Undergraduate student advisement begins during New Student Orientation and continues through graduation. All engineering students are assigned faculty advisors, and students are required to consult with their advisors during the advanced registration periods. Students must also obtain approval from their advisor for courses taken during the Winter or Summer Sessions and when adding or dropping courses. Students are also encouraged to meet with their engineering faculty advisors at other times to learn more about undergraduate academic options, the engineering profession, and graduate school opportunities.

The College Undergraduate Affairs Office also provides advisement to students who experience academic difficulties or who require additional guidance. The Assistant Dean for Undergraduate Affairs conducts a preliminary degree checkout with each engineering student early in his or her senior year to help identify any impediments to graduation.

The undergraduate curriculum in each engineering major consists of a core of required courses, a group of elective technical classes, and a group of elective general education courses. The core group includes courses in mathematics, chemistry, physics, computer science, and engineering. The technical electives allow students to investigate the sciences in more depth and to develop a concentration within their engineering discipline. The general education electives are chosen from the humanities and social sciences to provide a well-rounded education. The College's general education requirements are described in the following section. Additional requirements specified by individual engineering departments are given in the appropriate departmental sections.

The Dean's Scholar Program exists to serve the needs of students whose clearly defined educational goals cannot be effectively achieved by pursuing the standard curricula for all existing majors, minors, and interdisciplinary majors sponsored by the University. Driven by an overarching passion or curiosity that transcends typical disciplinary bounds and curricula, a Dean's Scholar's intellectual interests may lead to broad interdisciplinary explorations of an issue or to more intense, in-depth studies in a single field at a level akin to graduate work. However, it is important to note that because engineering degrees are professionally accredited, it is difficult for a
Dean’s Scholar to complete an engineering degree within four years. In consultation with faculty advisors and the Associate or Assistant Dean of their college, Dean’s Scholars design an imaginative and rigorous individual plan of study to meet the total credit hours required for graduation. Contact the Assistant/Associate Dean in the college or go to www.udel.edu/deanscholar for more information and the application.

**GENERAL EDUCATION REQUIREMENTS**

The College of Engineering requires that six courses (minimum of 18 credits) be chosen from the humanities and social sciences subject to the constraints listed below and the approval of the student’s advisor. The courses selected must provide both breadth and depth and not be limited to a selection of unrelated introductory courses. The University’s multicultural course requirement may be included in this set of six courses (see p. 57). Detailed guidelines, which include a list of courses which may be used to satisfy the program’s requirements, may be obtained from the Assistant Dean for Undergraduate Affairs.

- At least two courses (minimum of six credits) must be in the humanities. Humanities include courses in areas such as Art History, English Literature, Foreign Languages other than the student’s native language, History, and Philosophy.
- At least two courses (minimum of six credits) must be in the social sciences. The social sciences include courses in areas such as Economics, Political Science, Psychology, and Sociology.
- At least two courses (minimum of six credits) must be above the introductory level. These courses must build upon the content of a previous course, as approved by the faculty advisor. Courses which fulfill this requirement are normally at the 300-level or above.
- At least two of the six courses (minimum of six credits) must be thematically related. Courses which fulfill this requirement are typically in the same department or program.

Courses in mathematics, science, or engineering may not be used to satisfy any General Education Program requirement. Students must consult their faculty advisors and the guidelines published by the College of Engineering for the proper classification of general education courses.

**ACADEMIC STANDARDS**

The engineering departments have established minimum standards for certain courses and for progression to the sophomore or junior level for each of their majors. These standards are given in the appropriate departmental sections.

In order to graduate, engineering students must satisfy the general University requirements for a baccalaureate degree (see page 43) as well as all the requirements of their engineering major. Additionally, engineering students must have at least a 2.0 average in all engineering, mathematics, and science courses used to fulfill graduation requirements. If a course is repeated, only the last grade will be used to compute the engineering grade-point average; however, all grades are used to compute the University’s cumulative grade-point index.

**TRANSFER STUDENTS**

The engineering curricula are very demanding, and transfer applicants must have a good record in mathematics and science. Thus, all students who wish to transfer into the College of Engineering should contact the Assistant Dean for Undergraduate Affairs (302-831-8659) to discuss curriculum requirements and transfer policies before beginning the application process.

Students at the University of Delaware who wish to transfer into a major within the College of Engineering must make a formal request to the appropriate engineering department by May 1 for entrance in the Fall semester or by December 1 for entrance in the Spring semester. The student should contact the department office well in advance of these deadlines to determine the specific information which must be included in the application.

Students from outside the University of Delaware who wish to transfer into the College of Engineering must make a formal application through the University Admissions Office by March 1 for entrance in the Fall semester or by November 15 for entrance in the Spring Semester.

**AIR force ROTC**

The Air Force Reserve Officer Training Corps (AFROTC) provides a program for qualified college men and women to earn commissions as Second Lieutenants in the United States Air Force while completing their University course requirements. Commissioning follows the award of a University bachelor’s degree. Those who have bachelor’s degrees and are enrolled in graduate courses are also eligible. Questions concerning applicant qualifications should be directed to the unit’s admission officer.

Telephone: (302) 831-2863
www.udel.edu/afrotc

**PROGRAMS OFFERED**

Four-Year Program. The four-year program is composed of a General Military Course (GMC) and a Professional Officer Course (POC). The first two years, the GMC, provide a general introduction to the Air Force and the various career fields. Students enrolled in the GMC who are not receiving an Air Force Scholarship incur no reserve or active duty service obligation to the Air Force and may elect to discontinue the program at any time. The final two years, the POC, concentrate on developing leadership and management skills and on a study of American defense policy. Students must compete for entry into the POC. If accepted, they must attend field training at a designated Air Force base during the summer following their sophomore year of college. When they return to the University in the Fall, they are placed under contract with the Air Force to complete the program and serve a minimum of four years on active duty. Pilot and navigator candidates incur an additional obligation because of specialized training following commissioning.

Two-Year Program. The two-year program is normally offered to prospective juniors and graduate students. The academic requirements for this program are identical to the final two years of the four-year program.

One-Year Program. The one-year program is sometimes offered to senior or graduate students. The academic requirements for this program are identical to the final year of the four-year program. Students in this program will normally attend field training after graduation, for those finishing undergraduate degree requirements, and after one year program attendance, for those in a graduate program.

General Requirements for POC Acceptance. Students competing for acceptance as POC cadets must complete the four-year or two-year program prerequisites, pass the Air Force Officer Qualifying Test, be physically qualified, meet certain age requirements, be in good academic standing, and be able to meet all Air Force enlistment standards.
THE CURRICULUM

**General Military Course (GMC)**

Freshman year: Evolution: The Foundations of the USAF I and II AFSC 110 (fall) and AFSC 111 (spring). Each of these one-credit courses consists of approximately one hour of academic class each week. In combination, these two courses survey the roles of the Department of Defense and the U.S. Air Force in our society.

Sophomore year: U.S. Air/Space Power I and II – AFSC 210 (fall) and AFSC 211 (spring). Each of these one-credit courses consists of approximately one hour of academic class each week. These two GMC courses survey the history of air power from the 18th century to the present.

GMC courses are open to all freshman and sophomore students. Leadership activities are open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the Professor of Aerospace Studies. Leadership activities are scheduled for two hours each week.

**Professional Officer Course (POC)**

Junior year: Leadership Studies I and II — AFSC 310 (fall) and AFSC 311 (spring). Each of these three-credit courses consists of two-and-a-half hours of academic classes each week. Here the student is introduced to leadership and management concepts. The courses are designed to provide a foundation for basic leadership and management skills, with emphasis on communications.

Senior year: National Security Affairs I and II — AFSC 410 (fall) and AFSC 411 (spring). Each of these three-credit courses consists of two-and-a-half hours of academic classes each week. These courses focus on our national security policy—its evolution, actors, processes, and current issues. Emphasis is also given to military professionalism, military justice, and communication skills.

POC courses are open to all juniors and seniors. Leadership activities are open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the Professor of Aerospace Studies. Leadership activities are scheduled for two hours each week.

**Scholarships Available.** The AFROTC College Scholarship Program provides four- to eight-semester scholarships to students on a competitive basis. Scholarships are available in technical and non-technical fields and are based on the whole-person concept and certain age restrictions. Any University of Delaware student may apply for these scholarships. Opportunity for scholarship selection is enhanced by enrolling in AFROTC. Those selected may receive full tuition, lab expenses, incidental and textbook fees, plus a monthly, nontaxable allowance during the school year. Students who accept a scholarship enter the AFROTC program as a contract cadet.

Professional Officer Course Incentive (POC) Scholarships are available for all students who meet certain age and academic requirements and are under contract as a POC cadet. These students receive $1,500 per semester towards tuition, plus $225 per semester for books, plus a monthly stipend. All majors are eligible to receive the POC scholarship.

**Air Force ROTC Nurse Program.** Air Force ROTC makes it possible for qualified nursing school applicants to enroll in its programs and, upon completion of all academic requirements, receive a commission as a Second Lieutenant in the United States Air Force Medical Corps. Four- to eight-semester scholarships are available to highly qualified applicants.

CHEMICAL ENGINEERING

The Department of Chemical Engineering offers a program leading to the Bachelor of Chemical Engineering, including an Honors Degree option, as well as a combined Bachelor's - Master's Program. Chemical Engineering is a combination of biology, chemistry, mathematics and physics with the art and creativity of engineering. The department has much more inclusive descriptions of the profession for those interested.

The curriculum for chemical engineering provides an early start in the discipline. In the first year, the course CHEG 112 applies the student's background in science and mathematics to the solution of several engineering problems. Physical chemistry is introduced earlier than at many other schools, enabling much of the chemical engineering science component to be completed by the end of the third undergraduate year. As a result, the fourth year provides opportunities for in-depth pursuit of technical topics of special interest. A student can choose the three technical electives and the three chemical engineering technical electives to concentrate or minor in a special area. Examples of these concentrations are given below.

The early introduction to the discipline enables the student who has made an inappropriate choice to transfer out of the chemical engineering without loss of status. However, it also makes it difficult for students to transfer into the program during the sophomore or junior years. Students may transfer into Chemical Engineering after completing CHEG 112, CHEM 111, CHEM 112, CHEM 119 (or CHEM 103/104), MATH 242, MATH 243 and PHYS 207. Admission is competitive and is based on the grade point index in the required courses as listed.

**DEGREE: BACHELOR OF CHEMICAL ENGINEERING**

**MAJOR: CHEMICAL ENGINEERING**

<table>
<thead>
<tr>
<th>CURRICULUM</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>ENGL 110 Critical Reading and Writing (minimum grade C)</td>
<td>3.0</td>
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<tr>
<td>UNIVERSITY REQUIREMENTS</td>
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<tr>
<td>ENG 110</td>
<td>Critical Reading and Writing (minimum grade C)</td>
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<td>MAJOR REQUIREMENTS</td>
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<tr>
<td>CHEM 111</td>
<td>General Chemistry</td>
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<tr>
<td>CHEM 119</td>
<td>Quantitative Chemistry I</td>
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<tr>
<td>CHEM 112</td>
<td>General Chemistry</td>
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<tr>
<td>CHEM 443</td>
<td>Physical Chemistry</td>
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<tr>
<td>CHEM 444</td>
<td>Physical Chemistry</td>
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<td>CHEM 445</td>
<td>Physical Chemistry Laboratory I</td>
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<tr>
<td>CHEM 331</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 333</td>
<td>Organic Chemistry Laboratory I [lecture only]</td>
</tr>
<tr>
<td>CHEM 332</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 527</td>
<td>Introductory Biochemistry</td>
</tr>
<tr>
<td>MATH 242</td>
<td>Analytic Geometry and Calculus B</td>
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</tbody>
</table>

Total Credits: 18.0
The purpose of the technical electives is to advance the scientific or engineering background of the chemical engineer. The technical electives program consists of a minimum of nine credits taken from courses in the following list, normally three courses. At least two of these courses (six credits) must be at the intermediate level (generally 300-600). Students should select their technical electives in the spring of their junior year to avoid scheduling conflicts. Students should formulate an academic plan for their technical and chemical engineering electives with the assistance of their academic advisor.

The technical elective program is under constant review by the faculty. An updated list is available in the department office, and a formal mechanism exists to make substitutions for technical electives. The Technical Electives may be coupled with the Chemical Engineering Technical Electives to obtain a technical concentration.

### Biology
- BISC 207 Introductory Biology I
- BISC 208 Introductory Biology II
- BISC 300 Introduction to Microbiology
- BISC 305 Cell Physiology
- BISC 306 General Physiology
- BISC 321 Environmental Biology
- BISC 401 Molecular Biology of the Cell
- BISC 403 Genetic and Evolutionary Biology
- Lab Courses BISC 315, 316, 411, 413
- BISC 4xx Biology course chosen with the approval of the advisor

### Chemistry
- CHEG 595 Patent Law for Engineers and Scientists
- CHEG 333 (1 credit when the 2 credit option is chosen) 334, 438, 446, and 458 may be used as an upper level technical elective.
- CHEM 437 Instrumentation Methods
- CHEM 457 Inorganic Chemistry
- CHEM 527 Introductory Biochemistry
- CHEM 6xx Chemistry course chosen with the approval of the advisor
- CHEM 8xx Chemistry course chosen with the approval of the advisor

### Computer Science
- CISC 105 General Computer Science
- CISC 181 Introduction to Computer Science
- CISC 220 Data Structures
- CISC 260 Machine Organization and Microcomputers
- CISC 280 Programming Development Techniques
- CISC 310 Logic and Programming
- CISC 360 Computer Architecture
- CISC 361 Operating Systems

### Electronic Materials
- CPE 202 Introduction to Digital Systems
- CPE 210 Introduction to Combinational Logic
- CPE 211 Introduction to Sequential Circuits

### Mathematics
- MATH 243 Analytic Geometry and Calculus C
- MATH 302 Ordinary Differential Equations I
- MATH 305 Applied Math for Chemical Engineering
- PHYS 207 Fundamentals of Physics I
- PHYS 208 Fundamentals of Physics II
- MSEG 302 Materials Science for Engineers
- CHEG 009 Chemical Engineering Freshman Seminar
- CHEG 112 Introduction to Chemical Engineering
- CHEG 231 Chemical Engineering Thermodynamics
- CHEG 325 Chemical Engineering Thermodynamics
- CHEG 332 Chemical Engineering Kinetics
- CHEG 341 Fluid Mechanics
- CHEG 342 Process Dynamics and Control
- CHEG 443 Mass Transfer Operations
- CHEG 445 Chemical Engineering Laboratory II
- CHEG 473 Chemical Engineering Projects

### Mechanical Engineering/Industrial Engineering
- MEEG 202 Introduction to Digital Systems
- MEEG 210 Introduction to Combinational Logic
- MEEG 211 Introduction to Sequential Circuits

### Environmental Engineering
- CIEG 431 Water Supply Engineering
- CIEG 432 Wastewater Engineering
- CIEG 433 Hazardous Waste Management
- CIEG 434 Air Pollution Control
- CIEG 435 Industrial Waste Management
- CIEG 436 Solid Waste Management
- CIEG 438 Water and Wastewater Engineering

### Mechanical Engineering/Applied Mathematics
- MEEG 690 Intermediate Engineering Mathematics
- MEEG 691 Advanced Engineering Mathematics

### Mechanics
- CIEG 301 Analysis of Structures
- CIEG 311 Dynamics
- MEEG 112 Statics
- MEEG 211 Dynamics
- MEEG 215 Mechanics of Solids
- MEEG 321 Materials Engineering

### Physics
- PHYS 209 Fundamentals of Physics III
- PHYS 319 Classical Mechanics I
- PHYS 6xx Physics course chosen with the approval of the advisor

### Statistics
- MATH 450 Statistics for the Engineering and Physical Sciences
- STAT 6xx Statistics course chosen with the approval of the advisor

### Chemical Engineering Technical Electives
- ELEG 205 Analog Circuits I
- ELEG 240 Physical Electronics
- ELEG 302 Introduction to Devices and Materials
- ELEG 340 Solid State Electronics
- ELEG 423 Electrical Properties of Matter I

### Materials Science/Engineering
- MSEG 406 Corrosion and Protection
- MSEG 6xx-8xx With approval of advisor
- MEEG 321 Materials Engineering
- MEEG 617 Composite Materials

### Materials Science
- CHEG 445 Hazardous Waste Management
- CHEG 595 Patent Law for Engineers and Scientists

### Concentrations
- The technical electives and the chemical engineering electives can be coupled to provide a more intense concentration in an area of interest. The groupings below are some examples of this approach.

### Biology
- BISC 401 Molecular Biology of the Cell
- CHEM 327 Introductory Biochemistry
- CHEG 620 Biochemical Engineering
- CHEG 650 Biomedical Engineering
- CHEG 667 Metabolic Engineering

### Chemistry
- CHEM 445 Inorganic Chemistry
- CHEM 527 Introductory Biochemistry
- CHEG 606 Introduction to Catalysis
- CHEG 616 Chemistry and Physics of Surfaces and Interfaces
HONORS BACHELOR OF CHEMICAL ENGINEERING

A recipient of the Honors Bachelor of Chemical Engineering must satisfy the following:
1. All requirements for the Bachelor of Chemical Engineering degree.
2. All generic University requirements for the Honors Degree (see page 43). Graduate courses approved for this purpose by the department may be counted as Honors courses.

DEPARTMENTAL STANDARDS

The department has rigorous standards for admission into the courses in the department. These standards have evolved over time and are intended to promote success in the sequential development of the material. In general students must have a minimum grade of C- in all chemical engineering prerequisite courses to qualify for admission to the next course.

Admission to CHEG 112:
1. A minimum grade of C- in MATH 242.
2. Corequisite is MATH 243.

Admission to CHEG 231:
1. A minimum grade of C- in CHEG 112.
2. A minimum grade of C- in MATH 243.

Admission to CHEG 320:
1. A minimum grade of C- in CHEG 112.
2. A minimum grade of C- in MATH 302.

Admission to CHEG 325:
1. A minimum grade of C- in CHEG 231.

Admission to CHEG 332:
1. A minimum grade of C- in CHEG 325.
2. A minimum grade of C- in MATH 305.

Admission to CHEG 341:
1. A minimum grade of C- in CHEG 231.
2. A minimum grade of C- in MATH 302.

Admission to CHEG 342:
1. A minimum grade of C- in CHEG 341.

Admission to CHEG 345:
1. A minimum grade of C- in CHEG 325.
2. A minimum grade of C- in CHEG 332.
3. A minimum grade of C- in CHEG 341.
4. Corequisite is CHEG 342.

Admission to CHEG 401:
1. A minimum grade of C- in CHEG 342.

Admission to CHEG 443:
1. A minimum grade of C- in CHEG 342.

Admission to CHEG 445:
1. A minimum grade of C- in CHEG 345.
2. A minimum grade of C- in CHEG 332.
3. Corequisite is CHEG 443.

Admission to CHEG 452:
1. A minimum grade of C- in CHEG 320.
2. A minimum grade of C- in CHEG 332.
3. A minimum grade of C- in CHEG 443.

Graduation Requirements:
1. A "P" (pass) in CHEG 009.
2. A minimum grade of C- in all other Chemical Engineering courses counted towards graduation.

CHEMICAL ENGINEERING CURRICULUM—MASTER'S-BACHELOR'S PROGRAM

Under unusual circumstances, a highly qualified student may earn a Bachelor of Chemical Engineering and a Master of Chemical Engineering in four years. This program assumes that the student enters with advanced sophomore standing and is able to cope with at least one term of a substantial overload. Interested students should contact the department for further information and a sample schedule. It should be noted that, in order to ensure a broad educational experience, the Department does not admit Delaware undergraduates to its Ph. D. program unless they have at least three years of industrial experience or have earned a master's degree at another institution.

CIVIL AND ENVIRONMENTAL ENGINEERING

The Civil and Environmental Engineering Department offers programs which lead to the degrees of Bachelor of Civil Engineering and Bachelor of Environmental Engineering, both with Honors Degree options, as well as a minor in Civil Engineering.

Traditionally, civil engineering has been identified with the planning and design of constructed facilities such as dams, bridges, buildings, roads, waterways, and tunnels. Modern civil engineering now addresses larger segments of societal infrastructure such as mass transportation systems, water resource exploration and management, environmental protection, coastal management, and off-shore structures. The Civil Engineering curriculum includes specialization options in structural engineering, geotechnical engineering, environmental engineering, hydraulic and ocean engineering, and transportation and construction engineering as shown by the listed Technical Electives.

Areas concerned with pollution control, water supply, and water resource management are now considered to comprise the distinct discipline of Environmental Engineering. The Environmental Engineering curriculum is focused on causes, control, and prevention of environmental contamination, environmental facilities design and construction, and pollution transport and control processes. Each of these degrees is described separately below.

DEPARTMENTAL POLICIES

In general, 300- and 400-level courses in civil engineering are open only to students majoring in civil or environmental engineering. Students who have declared a civil engineering minor and students enrolled in other departments of the College of Engineering may be enrolled in 300 and 400-level civil engineering courses with the approval of their home department advisor. In some instances, other students may be permitted to enroll in selected 300 and 400-level courses, but they must have the permission of both the course instructor and the chair of the Civil and Environmental Engineering Department.

The Department has developed standards that require minimum grades in certain courses. These standards are intended to promote success in the sequential development of the curriculum. The requirements for the civil and environmental engineering majors are as follows:

Civil Engineering

Admission to 300- and 400-level civil engineering and mechanics courses requires:
1. A minimum grade of C- in MATH 241 and MATH 242.
2. A minimum grade of C- in CHEM 103.
3. A minimum grade of C- in PHYS 207.
Environmental Engineering

Admission to 300- and 400-level civil engineering and mechanics courses requires:
1. A minimum grade of C- in MATH 241 and MATH 242.
2. A minimum grade of C- in CHEM 111 and CHEM 112.
3. A minimum grade of C- in PHYS 207.

Admission to CHEG 231 requires:
1. A minimum grade of C- in MATH 243.

Admission to CHEG 325 requires:
1. A minimum grade of C- in CHEG 231.
2. A minimum grade of C- in MATH 302.

Admission to CHEG 342 requires:
1. A minimum grade of C- in CHEG 305 and CHEG 306.

Admission to CHEG 342 requires:
1. A minimum grade of C- in MATH 241 and MATH 242.

Note: Students who begin in MATH 241 but do not have credit for MATH 241 may use four free elective credits in place of the four credits for MATH 241.

TECHNICAL ELECTIVES

The required course curriculum gives students a broad introduction to all the major areas of civil engineering offered by the program: Structural and Geotechnical Engineering, Environmental Engineering and Water Resources, Hydraulics and Ocean Engineering, and Transportation and Construction Engineering.

In addition, three technical elective courses in the Civil Engineering curriculum give students the opportunity to complete their education by concentrating in an area of special interest. The technical electives can also be chosen to provide a more general civil engineering education.

The following is a list of departmental technical electives approved for a concentration in one of the above mentioned areas or in general civil engineering. Some of these courses may not be offered on a particular year. A current list is available in the department office. Some courses offered in other departments may also be approved as technical electives. Students should check with their advisors before selecting courses.

Environmental and Water Resource Engineering

CIEG 320 Soil Mechanics
CIEG 323 Soil Mechanics Laboratory
CIEG 321 Geotechnical Engineering
CIEG 451 Senior Design Project
CIEG 482 System Design and Operation
CIEG 302 Structural Design
CIEG 440 Water Resources Engineering

Technical Electives

Three courses giving a total of at least three additional design points must be taken; see current department technical elective listing. This technical elective program is under constant review by the faculty. An updated list is available in the department office. Students should check with their advisors before selecting courses and be aware that a formal mechanism exists to provide additional flexibility in the selection of their technical elective courses.

CREDITS TO TOTAL A MINIMUM OF ...........................................126

Note: Students who begin in MATH 241 but do not have credit for MATH 241 may use four free elective credits in place of the four credits for MATH 241.
Undergraduate CIVIL and ENVIRONMENTAL ENGINEERING • Engineering

CIEG 408 Introduction to Bridge Design
CIEG 409 Forensic Engineering
CIEG 410 Experimental Mechanics of Composite Materials
CIEG 411 Structural Dynamics Design
CIEG 417 Advanced Structural Analysis
CIEG 418 Continuously Supported Structures
CIEG 422 Earth Structures Engineering
CIEG 425 Geoenvironmental Engineering
CIEG 459 Railroad Engineering
CIEG 486 Construction Management and Methods

Transportation and Construction Engineering
CIEG 452 Transportation Facilities Design
CIEG 454 Urban Transportation Planning
CIEG 459 Railroad Engineering
CIEG 486 Construction Management and Methods
GEOG 328 Transportation Geography
STAT 420 Data Analysis and Nonparametric Statistics

Honors Bachelor of Civil Engineering
A recipient of the Honors Bachelor of Civil Engineering must satisfy the following:

1. All requirements for the Bachelor of Civil Engineering degree.
2. All generic University requirements for the Honors Degree (see p. 43). Graduate courses approved for this purpose by the department may be counted as Honors courses.
3. The Honors Thesis must be within the disciplines of Civil and Environmental Engineering. It must be supervised by a faculty member from the Department of Civil and Environmental Engineering and successfully presented orally in front of a committee approved by the department Undergraduate Committee.

Minor in Civil Engineering
A minor in civil engineering may be earned by a student in any University bachelor’s degree program through successful completion of a minimum of 21 credits in civil engineering and engineering mechanics. Before beginning the civil engineering courses, the student must meet the required mathematics and physics prerequisites. A grade of C- or better is required in all of the courses completed for the minor.

The required civil engineering and engineering mechanics courses are the following:
CIEG 211 Statics ........................................... 3
CIEG 212 Solid Mechanics (Lab optional) ............ 3
CIEG 311 Dynamics ....................................... 3
CIEG 305 Fluid Mechanics (Lab optional) ............ 3

Further, an additional 9 credits (3 courses) in civil engineering must be taken of which at least 6 credits must be at the 300-level or higher. These courses should be selected with the specific advice of an advisor in the Civil and Environmental Engineering Department to meet each student’s objectives. For students oriented toward earth sciences these might include CIEG 320, 323 and 321; for those interested in the environment, CIEG 233 and 331; for those interested in urban topics, CIEG 331 and 351; for those with interests in construction and structures, CIEG 301 and 302; for those interested in the oceans, CIEG 440 and 471.

Accomplishment of a minor in civil engineering has many advantages for students who are earning degrees in other sciences such as geology or in other professional areas such as business administration, but it must be understood that meeting the requirements for a minor in civil engineering without fulfilling the remaining requirements for an accredited engineering degree does not provide the breadth and depth of knowledge required to be a civil engineer.

Degree: Bachelor of Environmental Engineering Major: Environmental Engineering

Curriculum

Credits

Superior figures indicate semester (fall or spring) and/or year or years in which the course should be taken, i.e. Ifall of freshman year, Sspring of sophomore year, etc.

University Requirements
ENGL 110 Critical Reading and Writing
(minimum grade C-). ................................................ 3.0

Major Requirements

General Education Program 18-1-4
See pp. 164-165: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 57).

ENG 410 Technical Writing .................................................. 3.0
CHEM 111 General Chemistry .................................................. 3.0
CHEM 119 Quantitative Chemistry I ........................................ 3.0
CHEM 112 General Chemistry .................................................. 3.0
MATH 241 Analytic Geometry and Calculus A .................................. 4.0
MATH 242 Analytic Geometry and Calculus B .................................. 4.0
MATH 243 Analytic Geometry and Calculus C .................................. 4.0
PHYS 107 Fundamentals of Physics I .................................................. 4.0
BISC 301 Environmental Biology .................................................. 3.0
CISC 106 General Computer Science for Engineers .................................. 3.0
MATH 450 Statistics for Engineering and Physical Sciences .................................. 3.0
CHEG 321 Chemical Engineering Thermodynamics .................................. 3.0
CHEG 325 Chemical Engineering Thermodynamics .................................. 3.0
CIEG 305 Fluid Mechanics .................................................. 3.0
CIEG 306 Fluid Mechanics Laboratory .................................................. 3.0
CIEG 344 Air Pollution Control .................................................. 3.0
CIEG 353 Introduction to Environmental Engineering .................................. 3.0
CIEG 211 Statics .................................................. 3.0
CIEG 212 Solid Mechanics .................................................. 3.0
CIEG 213 Solid Mechanics Laboratory .................................................. 3.0
CIEG 239 Environmental Engineering Processes .................................. 3.0
CIEG 337 Environmental Engineering Laboratory .................................. 3.0
CIEG 348 Water and Wastewater Engineering .................................. 3.0
CIEG 347 Water & Wastewater Quality .................................................. 3.0
CIEG 436 Solid Waste Management .................................................. 3.0
CIEG 440 Water Resources Engineering .................................................. 3.0
CIEG 461 Senior Design Project .................................................. 3.0
CIEG 461 Senior Design Project .................................................. 3.0
Earth Science Elective .................................................. 3.0

One course taken at the 300-level or above from geology, soil science, or hydrology

Technical Electives 18-3.4
Six courses chosen from the current list of approved technical electives.
The technical elective program is under constant review by the faculty. An updated list is available in the department office. Students should check with their advisors before selecting courses and should be aware that a formal mechanism exists to provide additional flexibility in the selection of their technical elective courses.

Credits to Total a Minimum of .................................................. 126

Technical Electives
Six courses, totaling eighteen credit hours, are provided to allow the student flexibility at the intermediate and advanced levels of the program. An area of concentration is first determined, defined by a set of specific core technical electives as given below. The remaining technical electives can then be chosen to further pursue this direction of study, or to provide a more diversified environmental engineering education. All technical electives must be upper level courses in engineering, the sciences, computer science, or mathematics. Students should select their area of concentration and desired technical electives with the assistance of their academic advisor. It is advisable to select these courses in the spring of the sophomore year to avoid scheduling conflicts and to insure that prerequisite courses are taken.

The core technical electives and additional technical electives for the environmental engineering concentrations are shown below.
Environmental Facilities Design and Construction

Required Technical Electives
- CIEG 301 Structural Analysis
- CIEG 302 Structural Design
- CIEG 320 Soil Mechanics
- CIEG 323 Soil Mechanics Laboratory

Pollution Transport and Control Processes

Required Technical Electives
- CIEG 322 Chemical Engineering Kinetics
- CIEG 342 Heat and Mass Transfer
- CHEM 443 Physical Chemistry I

Environmental Biotechnology

Required Technical Electives
- CHEM 331 Organic Chemistry
- CHEM 333 Organic Chemistry Lab
- FSL 319 Environmental Soil Microbiology
- BISC 300 Introduction to Microbiology
- CHEM 342 Introduction to Biochemistry

Additional Recommended Technical Electives
- CHEM 444 Physical Chemistry
- CIEG 371 Geotechnical Engineering
- CIEG 407 Building Design
- CIEG 433 Hazardous Waste Management
- CIEG 482 Systems Design and Operation
- GEO 421 Environmental and Applied Geology
- GEO 446 General Geochemistry
- MSEG 424 Air Pollution Processes
- MSEG 302 Materials Science
- PLSC 608 Soil Chemistry
- BISC 301 Molecular Biology of Cells
- CIEG 311 Molecular Biology for Engineers
- BISC 641 Microbial Ecology
- CIEG 636 Biological Aspects of Environmental Engineering
- PLSC 619 Soil Microbiology

Note: This list is not exhaustive. Consult your advisor.

HONORS BACHELOR OF ENVIRONMENTAL ENGINEERING

A recipient of the Honors Bachelor of Environmental Engineering must satisfy the following:
1. All requirements for the Bachelor of Environmental Engineering degree.
2. All generic University requirements for the Honors Degree (see page 43). Graduate courses approved for this purpose by the department may be counted as Honors courses.
3. The Honors Thesis must be within the disciplines of Civil and Environmental Engineering and successfully presented orally in front of a committee approved by the department.

DEPARTMENTAL REQUIREMENTS

To qualify for sophomore standing, students must have satisfactorily completed MATH 241, MATH 242, CISC 181, PHYS 207, and CPEG 202 by the end of the summer session of their freshman year. With few exceptions, students are expected to complete this program in eight regular semesters. With electrical and computer engineering courses being offered only once each year, it is imperative that students follow as closely as possible the course sequences outlined below.

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www.ece.udel.edu

DEGREE: BACHELOR OF ELECTRICAL ENGINEERING
MAJOR: ELECTRICAL ENGINEERING

CREDITS

See p. 164: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 57). ECON 151 is also required within the General Education program.

ENGL 110 Critical Reading and Writing (minimum grade C) 3 credits

DEGREES: BACHELOR OF ELECTRICAL ENGINEERING

CURRICULUM

Major: Electrical Engineering

ENGL 110 Critical Reading and Writing 3 credits
MATH 241 Analytic Geometry and Calculus A 4 credits
MATH 242 Analytic Geometry and Calculus B 4 credits
MATH 243 Analytic Geometry and Calculus C 4 credits
MATH 341 Differential Equations with Linear Algebra I 3 credits
MATH 342 Differential Equations with Linear Algebra II 3 credits
CSCG 301 General Chemistry 4 credits
PHYS 207 Fundamentals of Physics I 4 credits
PHYS 208 Fundamentals of Physics II 4 credits
CISC 105 Introduction to Computer Science I 3 credits
CISC 181 Introduction to Computer Science II 3 credits
CISC 230 Data Structures 3 credits
CPEG 202 Introduction to Digital Systems 3 credits
CPEG 222 Microprocessor Based Systems 3 credits
ELEG 205 Analog Circuits I 3 credits
ELEG 212 Signals and Communications 3 credits
ELEG 240 Physical Electronics 3 credits
ELEG 305 Signal Processing I 3 credits
ELEG 309 Electronic Circuit Analysis I 3 credits
ELEG 310 Random Signals and Noise 3 credits
ELEG 340 Solid State Electronics 3 credits
ELEG 370 Engineering Electromagnetics 3 credits

Design Requirement 4 credits

In addition to the content of the normal program, every student must take at least four credits in ELEG courses designated as "design." Regularly offered design courses include ELEG 410, ELEG 430, ELEG 438, and ELEG 439. Other courses may be offered irregularly which satisfy the design requirement. Students should consult with their advisors before selecting their design course or courses.
HONORS BACHELOR OF ELECTRICAL ENGINEERING

A recipient of the Honors Bachelor of Electrical Engineering must satisfy the following:
1. All requirements for the Bachelor of Electrical Engineering degree.
2. All generic University requirements for the Honors Degree (see page 43). Graduate courses approved for this purpose by the department may be counted as Honors courses.

DEGREE: BACHELOR OF COMPUTER ENGINEERING

MAJOR: COMPUTER ENGINEERING

Superior figures indicate semester (fall or spring) and/or year or years in which the course should be taken, i.e. Fall of freshman year, Spring of sophomore year, etc.

CURRICULUM

UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C) 3

MAJOR REQUIREMENTS

General Education Program 18

See p. 164: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 57). ECON 151 is also required within the General Education program.

ENGL 301 Expository Writing 3

MATH 241 Analytical Geometry and Calculus A 4

MATH 242 Analytical Geometry and Calculus B 4

MATH 243 Analytical Geometry and Calculus C 4

MATH 341 Differential Equations & Linear Alg I 3

MATH 342 Differential Equations & Linear Alg II 3

PHYS 207 Fundamentals of Physics 4

PHYS 208 Fundamentals of Physics 4

CHEM 103 General Chemistry 4

CISC 105 General Computer Science 4

CISC 181 Introduction to Computer Science I 3

CISC 220 Data Structures 3

CISC 361 Operating Systems 3

Students with adequate programming experience may substitute the CISC 181, CISC 220 and CISC 280 sequence for the CISC 105, CISC 181 and CISC 220 sequence.

CREDITS TO TOTAL A MINIMUM OF 125

HONORS BACHELOR OF COMPUTER ENGINEERING

A recipient of the Honors Bachelor of Computer Engineering must satisfy the following:
1. All requirements for the Bachelor of Computer Engineering degree.
2. All generic University requirements for the Honors Degree (see page 43). Graduate courses approved for this purpose by the department may be counted as Honors courses.

MATERIALS SCIENCE AND ENGINEERING

Although the Materials Science and Engineering Department offers no degrees at the undergraduate level, undergraduate students study the basic concepts associated with the engineering properties of materials in undergraduate courses taught by the Materials Science and Engineering faculty. In addition, the College offers a minor in materials science, and all engineering departments offer senior projects concerned with the properties of materials. These technical elective courses are strongly recommended for students intending later to pursue Master’s or Doctoral degrees in Materials Science and Engineering.

Telephone: (302) 831-2062
E-mail: matsci@udel.edu

REALIZED REQUIREMENTS FOR A MINOR IN MATERIALS SCIENCE

A minor in materials science requires the completion of 15 credits with a minimum grade of C- in all courses. MSEG 302 is a required course, and the remaining may be drawn from a wide variety of materials science, engineering, physics, and chemistry courses up to the 600-level. All courses used to fulfill the requirements of the minor must be approved by a materials science advisor. A listing of commonly offered courses is maintained by the Chair of the Materials Science and Engineering Department. Other materials courses may be approved as appropriate. For further information, contact the Materials Science and Engineering Department at 302-831-2062.

MECHANICAL ENGINEERING

The Department of Mechanical Engineering offers an ABET-accredited program leading to the Bachelor of Mechanical Engineering, including a University of Delaware Honors Degree Option. Mechanical engineers receive one of the broadest educations of any of the modern engineering disciplines and consequently are well prepared to apply basic engineering principles to a wide variety of society’s needs.

The educational program is structured around a basic core program that will enable the Bachelor of Mechanical Engineering graduate to follow many career paths, including research, development, design, production, maintenance, management, patent law, or education. The curriculum also allows a student to select engineering fields of particular interest for study, such as aerospace, materials, biomechanics, controls, design and systems, robotics, energy, and fluids.

The degree program is designed to serve not only those students who go into industry or government directly after the B.M.E. degree, but also those who go on to a graduate program in engineering or continue their education in other professions such as medicine, law
DEGREE: BACHELOR OF MECHANICAL ENGINEERING
MAJOR: MECHANICAL ENGINEERING

MAJOR REQUIREMENTS

General Education Program

See pp. XXX-XXX: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. XX). All students must take the following course:

MAE 101 / MEEG 101 Critical Reading and Writing (minimum grade C) 3

MAJOR REQUIREMENTS

Technical Electives

Technical electives in the senior year of the Bachelor of Mechanical Engineering curriculum provide the student with an opportunity to pursue areas of particular interest. The technical electives are taken after much of the basic engineering science has been mastered and comprise four coordinated courses (a minimum of 12 credits).

Students can choose towards the end of sophomore or early junior year to pursue one of two concentrations: Aerospace or Biomedical Engineering to focus their upperclass studies. For those pursuing the degree without a concentration, there are three suggested focus areas: Fluids and Thermal Engineering, Solid Mechanics and Materials, and Design (Dynamic Design and Manufacturing).

Required Course

Two of the following three-credit courses must also be taken:

MEEG 482 Clinical Biomechanics 3
MEEG 483 Orthopaedic Biomechanics 3
MEEG 484 Biomaterials and Tissue Engineering 3
MEEG 612 Biomechanics of Human Movement 3

Independent study, Senior Research and additional courses for satisfying this requirement can be approved by the Department.

DEGREE: BACHELOR OF MECHANICAL ENGINEERING
CONCENTRATION: BIOMEDICAL ENGINEERING

Students may add this Concentration to their Bachelor of Mechanical Engineering Major starting as early as the end of their sophomore year. To qualify for a Concentration in Biomedical Engineering, Mechanical Engineering students must complete all requirements for the Bachelor of Mechanical Engineering degree. In addition, the student is required to complete at least 13 credits in accord with the following requirements. (Note that all of these courses may also be used to satisfy technical elective requirements for the BME degree.)

MAJOR REQUIREMENTS

Basic Biology Courses

All students must take two courses in basic biology such as:

CURIUM CREDITS
HESC 220 Anatomy and Physiology 3
HESC 420 Functional Human Anatomy 4

Advanced courses in Biomedical Engineering

Two of the following three-credit courses must also be taken:

MEEG 482 Clinical Biomechanics 3
MEEG 483 Orthopaedic Biomechanics 3
MEEG 484 Biomaterials and Tissue Engineering 3
MEEG 612 Biomechanics of Human Movement 3

 Required Course

All students must take the following course:

MEEG 432 Aerodynamics 3

Advanced courses in Aerospace Engineering

Three of the following three-credit courses must also be taken:

MEEG 411 Structural Mechanics for Mechanical and Aerospace Engineering 3
MEEG 423 Vibrations 3
MEEG 441 Combustion 3
MEEG 481 Computer Solution of Engineering Problems 3
MEEG 624 Control of Dynamic Systems 3
CIEG 401 Introduction to the Finite Element Method 3

* Independent study, Senior Research and additional courses for satisfying this requirement can be approved by the Department.
HONORS BACHELOR OF MECHANICAL ENGINEERING
A recipient of Honors Bachelor of Mechanical Engineering must satisfy the following:
1. All requirements for the Bachelor of Mechanical Engineering degree.
2. All generic University requirements for the Honors Degree (see page 43) Graduate courses approved for this purpose by the department may be counted as Honors courses.

ARTS AND SCIENCE
ENGINEERING DOUBLE DEGREE

The Arts and Science–Engineering program is a five-year curriculum which leads to a Bachelor of Arts from the College of Arts and Science and a Bachelor of Chemical, Civil, Computer, Electrical, Environmental, or Mechanical Engineering from the College of Engineering. Students who elect to complete this program must fulfill all the requirements of their four-year engineering major as well as a minimum of 30 additional credit hours in Arts and Science courses. Within these 30 credits, students must complete the college-level requirements of the College of Arts and Science and earn 15 credits of electives in an Arts and Science area of concentration. All elective courses are chosen in consultation with advisors in both colleges so as to take every advantage of situations where a course can fulfill requirements of both the Engineering and Arts and Science degrees.

Students who wish to pursue the five-year Arts and Science–Engineering program must be initially admitted to a major within the College of Engineering. Engineering students who are interested in this special curriculum should meet with the Assistant Dean during their first year because it may not be possible to complete this curriculum in five years if the change is made after the freshman year. Once admitted to the five-year curriculum, a student may switch back to a normal four-year Engineering program or change to an Arts and Science major for which they are academically qualified.

Area of Concentration. The 15 credit hours which compose the Arts and Science area of concentration are chosen by the student in order to acquire some depth of knowledge in a particular field. In most cases, these 15 credits will not be sufficient to complete a major in an Arts and Science department. An Arts-Engineering student whose Arts and Science area of concentration falls short of the requirements for a specific major will graduate with a Bachelor of Arts from the College of Arts and Science. With careful planning, however, it is sometimes possible to obtain a second major in Arts and Science by taking more than the minimum of 30 credit hours or by specializing in a scientific or mathematical field which has a number of course requirements in common with the engineering major.

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DEGREE: BACHELOR OF ARTS
—BACHELOR OF [CHEMICAL, CIVIL, COMPUTER, ELECTRICAL, ENVIRONMENTAL, OR MECHANICAL] ENGINEERING

MAJOR: NONE REQUIRED—[CHEMICAL, CIVIL, COMPUTER, ELECTRICAL, ENVIRONMENTAL, OR MECHANICAL] ENGINEERING

CURRICULUM

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<th>CREDITS</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>ENGL 110 Critical Reading and Writing (minimum grade C-)</td>
<td>3</td>
</tr>
<tr>
<td>Three credits in an approved course or courses stressing multicultural, ethnic, and/or gender-related content (see p. 57) These credits may also fulfill some of the breadth requirements.</td>
<td>3-4</td>
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UNIVERSITY REQUIREMENTS

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<th>CREDITS</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>FOREIGN LANGUAGES Completion of the intermediate level course [107 or 112] in a given language. Students with four or more years of high school work in a single foreign language may attempt to fulfill the requirement in that language by taking an examination exemption.</td>
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BREADTH REQUIREMENTS (See page 85)

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<th>CREDITS</th>
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<tbody>
<tr>
<td>WRITING (minimum grade C-)</td>
<td>3</td>
</tr>
<tr>
<td>A three-credit writing course involving significant writing experience including two papers with a combined minimum of 3,000 words to be submitted for extended faculty critique of both composition and content. These credits may also fulfill some of the breadth requirements. (See list of courses approved for second writing requirement, page 83.)</td>
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</tr>
</tbody>
</table>

FOREIGN LANGUAGE Completion of the intermediate level course [107 or 112] in a given language. Students with four or more years of high school work in a single foreign language may attempt to fulfill the requirement in that language by taking an examination exemption.

Area of Concentration: The 15 credit hours which compose the Arts and Science area of concentration are chosen by the student in order to acquire some depth of knowledge in a particular field. In most cases, these 15 credits will not be sufficient to complete a major in an Arts and Science department. An Arts-Engineering student whose Arts and Science area of concentration falls short of the requirements for a specific major will graduate with a Bachelor of Arts from the College of Arts and Science. With careful planning, however, it is sometimes possible to obtain a second major in Arts and Science by taking more than the minimum of 30 credit hours or by specializing in a scientific or mathematical field which has a number of course requirements in common with the engineering major.

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ENGINEERING COLLEGE REQUIREMENTS

For a degree in the College of Engineering, the student must fulfill all the requirements of the chosen engineering major, including the College of Engineering General Education Program. Requirements for degrees in each of the engineering disciplines are described earlier in this chapter.

CREDITS TO TOTAL A MINIMUM OF 152-158
Minimum total credit hours will vary, dependent upon the engineering major selected.