The College of Engineering offers baccalaureate degrees in chemical, civil, environmental, electrical, computer, and mechanical engineering and minors in civil engineering and in materials science. The College of Engineering and the College of Arts and Science also offer a joint five-year program which leads to a bachelor's degree in one of the engineering majors as well as a bachelor's degree from the College of Arts and Science (see page 170). Additionally, the College of Engineering and the College of Business and Economics offer a joint five-year program which leads to a baccalaureate degree in an engineering major and a Master of Business Administration degree from the College of Business and Economics. Inquiry should be made to the Assistant Dean for Undergraduate Affairs (200 Academy Street, 302-831-8659) by March 1 of the sophomore year of engineering study. The University's Air Force ROTC program is also administered through the College of Engineering.

In addition to academic programs, the College of Engineering also maintains the Resources to Insure Successful Engineers (RISE) Program. RISE provides financial assistance, counseling, and social support to students from minority groups who are underrepresented in engineering. The program begins with a pre-freshman Summer Academy and continues to graduation. Interested individuals should contact the Assistant Dean and Director of the RISE Program at 302-831-6315.

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.

**CURRICULUM ORGANIZATION**

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 courses 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.

**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.
The Air Force Reserve Officer Training Corps (AFROTC) provides completions as Second Lieutenants in the United States Air Force while completing their University course requirements. Commissioning entrance in the Fall semester or by November 15 for entrance in the Spring semester. The student should contact the department office before beginning the application process.

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 57) 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 (200 Academy Street, 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. Questions concerning applicant qualifications should be directed to the unit's admission officer.

Telephone: (302) 831-2863
http://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 four weeks of 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.

**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 GMC courses survey the history of air power from the 18th century to the present.

GMC courses are open to all freshmen 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 nontechnical 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 $200 monthly, nontaxable allowance during the school year. Students who accept a scholarship enter the AFROTC program as a contract cadet.

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

| Telephone: (302) 831-2399 |
| E-mail: zydey@che.udel.edu |
| http://www.che.udel.edu |

DEGREE: BACHELOR OF CHEMICAL ENGINEERING

MAJOR: CHEMICAL ENGINEERING

CURRICULUM

Credits
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.

UNIVERSITY REQUIREMENTS

English 110: Critical Reading and Writing (minimum grade C) 3 F

MAJOR REQUIREMENTS

General Education Program

See pp. 161-162: College General Education Program

General Education Program

An additional three-credit general education course must be taken in the humanities or social sciences. Furthermore, three of the general education courses (minimum of nine credits) must be in the same department or program, and at least one of these three courses must be above the introductory level. Courses classified as "Group D" by the College of Arts and Science may not be used to fulfill this requirement. One of the General Education courses must fulfill the University multicultural requirement (see p. 57).

CHEM 111 General Chemistry 3 F
CHEM 119 Quantitative Chemistry I 2 F
CHEM 112 General Chemistry 3 F
CHEM 443 Physical Chemistry I 2 F
CHEG 444 Physical Chemistry I 2 F
CHEG 445 Physical Chemistry Laboratory I 1 F
CHEM 311 Organic Chemistry 3 F
CHEM 333 Organic Chemistry Laboratory I (lecture only) 1 F
CHEM 332 Organic Chemistry 3 F

MATH 242 Analytic Geometry and Calculus B 4 F
MATH 243 Analytic Geometry and Calculus C 4 F
MATH 302 Ordinary Differential Equations I 3 F
MATH 305 Applied Math for Chemical Engineering 3 F

PHYS 207 Fundamentals of Physics I 4 F
PHYS 208 Fundamentals of Physics II 4 F

MSEG 302 Materials Science for Engineers 4 F

CHEG 009 Chemical Engineering Freshman Seminar 0 F
CHEG 112 Introduction to Chemical Engineering 3 F
CHEG 231 Chemical Engineering Thermodynamics 3 F
CHEG 325 Chemical Engineering Thermodynamics 4 F
CHEG 332 Chemical Engineering Kinetics 3 F
CHEG 341 Fluid Mechanics 3 F
CHEG 320 Engineering Economics and Risk Assessment 2 F
CHEG 342 Heat and Mass Transfer 4 F
CHEG 345 Chemical Engineering Laboratory I 3 F
CHEG 401 Chemical Process Dynamics and Control 4 F
CHEG 443 Mass Transfer Operations 3 F
CHEG 445 Chemical Engineering Laboratory II 3 F
CHEG 473 Chemical Engineering Projects 3 F

Can be substituted for CHEG 445 with advisor's approval. This option is only available for students who received a minimum grade of B in CHEG 345. Not that UNIV 401-402 is equivalent to CHEG 473-474.

CHEG 432 Chemical Process Analysis 3 F

Technical Electives

General Technical Electives

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 one of these courses (six credits) must be at the intermediate level (generally 300-600). Students should select their technical electives in the spring of sophomore 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 301/311 Molecular Biology of the Cell
Chemical Engineering Technical Electives

The curriculum provides three chemical engineering technical electives in the senior year. These courses are intended to provide some flexibility in selecting a chemical engineering program at the advanced level. Students should decide with the assistance of their advisor if they should conduct a program of independent research and then choose their course elective(s).

Chemical engineering technical electives are defined as follows:
- Any Chemical Engineering course numbered 466 to 474; UNIV 401-UNIV 402 Senior Thesis directed by a Chemical Engineering Faculty; any 600- or 800-level course in Chemical Engineering. Courses at the 600 and 800-level are graduate courses open, with the consent of the instructor, to students with senior standing.

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 301  Molecular Biology of the Cell
- CHEG 527  Introductory Biochemistry
- CHEG 620  Biochemical Engineering
- CHEG 650  Biomedical Engineering

Chemistry

- CHEG 457  Inorganic Chemistry
- CHEG 527  Introductory Biochemistry
- CHEG 606  Introduction to Catalysis
- CHEG 617  Colloid Science and Engineering
- CHEG 636  Advanced Chemical Kinetics

CREDITS TO TOTAL A MINIMUM OF 128

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 for CHEG 112 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 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) Admission to 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) Admission to CHEG 443.

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

Admission to CHEG 432:
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.

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.

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.

Graduation Requirements:
1) A minimum grade of C- in MATH 241 and MATH 242.
2) A minimum grade of C- in MATH 302.

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.

UNDERGRADUATE  CIVIL AND ENVIRONMENTAL ENGINEERING  •  ENGINEERING
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 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

Note: Students who begin in MATH 242 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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIEG 305</td>
<td>Fluid Mechanics</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 306</td>
<td>Fluid Mechanics Laboratory</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 121</td>
<td>Statics</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 311</td>
<td>Dynamics</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 312</td>
<td>Solid Mechanics Laboratory</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 320</td>
<td>Soil Mechanics</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 323</td>
<td>Soil Mechanics Laboratory</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 407</td>
<td>Senior Design Project</td>
<td>4.0</td>
</tr>
<tr>
<td>CIEG 482</td>
<td>System Design and Operation</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 302</td>
<td>Structural Design</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 440</td>
<td>Water Resources Engineering</td>
<td>3.5</td>
</tr>
</tbody>
</table>

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 should be aware that a formal mechanism exists to provide additional flexibility in the selection of their technical elective courses.

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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIEG 401</td>
<td>Introduction to the Finite Element Method</td>
<td></td>
</tr>
<tr>
<td>CIEG 407</td>
<td>Building Design</td>
<td></td>
</tr>
<tr>
<td>CIEG 409</td>
<td>Forensic Engineering</td>
<td></td>
</tr>
<tr>
<td>CIEG 429</td>
<td>Water and Wastewater Engineering</td>
<td></td>
</tr>
<tr>
<td>CIEG 402</td>
<td>Transportation Facilities Design</td>
<td></td>
</tr>
<tr>
<td>CIEG 471</td>
<td>Introduction to Coastal Engineering</td>
<td></td>
</tr>
<tr>
<td>CIEG 486</td>
<td>Construction Management and Methods</td>
<td></td>
</tr>
<tr>
<td>BISC 371</td>
<td>Introduction to Microbiology</td>
<td></td>
</tr>
<tr>
<td>BISC 691</td>
<td>Environmental and Applied Geology</td>
<td></td>
</tr>
<tr>
<td>BSEG 428</td>
<td>Hydrology</td>
<td></td>
</tr>
<tr>
<td>CIEG 401</td>
<td>Introduction to the Finite Element Method</td>
<td></td>
</tr>
<tr>
<td>CIEG 407</td>
<td>Building Design</td>
<td></td>
</tr>
<tr>
<td>CIEG 429</td>
<td>Earth Structures Engineering</td>
<td></td>
</tr>
<tr>
<td>CIEG 437</td>
<td>Water and Wastewater Quality</td>
<td></td>
</tr>
<tr>
<td>CIEG 471</td>
<td>Introduction to Coastal Engineering</td>
<td></td>
</tr>
<tr>
<td>CIEG 486</td>
<td>Construction Management and Methods</td>
<td></td>
</tr>
<tr>
<td>CIEG 492</td>
<td>Transportation Facilities Design</td>
<td></td>
</tr>
<tr>
<td>CIEG 493</td>
<td>Urban Transportation Planning</td>
<td></td>
</tr>
<tr>
<td>CIEG 495</td>
<td>Railroad Engineering</td>
<td></td>
</tr>
<tr>
<td>CIEG 498</td>
<td>Construction Management and Methods</td>
<td></td>
</tr>
<tr>
<td>BSEG 432</td>
<td>Transportation Geography</td>
<td></td>
</tr>
<tr>
<td>STAT 420</td>
<td>Data Analysis and Nonparametric Statistics</td>
<td></td>
</tr>
</tbody>
</table>

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. Those courses shall 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.

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**DEGREE: BACHELOR OF ENVIRONMENTAL ENGINEERING**

**MAJOR: ENVIRONMENTAL ENGINEERING**

**CURRICULUM**

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 110 Critical Reading and Writing (minimum grade C)</td>
<td>3</td>
</tr>
</tbody>
</table>

**UNIVERSITY REQUIREMENTS**

See pp. 161-162: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 57).

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 410 Technical Writing</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 111 General Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 119 Quantitative Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 112 General Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>MATH 241 Analytic Geometry and Calculus A</td>
<td>4</td>
</tr>
<tr>
<td>MATH 242 Analytic Geometry and Calculus B</td>
<td>4</td>
</tr>
<tr>
<td>MATH 243 Analytic Geometry and Calculus C</td>
<td>4</td>
</tr>
<tr>
<td>MATH 302 Ordinary Differential Equations</td>
<td>2.5</td>
</tr>
<tr>
<td>PHYS 207 Fundamentals of Physics I</td>
<td>4</td>
</tr>
<tr>
<td>BISC 321 Environmental Biology</td>
<td>3</td>
</tr>
<tr>
<td>CISC 106 General Computer Science for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>MATH 450 Statistics for Engineering and Physical Sciences</td>
<td>3.5</td>
</tr>
<tr>
<td>CHEG 231 Chemical Engineering Thermodynamics</td>
<td>3.5</td>
</tr>
<tr>
<td>CHEG 232 Chemical Engineering Thermodynamics</td>
<td>3.5</td>
</tr>
<tr>
<td>CHEG 305 Fluid Mechanics</td>
<td>3.5</td>
</tr>
<tr>
<td>CHEG 306 Fluid Mechanics Laboratory</td>
<td>3.5</td>
</tr>
<tr>
<td>CHEG 434 Air Pollution Control</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 135 Introduction to Environmental Engineering</td>
<td>1</td>
</tr>
<tr>
<td>CIEG 211 Statics</td>
<td>2.5</td>
</tr>
<tr>
<td>CIEG 212 Solid Mechanics</td>
<td>2.5</td>
</tr>
<tr>
<td>CIEG 213 Solid Mechanics Laboratory</td>
<td>2.5</td>
</tr>
<tr>
<td>CIEG 233 Environmental Engineering Processes</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 337 Environmental Engineering Laboratory</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 430 Water &amp; Wastewater Engineering</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 437 Water &amp; Wastewater Quality</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 436 Solid Waste Management</td>
<td>3.5</td>
</tr>
<tr>
<td>CIEG 440 Water Resources Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CIEG 461 Senior Design Project</td>
<td>2.5</td>
</tr>
<tr>
<td>CIEG 461 Senior Design Project</td>
<td>2.5</td>
</tr>
<tr>
<td>Earth Science Elective</td>
<td>3.5</td>
</tr>
</tbody>
</table>

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

**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**

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIEG 301 Structural Analysis</td>
<td></td>
</tr>
<tr>
<td>CIEG 302 Structural Design</td>
<td></td>
</tr>
<tr>
<td>CIEG 320 Soil Mechanics</td>
<td></td>
</tr>
<tr>
<td>CIEG 323 Soil Mechanics Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

**Pollution Transport and Control Processes**

**Required Technical Electives**

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEG 332 Chemical Engineering Kinetics</td>
<td></td>
</tr>
<tr>
<td>CHEG 342 Heat and Mass Transfer</td>
<td></td>
</tr>
<tr>
<td>CHEG 443 Physical Chemistry I</td>
<td></td>
</tr>
</tbody>
</table>

**Additional Recommended Technical Electives**

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BISC 371 Introduction to Microbiology</td>
<td></td>
</tr>
<tr>
<td>CHEM 331 Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td>CHEM 444 Physical Chemistry</td>
<td></td>
</tr>
<tr>
<td>CIEG 321 Geotechnical Engineering</td>
<td></td>
</tr>
<tr>
<td>CIEG 407 Building Design</td>
<td></td>
</tr>
<tr>
<td>CIEG 433 Hazardous Waste Management</td>
<td></td>
</tr>
<tr>
<td>CIEG 482 Systems Design and Operation</td>
<td></td>
</tr>
<tr>
<td>GEOG 421 Environmental and Applied Geology</td>
<td></td>
</tr>
<tr>
<td>GEOG 466 General Geochimistry</td>
<td></td>
</tr>
<tr>
<td>MEEG 424 Air Pollution Processes</td>
<td></td>
</tr>
<tr>
<td>MSEG 302 Materials Science</td>
<td></td>
</tr>
<tr>
<td>PLS 608 Soil Chemistry</td>
<td></td>
</tr>
</tbody>
</table>

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 Undergraduate Committee.

**ELECTRICAL AND COMPUTER ENGINEERING**

The Department of Electrical and Computer Engineering offers programs that lead to the degrees of Bachelor of Electrical Engineering and Bachelor of Computer Engineering, both with Honors Degree Options. The Electrical Engineering curriculum prepares graduates to enter the broad profession of modern electrical engineering. The Computer Engineering curriculum is more focused on the application of electrical engineering principles to the design of computers, networks of computers, or sometimes systems that include computers.

Coursework in electrical and computer engineering starts with the first term of the freshman year, with successive years building on prerequisite courses and including an unusually high number of courses with laboratories.
There are three basic parts to the Delaware curriculum in engineering: (1) a core group of courses, (2) an elective group of technical courses, and (3) a "general education" component that includes six courses in the humanities and social sciences and two in written communications.

The core group consists of required courses in mathematics, chemistry, computer science, and electrical and computer engineering.

Technical electives are chosen from a set of approved courses in the fields of engineering, mathematics, natural science, and computer science. These electives provide the student with the opportunity to study a particular area of interest at a greater depth. The technical elective courses chosen by the student must follow the specific guidelines for the student's major and be approved by the departmental advisor. Students must take at least four credits in courses designated as "design."

The general education program must include courses from the humanities and from the social sciences, including courses at an advanced level. Electrical and Computer Engineering students must include a course in microeconomics and two writing courses (ENGL 110 and ENGL 301).

Any deviation from these requirements must be approved by the ECE Department Chair or his/her designee.

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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http://www.ece.udel.edu

DEGREE: BACHELOR OF ELECTRICAL ENGINEERING
MAJOR: ELECTRICAL ENGINEERING

CURRICULUM

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 110 Critical Reading and Writing (minimum grade C)</td>
<td>3 1/2</td>
</tr>
</tbody>
</table>

CREDIT TOTAL

| MINIMUM OF | 125 |

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

CURRICULUM

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 310 Random Signals and Noise</td>
<td>3 1/2</td>
</tr>
<tr>
<td>ELEG 340 Solid State Electronics</td>
<td>3 1/2</td>
</tr>
<tr>
<td>ELEG 370 Engineering Electromagnetics</td>
<td>3 1/2</td>
</tr>
</tbody>
</table>

CREDIT TOTAL

| 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.
Design Requirement

In addition to the normal program, every student must take at least four credits in a CPEG course designated as "design." Regularly offered CPEG design courses include CPEG 422 and CPEG 460. Other courses may be offered irregularly which satisfy the design requirement. Students should consult with their advisors before selecting their design course or courses.

Technical Electives

In addition to the design requirement, each student, in consultation with their advisor, must select a program of technical electives satisfying the following:

1. With some exceptions, technical electives consist of 300-level or above engineering, mathematics, natural sciences, and computer science courses.
2. With the permission of the student's advisor, certain 200-level courses, such as PHYS 209, are permitted.
3. At least 15 technical elective credits must be taken.
4. Of the 15 technical elective credits, at least 9 must be in CPEG or ELEG courses.
5. Of the 9 credits in ELEG or CPEG, at least 6 must be in 400-level or above ELEG or CPEG courses.

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 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.

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 a program leading to the Bachelor of Mechanical Engineering, including an 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 or business administration. Undergraduates are encouraged to participate in research projects with faculty and graduate students which may involve the use of state-of-the-art instrumentation, electronics and networking computers.

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). Although the majority of the available electives are drawn from the Mechanical Engineering department, courses from other departments and colleges can be selected with the approval of the departmental faculty.

There are five suggested focus areas, Aerospace Engineering, Biomedical Engineering, Fluids and Thermal Engineering, Solid Mechanics and Materials, and Design (Dynamics, Design and Manufacturing). However, technical elective programs can be structured to meet individual interests and students are encouraged to discuss their educational objectives with their advisor early in the junior year and to develop an agreed selection of technical electives.

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http://www.me.udel.edu/

DEGREE: BACHELOR OF MECHANICAL ENGINEERING

MAJOR: MECHANICAL ENGINEERING

CURRICULUM

CREDITS

Superior figures indicate semester (fall or spring) and/or year or years in which the course should be taken, i.e. 1st fall of freshman year, spring of sophomore year, etc.

UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C) .. 3 1 F

MAJOR REQUIREMENTS

General Education Program

See pp. 161-162: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 57).

CHEM 103 General Chemistry ........................................... 4 1 F
MATH 241 Analytic Geometry and Calculus A ........................................... 4 1 F
MATH 242 Analytic Geometry and Calculus B ........................................... 4 1 S
MATH 243 Analytic Geometry and Calculus C ........................................... 4 2 F
MATH 351 Engineering Mathematics I ........................................... 3 2 S
MATH 352 Engineering Mathematics II ........................................... 3 2 S
MATH 353 Engineering Mathematics III ........................................... 3 2 S
PHYS 107 Fundamentals of Physics I ........................................... 4 1 S
PHYS 245 Introduction to Electricity and Electronics ........................................... 4 2 S
PHYS 310 Introduction to Thermal Physics ........................................... 3 3 F
MSEG 302 Materials Science for Engineers ........................................... 4 2 S
MEEG 101 Introduction to Mechanical Engineering ........................................... 3 1 F
MEEG 112 Statics ........................................... 3 1 S
MEEG 202 Computer-Aided Engineering Design Laboratory ........................................... 3 2 S
MEEG 211 Dynamics ........................................... 3 2 S
MEEG 215 Mechanics of Solids ........................................... 4 2 F

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by specializing in a scientific or mathematical field which has a number of course requirements in common with the engineering major. 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-Engineering program, which Arts and Science area of concentration falls short of 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 during their first year if needed. Engineering students who are interested in the Arts-Engineering program must be initially admitted to a major in an Arts and Science department within the College of Engineering. This requires careful course selection in order to acquire the required knowledge in a particular field.

Credits: Bachelor of Arts

**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.

Minimum total credit hours will vary, dependent upon the engineering major selected.

**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.