12 credits each semester, with the exception of the final semester
- At least C– in all ME Major required courses except MAE 3780, ENGRD 2100, PHYS 3360, PHYS 2214, MAE 3272, MAE 4272, and MAE 4300. Consult www.mae.cornell.edu for additional academic standards information

Operations Research and Engineering

- Cumulative GPA ≥ 2.0
- Cumulative GPA ≥ 2.0 in required Operations Research and Engineering courses
- At least C– in all Operations Research courses, and by the end of the sixth semester, a grade of at least C– in ENGRD 2110
- Satisfactory progress (a minimum of 12 credits per semester)
- No failing grades, no incompletes

Science of Earth Systems

- Semester GPA ≥ 2.0
- Cumulative GPA ≥ 2.0
- At least C– in all required courses

Academic Actions

At the end of each semester, the records of all students who have not yet affiliated with a Major are reviewed by the faculty committee on Academic Standards, Petitions, and Credit (ASPAC), and the records of students who have joined a Major are reviewed by faculty committees in those departments. Students who fail to meet the conditions for good standing receive written warnings, may be required to take a leave of absence, or may be withdrawn from the college.

A warning should be taken seriously. A student who receives a warning and continues to perform unsatisfactorily may be withdrawn from the degree program. Poor performance also diminishes prospects for employment or graduate school. Students should determine what their underlying difficulties are and address them, perhaps with the help of their faculty advisor or the staff in Engineering Advising.

When students fail to make adequate progress in a technical subject in a given semester, the review committee may require them to take time off to improve their understanding of the areas in which they are having difficulty. This is known as a required leave of absence. It will result in a postponement of graduation, but it can be regarded as an opportunity to address academic deficiencies before rejoining the engineering degree program. Students on a required leave of absence are not permitted to enroll in courses at Cornell. They may choose to go to other institutions to retake the courses that caused them difficulty. After a required leave of absence, students may return to the engineering program but are required to repeat the courses that were not satisfactorily completed before their leave—courses taken elsewhere are not counted toward graduation unless permission is granted by ASPAC (or the Major, for affiliated students). Exceptions to these rules must be requested in writing to ASPAC (or, for affiliated students, to the undergraduate consultant of their Major).

Occasionally, the faculty committee decides that a student is having such basic academic problems that they should leave the engineering program. This action is generally permanent. Students in this situation may wish to investigate other Majors at Cornell—Cornell Career Services in Barnes Hall is an excellent resource, as is the Office of Internal Transfer in Day Hall. Such students who want to continue their study of engineering are advised to seek admission to a different college or university.

Academic Integrity

The *Cornell University Academic Integrity Handbook* is distributed to new and transfer students. The code also appears (along with other campus policies) in the *Policy Notebook for the Cornell Community*, which is published by the Office of the Dean of Students and distributed to new students. It is available on the web at cuinfo.cornell.edu/Academic/AIC.html. An explanation of all aspects of academic integrity proceedings is available at www.theuniversityfaculty.cornell.edu/AcadInteg/.

The following is taken directly from the code (refer to the documents mentioned above for the entire code): “Absolute integrity is expected of every Cornell student in all academic undertakings ... Academic integrity is expected not only in formal course work situations but in all university relationships and interactions connected to the educational process, including the use of university resources. A Cornell student’s submission of work for academic credit indicates that the work is the student’s own. All outside assistance should be acknowledged, and the student’s academic position truthfully reported at all times. In addition, Cornell students have a right to expect academic integrity from each of their peers.”

The authority to determine whether a specific action shall be treated as a violation of the *Code of Academic Integrity* lies with the Academic Integrity Hearing Board. Those who violate the *Code of Academic Integrity* will be subject to penalties under this code and may also be subject to penalties under state and federal laws.

Students and staff members discovering an apparent violation should report the matter to the faculty member in charge of the course or to the chair of the appropriate Hearing Board. Procedures for dealing with alleged academic integrity violations are outlined in the code.

Dean’s List

Dean’s List citations are presented each semester to engineering students with exemplary academic records. The criteria for this honor are determined by the dean of the college.

For 2012–2012, the requirement is a semester GPA ≥ 3.50 (without rounding); no failing, unsatisfactory, missing, or incomplete grades (even in physical education); and at least 12 letter-grade credits (not S/U). Students may earn Dean’s List status retroactively if they meet these criteria after making up incompletes. Students who make the Dean’s List receive certificates from the Engineering Registrar’s office, and the honor is noted on their transcript.

Graduating with Distinction

Meritorious students graduating with a B.S. degree from the College of Engineering may

also receive degrees designated as *cum laude*, *magna cum laude*, or *summa cum laude*.

Cum laude is awarded to all engineering students with an overall GPA ≥ 3.50 . Cum laude is also awarded to all engineering students who received a semester GPA ≥ 3.50 in each of the last four semesters of attendance at Cornell; in each of these semesters, at least 12 letter-grade credits must be taken with no failing, unsatisfactory, missing, or incomplete grades. If the student is an Engineering Co-op student, then the Engineering Co-op summer term will count as one of the last four. Students who were approved for prorated tuition in their final semester will be awarded cum laude if they received a semester GPA ≥ 3.50 in their last semester and meet the conditions above in the prior four semesters.

Magna cum laude is awarded to all engineering students with a GPA ≥ 3.75 (based on all credits taken at Cornell).

Summa cum laude is awarded to all engineering students with a GPA ≥ 4.0 (based on all credits taken at Cornell).

Note: All GPA calculations are minimums and are not rounded.

Major Honors Programs

To enter a Major honors program, a student must be on track to graduate with distinction. A student must be in the program for at least two semesters before graduation. If the student's Major has an approved honors program and the requirements for (1) distinction, (2) Bachelor of Science degree, and (3) Major honors program are fulfilled, the faculty of the Major may recommend that the student graduate with the notation of "With Honors" on their diploma and transcript.

Biological Engineering (BE) Honors Program

To participate in this Honors Program, students must meet the Major Honors Programs criteria as delineated above, and must have at least 9 credits beyond the minimum required for graduation in BE. These 9 credits shall be drawn from one or more of the following, with at least 6 credit hours in the first category:

- A significant research experience or honors project under the direct supervision of a BEE faculty member using BEE 4991-4992: Honors Research, to be completed in their fourth year. A written senior honors thesis must be submitted as part of this component. A minimum grade of A- is required for successful completion of the honors requirement.
- A significant teaching experience under the direct supervision of a faculty member or as part of a regularly recognized course in the department (i.e. BEE 1510, 2510, or 2600) under BEE 4980: Undergraduate Teaching.
- Advanced or graduate courses. These additional courses must be technical in nature (i.e. in engineering, mathematics, biology, chemistry, and physics at the 4000 and graduate level).

Timing

Complete a written application (available in 207 Riley-Robb Hall) no later than the end of

the third week of the first semester of the fourth year, but it is better to make arrangements with a faculty member during the second semester of the third year.

Procedures

The student must have a BEE faculty advisor to supervise the honors program. A written approval of the faculty member who will direct the research is required. After the college verifies the student's GPA, the student will be officially enrolled in the honors program.

Civil Engineering (CE) Honors Program

To participate in this Honors Program, students must meet the Major Honors Programs criteria as delineated above. The program consists of at least 9 credits beyond the minimum required for graduation in CE. These 9 credits shall be drawn from one or more of the following components (with at least 2 credits in any selected component):

- A significant research experience or honors project under the direct supervision of a CEE faculty member using CEE 4000: Senior Honors Thesis (1–6 credits per semester). A significant written report or senior honors thesis must be submitted as part of this component. Letter grade only.
- A significant teaching experience under the direct supervision of a faculty member or as part of a regularly recognized course in the College of Engineering (i.e. CEE 4010: Undergraduate Engineering Teaching in CEE [1–3 credits per semester]).
- Advanced or graduate courses at the 5000 level or above.

No research, independent study, or teaching for which the student is paid may be counted toward the honors program.

Timing

Students must apply no later than the beginning of the first semester of their fourth year but are encouraged to apply as early as the first semester of their third year.

Procedures

Students must apply no later than the beginning of the first semester of their senior year but are encouraged to apply as early as the first semester of their junior year. All honors program students must be in the program for at least two semesters before graduation. Students must enter with and maintain a cumulative GPA equal to or greater than 3.5. Each applicant to the CEE Honors Program must have a faculty advisor or faculty member to supervise the student's individual program. (This need not be the student's faculty advisor.) Applications can be obtained from Hollister 221. Each program must be approved by the CEE Curriculum Committee, although the committee may delegate approval authority to the associate director for all but unusual proposals.

Computer Science (CS) Honors Program

To participate in this Honors Program, students must meet the Major Honors Programs criteria as delineated above and complete at least (9) credits above the minimum required for completing the major. These nine credits must include:

- At least one CS course (3-credit minimum) at or above the 5000-level with at least A– (no seminars or 2-credit project courses).

- At least two 3-credit semesters of CS 4999: Independent Reading and Research with a CS faculty member with at least an A– each semester.

Content

Honors courses may not be used to satisfy the CS electives, the CS project course, the technical electives, courses in the External Specialization, Major-approved elective, advisor-approved electives, or a student’s first vector. In essence, honors course work represents a depth of work that is well beyond the minimum requirements needed to fulfill the Major.

Timing

Candidates are required to send email to ugrad@cs.cornell.edu with the subject line “Honors Candidate”. The deadline for receipt of messages requesting honors is October 15 for May and August candidates and March 15 for January candidates, during or prior to senior year.

Preparation

Arrangements for CS 4999 projects should be made directly with faculty members in the department. Students are encouraged to discuss potential contacts with their advisors and to browse the department’s web page at www.cs.cornell.edu/ for specific leads on research opportunities.

Computer Science reserves the right to make changes in this program at any time.

Engineering Physics (EP) Honors Program

To participate in this Honors Program, students must meet the Major Honors Programs criteria as delineated on page 130 .

- Courses counting towards honors cannot be applied to the B.S. degree. The student must complete the following two requirements, which must result in at least 9 credits of work beyond the minimum required for graduation in EP:
 1. Enroll in Independent Study in Engineering Physics, AEP 4910, or an equivalent course, which must be taken for a minimum of 6 credits, over two semesters, for the purpose of completing an independent research project or senior thesis under the supervision of a Cornell engineering or science faculty member. The minimum enrollment is two credits in the first semester and four credits in the second. The level of work required for a successful completion of this project or thesis is to be consistent with the amount of academic credit granted.
 2. The student must enroll in an additional technical course at the 4000 level or above, for at least 3 credits.

Timing

Complete a written application no later than the end of the third week of the first semester of the fourth year, but it is better to make arrangements with a faculty member during the second semester of the third year.

Procedures

Before enrolling in AEP 4900, or the equivalent, submit to the associate director for undergraduate studies a brief proposal outlining the topic and scope of the proposed project

or thesis and a faculty supervisor's written concurrence. This proposal will be reviewed and either approved or returned to the candidate to correct deficiencies. The proposed research project or senior thesis is to consist of a research, development, or design project and must go beyond a literature search. A written report is required in the form of a technical paper with, for example, an abstract, introduction, methods section, results section, conclusions section, references, and figures. This report will be evaluated by the faculty supervisor and the chair of the EP Honors Committee. Following completion of the written report, an oral report is presented to an audience consisting of the faculty supervisor, the chair of the Honors Committee, and at least one other departmental faculty member, along with the other honors candidates. At least a grade of A– is required for successful completion of the honors requirement.

Environmental Engineering (EnvE) Honors Program

Contact the Undergraduate Program Director of Biological Engineering or the Associate Director of Civil and Environmental Engineering for information on requirements.

Independent Major (IM) Honors Program

To participate in this Honors Program, students must meet the Major Honors Programs criteria as delineated on page 130 and:

- Complete at least 9 credits above the minimum required for graduation, from courses selected at the advanced or graduate level (excluding credits awarded for research) and approved by the Major advisor.
- Have a written proposal of the honors project accepted by the Major advisor and the Independent Major Committee by the beginning of the seventh semester.
- Complete an honors thesis involving research of breadth, depth, and quality and demonstrating professional communication skills.

Information Science, Systems, and Technology (ISST) Honors Program

To participate in this Honors Program, students must meet the Major Honors Programs criteria as delineated on page 130 and:

- Three credit hours of ISST graded course work at least at the 5000 level (no S/U courses; no seminars or 2-credit project courses.)
- Six credit hours of INFO 4900: Independent Reading and Research with an ISST faculty member, spread over two semesters, with at least A– in each semester

or

- Three credit hours of INFO 4900 with an ISST faculty member and 3 credit hours of INFO 4910: Teaching in Information Science, Systems, and Technology, both with at least a grade of A–. It is expected that the INFO 4900 research will result in either a programming project and/or a written report. Courses at the 5000 or 6000 level taken to fulfill the honors requirement may be counted toward fulfillment of the primary or associated option requirements.

The 9 credits work required for honors are in addition to the minimum requirements for the major.

Materials Science and Engineering (MSE) Honors Program

To participate in this Honors Program, students must meet the Major Honors Programs criteria as delineated on page 130 and:

- Complete at least 9 credits above the minimum required for graduation in Materials Science and Engineering, so that the minimum number of credits for an honors degree is 141. The additional courses must be technical in nature, i.e. in engineering, mathematics, chemistry, and physics, at the 4000 and graduate levels, with selected courses at the 3000 level, which must be approved by the Major advisor.
- Write a senior honors thesis (8 credits) with at least a grade of A.

Timing

Complete a written application by the end of week 3 of the first semester of the fourth year, but it is better to make arrangements with a faculty member the semester before that.

Procedures

A faculty advisor must supervise the honors program. Written approval by the faculty member who will direct the research is required.

Operations Research and Engineering (ORE) Honors Program

To participate in this Honors Program, students must meet the Major Honors Programs criteria as delineated on page 130. An honors program shall consist of at least 9 credits beyond the minimum required for graduation in ORE, so that no part of the honors program can also be used to satisfy graduation requirements. The 9 credits shall be from one or more of the following with at least 4 credits from the first category:

- Advanced courses in ORIE at the 5000 level or above.
- A significant research experience or honors project under the direct supervision of an ORIE faculty member using ORIE 4999: ORIE Project. A significant written report must be submitted as part of this component.
- A significant teaching experience under the direct supervision of a faculty member in ORIE using ORIE 4990: Teaching in ORIE.

Timing

Complete a written application no later than the end of the third week of the first semester of the fourth year, but it is better to make arrangements with a faculty member during the first semester of the third year.

Procedures

A faculty advisor must supervise the honors program of each applicant. The honors advisor need not be the student's faculty advisor. The application to the program shall be a letter from the student describing the specific proposed honors program and include the explicit approval of the honors advisor. Each program (as well as any subsequent changes to the program) must be approved by the associate director of undergraduate studies.

Science of Earth Systems (SES) Honors Program

To participate in this Honors Program, students must meet the Major Honors Programs criteria as delineated on page 130 and:

- At least 9 credits above the minimum required for graduating and approved by the Major advisor;
- Have a written proposal of the honors project accepted by their faculty advisor and

the director of undergraduate studies, and filed with the Program coordinator;

- Complete an honors thesis (EAS 4910–4920 or 4990, at least 2 credits each) involving research of breadth, depth, and quality.

Timing

A written proposal of the honors project must have been accepted by a student's advisor and the director of undergraduate studies by the beginning of the seventh semester.

Procedures

A faculty advisor supervises each honors program. Written approval of the proposal or the thesis by the faculty member who will direct the research is required.

Changes in Status

Petitions to the Faculty

A petition is the official way to request action on academic matters that are not routine. The petition form, which may be obtained in Engineering Advising or online at www.engineering.cornell.edu/resources/registrar/forms.cfm, is used to notify the petitioner, the registrar, and the faculty advisor.

Petitions are required for such purposes as:

- Amending a program of study by adding courses after the first three weeks of the semester or dropping courses after the first seven weeks;
- Amending a college curriculum requirement, such as substituting a course or a stated sequence of courses in a degree-requirement area;
- Requesting an exception to a college academic policy based on extenuating circumstances.

The petition should include convincing evidence that an exception is warranted. A clearly stated petition has a better chance of approval than a poorly prepared one.

Students not yet affiliated with a Major should submit their petition to the Engineering Registrar. Affiliated students should check with their Major to determine where to submit their petition.

Leave of Absence

Students sometimes find it necessary to suspend their studies for a while. To do this, they must request a voluntary leave of absence in writing for a specified period of time and receive written approval.

Affiliated students request a voluntary leave through their Major. Unaffiliated students request a voluntary leave through Engineering Advising; the first step is an interview to establish conditions for the leave and subsequent return. Those who take a voluntary leave while not in good standing may be given a “conditional leave”. This requires them to meet specific conditions, established at the time the leave is granted, before they will be reinstated.

Students needing to take a health leave of absence based on medical or psychological issues must initiate this leave with Gannett Health Services. The health leave policy can be found at www.gannett.cornell.edu/services/leaveofabsence.cfm.

Leaves of absence last at least six months and are not generally granted for more than two years. **A leave of absence granted during a semester goes into effect on the day it is requested.** Students are responsible for any outstanding tuition or other university charges owed through that date. On-campus housing and dining charges may accrue until the student no longer utilizes the services. Leaves granted after the seventh week of a semester generally result in withdrawal from all course work (i.e. a “W” will appear next to each course on the transcript). Students who owe money to the university are ineligible for leaves of absence. Courses taken during a leave are to satisfy Cornell degree requirements and must be approved in advance through a formal transfer petition. At most 18 transfer

credits may be used to meet degree requirements after matriculation.

Students who intend to take a leave of absence should check with the Office of Financial Aid and Student Employment to find out about financial implications. This is especially important if they have taken out educational loans. Eligibility for medical insurance may also be affected.

Extramural Students

Students not enrolled full-time who register for individual courses through the School of Continuing Education and Summer Sessions are called *extramural students*. Tuition for extramural study is calculated according to the number of credits; no one may register as an extramural student for more than 11 credits per semester. Extramural students do not have the privilege of health insurance or the use of Gannett Health Services, unions, physical education facilities, or other services for which full-time Cornell students pay a fee. Engineering students on a leave of absence may not take Cornell extramural courses.

In the College of Engineering, credits earned in extramural courses taken in either fall or spring semester are counted as transfer credits. Summer-session courses taken at Cornell are not considered transfer credit (see section on transfer credit [page 123] for details).

Students may not enroll in courses extramurally during their last semester of undergraduate enrollment.

Since extramural students are not full-time, they may need to begin paying back student loans while taking classes. The Office of Financial Aid and Student Employment has more information.

The School of Continuing Education and Summer Sessions is located in B20 Day Hall.

Withdrawal

Students who voluntarily withdraw from the engineering degree program sever all connection with the college. Unaffiliated students who wish to withdraw should do so through Engineering Advising. Affiliated students should contact their Major.

A student who fails to register in the first three weeks of the semester, without benefit of a leave of absence or permission for study in absentia, will be deemed to have withdrawn.

Students who withdraw from the College of Engineering are eligible to apply for admission to one of the other six undergraduate colleges at Cornell. The university's internal transfer process should be followed.

Students who have withdrawn but wish to return must make a formal appeal for readmission. This is rarely granted. It is subject to a review of the student's academic background and depends on available space in the college and in the student's Major.

Rejoining the College After a Leave of Absence

To return after a leave of absence, the conditions established when the leave was granted must be satisfied and the college must be notified.

Students who wish to rejoin the college and have not yet affiliated with a Major should request permission to rejoin in a letter to Engineering Advising. This must be done at least six

weeks before the beginning of the semester in which the student wishes to return. The letter should describe the student's activities while away from Cornell, detail any academic work completed during this time, and specify the courses the student intends to take when they return. If permission to rejoin is granted, Engineering Advising will respond directly to the student. A student who is rejoining the college must see the faculty advisor to finalize course selection and should plan to return at least three working days before the beginning of classes. A call to set up an appointment is a good idea.

Affiliated students should apply to their Major for permission to rejoin the college. Majors must accept students in good standing who have successfully completed all appropriate portions of the Common Curriculum, including prerequisites for the Major, and who have met the requirements for affiliation. They are not required, however, to accept rejoining second-year students who are not in good standing or have not made adequate academic progress.

Ordinarily, students who take a leave of absence after affiliating with a particular Major return to that same Major. However, an affiliated student on leave of absence who wishes to transfer to a different Major at the time of rejoining must apply to the new Major. This process may take a few weeks, so notification of intent to rejoin with a change in Major must be received early. Majors are not required to accept a student who began the third year in another Major and later requested transfer. A student who is not accepted into the new Major must rejoin in the original Major.

Transferring from One Engineering Major to Another

Students who have affiliated with a Major program may want to transfer to a different Major. Other possible candidates for transfer are students who have been notified that they have been withdrawn from their Major (and, therefore, from the college). Such students may still be eligible to apply to another Major. Contact Engineering Advising for more information.

Students who transfer from outside Cornell into the College of Engineering are affiliated with a specified Major when they are admitted and are not usually eligible to transfer to another Major for a period of one year. Therefore, transfer students who want to change Majors may find it necessary to take a leave of absence or to delay graduation.

To apply for transfer to another Engineering Major, complete a Change of Major and/or Advisor form, which is available through Engineering Advising (167 Olin Hall) or any Engineering undergraduate Major office. Students must have permission from the intended Major to transfer; Majors are under no obligation to accept students who have already begun the fifth semester with a different affiliation.

Transferring to Another College at Cornell

Students sometimes come to the conclusion that they no longer wish to remain in the College of Engineering. When this happens, it is necessary for them to reevaluate their goals and motivations. Help is available from students' faculty advisors, Engineering Advising, and Cornell Career Services in Barnes Hall.

Students interested in transferring within Cornell should consult with the Office of Internal Transfer, 220 Day Hall. The staff can provide expert advising on the transfer process and information about each of the Cornell colleges to help students pinpoint their

interests. (Students planning to transfer within Cornell should make an appointment with the Office of Internal Transfer as early in the semester as possible.)

Students with satisfactory academic records may apply to the target college and, if accepted, transfer directly. Students who do not have strong academic records and those who have not taken courses in their target college may apply for conditional transfer. For more information, go to: <http://internaltransfer.cornell.edu>.

Procedures for Direct Intra-University Transfer

Students wishing to transfer to another undergraduate division within Cornell should visit the Office of Internal Transfer (220 Day Hall) to learn more about transfer procedures. The process requires registration with the Office of Internal Transfer as well as completion of an application for the target college. Application requirements and the criteria for admission vary by program. Go to <http://internaltransfer.cornell.edu> for additional information.

Admissions decisions are generally made at the end of each semester after final grades are available, and students are notified shortly thereafter.

Change of Name or Address

Students must keep the college advised of changes in their name, address, and phone number. This applies to both their home and local addresses. Important correspondence may be delayed by forwarding, and failure to receive mail on time is not a valid excuse for missed deadlines.

Students can update their addresses and phone numbers online through *the Student Center* on any networked campus terminal. (Public terminals are located outside the University Registrar's office and in many of the campus libraries and residence halls.) Changes of name or social security number should be submitted in writing to the University Registrar's office.

Career and Professional Development

From their first year of study, students need to plan for the next stage of life. Some will obtain additional education or training, while others will seek employment immediately after graduation. The College of Engineering and the university provide support for choosing options, whether seeking employment or pursuing appropriate advanced study.

In addition to career development, students should consider the many aspects of professional and personal development. It is recommended that students begin early to connect with professional and technical societies that can provide a network for the future. During the undergraduate years, participation in student professional and technical societies provides preparation for this next move. Obtaining legal recognition of commitment to the engineering field is also important. Students are encouraged to take the first steps toward professional engineering licensure during the fourth year by taking the Fundamentals of Engineering exam. (Students typically apply by April of the third year for the October exam in fourth year).

Career and professional development decisions are among the most important of life's decisions. Students are encouraged to seek advice early during their time at Cornell and to give careful thought and attention to the process.

The following information is designed to assist students in their career and professional development.

Deciding on a Career

Deciding on a career path and finding employment takes effort and commitment—especially in the fourth year. It is recommended that students plan, since this process can take much time and effort. The following resources can help.

Career Services at Cornell

Engineering Cooperative Education and Career Services

201 Carpenter Hall, 255.5006

www.engineering.cornell.edu/careerservices

The Engineering Cooperative Education and Career Services office assists students who are contemplating their career development, whether through employment (full-time entry-level, co-op, or summer) or further graduate study.

The office coordinates an on-campus recruiting program that annually brings 200+ employers to campus to conduct more than 6,000 interviews with engineering students for full-time entry-level, co-op, and summer positions. Also, in conjunction with Cornell Career Services, an extensive list of electronic job postings is maintained on Cornell's CCNet System. The office coordinates seminars on job search and résumé/interview preparation; counselors are available to discuss career-related issues individually and in group settings. Students are encouraged to use these services in preparing for success in the job market.

Engineering Cooperative Education Program

The Engineering Cooperative Education Program (Co-op) provides an opportunity for juniors to gain 28 weeks of paid career-related work experience over a semester and a

summer with employers nationwide and beyond. Co-op is an excellent way to explore career interests while acquiring an understanding of the engineering profession. Students must be enrolled in the College of Engineering (Computer Science and Biological Engineering Majors outside the college are also eligible). In most cases, a GPA >2.7 is required. For more information, please see the *Special Programs* section of this handbook (pages 112–114) or visit www.engineering.cornell.edu/coop.

Cornell Career Services

103 and 203 Barnes Hall, 255.5221
www.career.cornell.edu

Cornell Career Services (CCS) educates students about the career planning and job-search process and promotes linkages between students and employers or graduate and professional schools. CCS offers a broad range of programs and services that complement those provided in Engineering Cooperative Education and Career Services, focusing on five areas:

- Career development—career interest inventories, advising on decisions concerning Majors and careers, and networking opportunities.
- Career information—career library with an extensive collection of print, electronic, audio, and video reference materials on careers and career decision-making; employment; internships; graduate and professional schools; fellowships; and international opportunities to assist students with job searches and applying to graduate and professional schools.
- Job search strategies—job search seminars, employment career fairs, company information sessions, and on-campus interviews. A Career Guide provides sample résumés, cover letters, and advice on the job-search process. The on-campus recruiting program brings to campus more than 180 employers who conduct interviews for positions in the management consulting, financial services, retail, health care, and insurance industries.
- Employment information via CCNet electronic job posting service—on summer jobs, internships, and full-time jobs after Cornell.
- Graduate and professional school, including health careers and fellowships—advising and seminars on the application process, information resources, and Graduate and Professional School Days. A credentials service allows students and alumni to maintain confidential files of recommendation letters and personal data to be used in securing employment or in applying to graduate or professional schools.

The Cornell Career Services' web site provides a calendar of events, career resources, and links to Internet career sites.

Graduate Programs and Professional Study

Students who wish to continue with advanced study at Cornell or another institution should start planning early in the fourth year. They should identify the course of advanced study they wish to pursue and the schools, colleges, and universities they might attend. Peterson's *Graduate and Professional Programs* is a useful tool for identifying potential institutions, with names and addresses of people to contact. Faculty members can often give advice about appropriate schools to consider. If possible, students should visit the graduate and professional

schools they are considering.

Three graduate degrees are available in the College of Engineering: Master of Science (M.S.), Master of Engineering (M.Eng.), and Doctor of Philosophy (Ph.D.).

The M.S. and Ph.D. Programs

The M.S. and Ph.D. programs are offered by “Fields of Graduate Study”, which are associated with the Cornell Graduate School. Most engineering fields are directly connected to the obvious department or school, but, because of the interdisciplinary nature of some subjects areas, a field may not be associated with a department or school. The field of Applied Mathematics is an example of this.

Students in good standing in the M.S./Ph.D. programs generally receive full support during their graduate studies, which covers tuition, health insurance, plus a stipend for both the academic year and the summer. Support may be in the form of fellowships, teaching assistantships, or research assistantships.

To find out about an M.S. or Ph.D. program at Cornell, visit the appropriate department or school, or visit the admissions web site of the Cornell Graduate School, www.gradschool.cornell.edu/admissions.

The Master of Engineering Program

The Master of Engineering (M.Eng.) degree features intensive, one-year professional programs of study built around core courses, a flexible curriculum design, practical interdisciplinary study, and a project, which offer students advanced training in science, current technology, and engineering design. M.Eng. programs are offered in 15 Major fields of study. You can find out about these M.Eng. programs by visiting the M.Eng. web site, www.engineering.cornell.edu/meng, or the appropriate engineering department or school.

At the beginning of their senior year, qualified engineering students may request an early decision (by December of the senior year) on admission to the M.Eng. program. The early decision option may help them with decision-making as they near completion of the bachelor in science degree. Information on Early Decision is available through the Graduate Field Offices.

Qualified students may enroll simultaneously in the M.Eng. program in their eighth semester, while completing their B.S. degree, provided they need at most 8 credits to complete their B.S. degree. The grades of M.Eng. courses taken during the early-admission semester will count toward a student’s undergraduate GPA. Applicants must have a cumulative GPA ≥ 2.7 at the time of application and must submit an “Early Admission Petition and Course Record Form” with their application. All requirements for the B.S. degree must be completed before enrolling fully as a graduate student in the M.Eng. program, and at least one semester as a full-time M.Eng. student is required. The form for Early Admission is available in all Graduate Field Offices and at the Office of Research and Graduate Studies, 222 Carpenter Hall.

Professional Engineer Licensing

Legal recognition of qualification to practice engineering is obtained through the licensing process. All engineers who offer their services to the public are required to have a valid license to practice. Licensing requirements vary from state to state for the Professional

Engineer (P.E.) license. However, obtaining the P.E. license is a multistep process that has a common first step across the nation of passing the Fundamentals of Engineering exam. Students are eligible for the first step as they near graduation from an accredited engineering degree program.

To obtain the Professional Engineer (P.E.) license, a candidate must pass an Intern Engineer Examination, Fundamentals of Engineering, have a prescribed amount of experience in engineering practice, and pass the Professional Engineer Examination. Licensing for the P.E. is by individual state agency for the state in which the student wishes to practice. In New York, it is the New York State Board for Engineering and Land Surveying. Applications and other details are available at www.op.nysed.gov/prof/pels/.

Applications and informational brochures are available in 167 Olin Hall. Fourth-year students graduating in May are eligible to take the Fundamentals of Engineering exam in April.

Student Organizations

Student organizations in Engineering help connect classroom and career, develop professionalism, increase technical proficiency, and refine ethical judgment. Some organizations are involved in community service; many involve teams that compete in intramural soccer, football, hockey, and softball games; and a few manage coffee shops on weekday mornings in the departmental lounges. A complete listing of student organizations is available here: sao.cornell.edu/SO/.

Alpha Epsilon

c/o Professor Jim Bartsch, 314 Riley-Robb Hall
National honor society of agricultural, food, and biological engineering.

Alpha Sigma Mu

c/o Professor Shefford Baker, 329 Thurston Hall
Honorary society for students in materials engineering.

American Association of Environmental Engineers (AAEE)

c/o Professor Beth Ahner, 202 Riley-Robb Hall

American Association of Petroleum Geologists (AAPG)

c/o Professor Teresa Jordan, 4108 Snee Hall

American Indian Science and Engineering Society (AISES)

c/o Diversity Programs in Engineering Office, 146 Olin Hall
<http://aip.cornell.edu/cals/aip/student-life/organizations/aises/index.cfm>

American Institute of Aeronautics and Astronautics (AIAA)

108 Upson Hall

American Institute of Chemical Engineers (AIChE)

120 Olin Hall, aiche@cornell.edu
www.rso.cornell.edu/aiche

American Society of Civil Engineers (ASCE)

c/o Professor Jerry Stedinger, 213 Hollister Hall

American Society of Mechanical Engineers (ASME)

108 Upson Hall
www.rso.cornell.edu/ASME/

Association of Computer Science Undergraduates (ACSU)

c/o Nicole Roy, 303 Upson Hall
acsu.cornell.edu

Biomedical Engineering Society (BMES)

c/o Professor Chris Schaffer, B57 Weill Hall
Student chapter of the national BMES
www.rso.cornell.edu/bmes/

Chi Epsilon

c/o Professor James Bisogni, 217 Hollister Hall
Student chapter of the national honor society in civil engineering.

Cornell AEP Society (CAEPS)

c/o Professor Chris Xu, 212 Clark Hall

Student organization of the School of Applied and Engineering Physics.

Cornell Chapter of the American Meteorological Society (CCAMS)

c/o Mark W. Wysocki, 1114 Bradfield Hall

ccams.eas.cornell.edu/

Cornell Materials Society (CMS)

c/o Professor Michael Thompson, 328 Bard Hall

Undergraduate chapter of the Materials Research Society (MRS), The Materials Information Society (ASM), and The Minerals, Metals, and Materials Society (TMS).

Digital Gaming Alliance (DGA)

c/o Walker White, 4122 Upson Hall

The video games club at Cornell.

cornellgaming.org/

Encourage Young Engineering Students (EYES)

Public Service Center, 200 Barnes Hall

Committed to increasing the mathematics and science skills of evolving elementary, middle, and high school students.

Engineering Ambassadors Association

102 Hollister Hall

Introduces prospective first-year students to the College of Engineering

www.ea.cornell.edu

Engineering Representative to the Student Assembly

Engineering Student Assembly, Office of the Assemblies, 165 Day Hall

Engineers for a Sustainable World (ESW)

c/o Professor Park Doing, 396 Rhodes Hall

Dedicated to building a more sustainable world.

www.rso.cornell.edu/esw

Eta Kappa Nu (HKN)

c/o Clifford Pollock

224 Phillips Hall

Student chapter of the electrical and computer engineering honor society.

Information Science Student Association (ISSA)

c/o Christine Stenglein, 303 Upson Hall

rso.cornell.edu/issa/

Institute of Biological Engineering (IBE)

114 Riley-Robb Hall

Student chapter of the national IBE.

www.rso.cornell.edu/ibe/

Institute of Electrical and Electronics Engineers (IEEE)

c/o John Belina, 201 Phillips Hall
Student chapter of the national IEEE.

Institute for Operations Research and the Management Sciences (INFORMS)

c/o Cindy Jay, 203 Rhodes Hall
Student chapter of the national INFORMS.

National Society of Black Engineers (NSBE)

c/o Diversity Programs in Engineering Office, 146 Olin Hall
nsbe.cornell.edu

Omega Rho International Honor Society

c/o ORE, 203 Rhodes Hall
Student chapter of the Omega Rho International Honor Society.

Peer Advisor Program

c/o Engineering Advising, 167 Olin Hall
Helps first-year engineering students adjust to life at Cornell and Engineering.

Pi Tau Sigma

108 Upson Hall
Student chapter of the honorary mechanical engineering society.

Society of Automotive Engineers (SAE)

c/o Professor Albert George, 208 Upson Hall

Society of Hispanic Professional Engineers (SHPE)

c/o Diversity Programs in Engineering Office, 146 Olin Hall
shpe.cornell.edu

Society of Women Engineers (SWE)

c/o Diversity Programs in Engineering Office, 146 Olin Hall
www.swe.cornell.edu/

Tau Beta Pi

c/o John Belina, 201 Phillips Hall
Student chapter of the national engineering honor society.
rso.cornell.edu/tbp/

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the first two years of life. The first year of life is the most critical period for the development of the brain.

The second year of life is the most critical period for the development of the brain.

The third year of life is the most critical period for the development of the brain.

The fourth year of life is the most critical period for the development of the brain.

The fifth year of life is the most critical period for the development of the brain.

The sixth year of life is the most critical period for the development of the brain.

The seventh year of life is the most critical period for the development of the brain.

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The sixteenth year of life is the most critical period for the development of the brain.

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The twenty-fourth year of life is the most critical period for the development of the brain.

The twenty-fifth year of life is the most critical period for the development of the brain.

The twenty-sixth year of life is the most critical period for the development of the brain.

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