



# COLLEGE OF ENGINEERING

## Undergraduate Programs

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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.

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### ADVISEMENT

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.

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### 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.

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### 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 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 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 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 POC 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 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.

Telephone: (302) 831-2399  
E-mail: zydney@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. 1<sup>F</sup> fall of freshman year, 2<sup>S</sup> spring of sophomore year, etc.

### UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C-) 3 1<sup>F</sup>

### MAJOR REQUIREMENTS

**General Education Program** 18 1-4

See pp 161-162: College General Education Program

**General Education Program** 3 1-4

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 1 <sup>F</sup>
CHEM 119	Quantitative Chemistry I	2 1 <sup>F</sup>
CHEM 112	General Chemistry	3 1 <sup>S</sup>
CHEM 443	Physical Chemistry	3 2 <sup>F</sup>
CHEM 444	Physical Chemistry	3 2 <sup>S</sup>
CHEM 445	Physical Chemistry Laboratory I	1 2 <sup>S</sup>
CHEM 331	Organic Chemistry	3 3 <sup>F</sup>
CHEM 333	Organic Chemistry Laboratory I (lecture only)	1 3 <sup>F</sup>
CHEM 332	Organic Chemistry	3 3 <sup>S</sup>

MATH 242	Analytic Geometry and Calculus B	4 1 <sup>F</sup>
MATH 243	Analytic Geometry and Calculus C	4 1 <sup>S</sup>
MATH 302	Ordinary Differential Equations I	3 2 <sup>F</sup>
MATH 305	Applied Math for Chemical Engineering	3 2 <sup>S</sup>

PHYS 207	Fundamentals of Physics I	4 1 <sup>S</sup>
PHYS 208	Fundamentals of Physics II	4 2 <sup>F</sup>

MSEG 302	Materials Science for Engineers	4 3 <sup>F</sup>
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CHEG 009	Chemical Engineering Freshman Seminar	0 1 <sup>F</sup>
CHEG 112	Introduction to Chemical Engineering	3 1 <sup>S</sup>
CHEG 231	Chemical Engineering Thermodynamics	3 2 <sup>F</sup>
CHEG 325	Chemical Engineering Thermodynamics	4 2 <sup>S</sup>
CHEG 332	Chemical Engineering Kinetics	3 3 <sup>F</sup>
CHEG 341	Fluid Mechanics	3 3 <sup>F</sup>
CHEG 320	Engineering Economics and Risk Assessment	2 3 <sup>S</sup>
CHEG 342	Heat and Mass Transfer	4 3 <sup>S</sup>
CHEG 345	Chemical Engineering Laboratory I	3 3 <sup>S</sup>
CHEG 401	Chemical Process Dynamics and Control	4 4 <sup>F</sup>
CHEG 443	Mass Transfer Operations	3 4 <sup>F</sup>
CHEG 445	Chemical Engineering Laboratory II	

CHEG 473	Chemical Engineering Projects	3 4 <sup>F</sup>
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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. Note that UNIV 401-402 is equivalent to CHEG 473-474.

CHEG 432	Chemical Process Analysis	3 4 <sup>S</sup>
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### Technical Electives

**General Technical Electives** 9 2<sup>S</sup>, 4<sup>F-S</sup>

The purpose of the technical electives is to advance the scientific or engineering background of the chemical engineers. 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 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

BISC 303	Genetic and Evolutionary Biology
BISC 305	Cell Physiology
BISC 306	General Physiology
BISC 371	Introduction to Microbiology
BISC 4xx	Biology course chosen with the approval of the advisor

**Chemical Engineering**

CHEG 595	Patent Law for Engineers and Scientists
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**Chemistry**

Any three-credit combination of CHEM 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 (for those without programming experience)
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** (please note prerequisites)

CPEG 202	Introduction to Digital Systems
CPEG 210	Introduction to Combinational Logic
CPEG 211	Introduction to Sequential Circuits
ELEG 205	Linear Circuit Theory
ELEG 240	Physical Electronics
ELEG 340	Solid State Electronics
ELEG 423	Electrical Properties of Matter I

**Environmental Engineering**

CIEG 431	Water Supply Engineering
CIEG 432	Wastewater Engineering
CIEG 433	Hazardous Waste Management
CIEG 435	Industrial Wastes Management
CIEG 436	Solid Waste Management
CIEG 437	Water and Wastewater Quality

**Materials Science/Engineering**

MSEG 406	Corrosion and Protection
MSEG 6xx	(except for courses that are cross-listed with CHEG)
MSEG 8xx	With approval of advisor
MEEG 316	Materials Engineering
MEEG 410	Experimental Mechanics for Composite Materials
MEEG 617	Composite Materials

**Mathematics**

MATH 349	Elementary Linear Algebra
MATH 389	Graph Theory
MATH 426	Introduction to Numerical Analysis and Algorithmic Computation
MATH 428	Algorithmic and Numerical Solution of Differential Equations
MATH 5xx	Mathematics course chosen with the approval of the advisor
MATH 6xx	Mathematics course chosen with the approval of the advisor

**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 313	Physical Optics
PHYS 419	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** 9<sup>4</sup>

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
CHEM 527	Introductory Biochemistry
CHEG 620	Biochemical Engineering
CHEG 650	Biomedical Engineering

**Chemistry**

CHEM 457	Inorganic Chemistry
CHEM 527	Introductory Biochemistry
CHEG 606	Introduction to Catalysis
CHEG 617	Colloid Science and Engineering
CHEG 836	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.

**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. Stu-

dents 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.

**Admission to CHEG 332 requires:**

- 1) A minimum grade of C- in CHEG 325.
- 2) A minimum grade of C- in MATH 302.

**Admission to CHEG 342 requires:**

- 1) A minimum grade of C- in CIEG 305 and CIEG 306.

Telephone: (302) 831-2442

<http://www.ce.udel.edu>

**DEGREE: BACHELOR OF CIVIL ENGINEERING  
MAJOR: CIVIL ENGINEERING**

CURRICULUM CREDITS

Superior figures indicate semester (fall or spring) and/or year or years in which the course should be taken, i.e. <sup>1F</sup>fall of freshman year, <sup>2S</sup>spring of sophomore year, etc.

**UNIVERSITY REQUIREMENTS**

ENGL 110 Critical Reading and Writing (minimum grade C-) ..... 3 <sup>1F</sup>

**MAJOR REQUIREMENTS**

**General Education Program** ..... 18 <sup>1-4</sup>

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

ENGL 410	Technical Writing	3 <sup>2F</sup>
COMM 312	Oral Communications in Business	3 <sup>3F</sup>
CHEM 103	General Chemistry	4 <sup>1F</sup>
CISC 106	General Computer Science for Engineers	3 <sup>2S</sup>
MATH 241	Analytic Geometry and Calculus A	4 <sup>1F</sup>
MATH 242	Analytic Geometry and Calculus B	4 <sup>1S</sup>
MATH 243	Analytic Geometry and Calculus C	4 <sup>2F</sup>
MATH 351	Engineering Mathematics I	3 <sup>2S</sup>
MATH 353	Engineering Mathematics III	3 <sup>3F</sup>
MATH 450	Statistics for the Engineering and Physical Sciences	3 <sup>3S</sup>
PHYS 207	Fundamentals of Physics I	4 <sup>1S</sup>
CHEM 104	General Chemistry	4 <sup>2F</sup>
or		

GEOL 107	General Geology I	
or		
PHYS 208	Fundamentals of Physics II	
or		
PHYS 345	Introduction to Electricity and Electronics	
or		
BISC 207	Introductory Biology I	
or		
BISC 208	Introductory Biology II	
CIEG 126	Introduction to Surveying and Computer Aided Drafting	3 1S
MSEG 302	Materials Science for Engineers	4 2S
CIEG 305	Fluid Mechanics	3 3F
CIEG 306	Fluid Mechanics Laboratory	1 3S
CIEG 125	Introduction to Civil Engineering	2 1F
CIEG 211	Statics	3 2F
CIEG 212	Solid Mechanics	3 2S
CIEG 213	Solid Mechanics Laboratory	1 2S
CIEG 331	Environmental Engineering	3 3S
CIEG 301	Structural Analysis	4 3F
CIEG 311	Dynamics	3 2S
CIEG 351	Transportation Engineering	3 3S
CIEG 320	Soil Mechanics	3 3F
CIEG 323	Soil Mechanics Laboratory	1 3S
CIEG 321	Geotechnical Engineering	4 4F, 4S
CIEG 461	Senior Design Project	3 4F
CIEG 482	System Design and Operation	4 3S
CIEG 302	Structural Design	3 4F
CIEG 440	Water Resources Engineering	9 4F, 4S

**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 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**

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 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.

**General Civil Engineering**

CIEG 401	Introduction to the Finite Element Method
CIEG 407	Building Design
CIEG 409	Forensic Engineering
CIEG 438	Water and Wastewater Engineering
CIEG 452	Transportation Facilities Design
CIEG 471	Introduction to Coastal Engineering
CIEG 486	Construction Management and Methods

**Environmental and Water Resource Engineering**

CIEG 407	Building Design
CIEG 433	Hazardous Waste Management
CIEG 437	Water and Wastewater Quality
CIEG 438	Water and Wastewater Engineering

BISC 371	Introduction to Microbiology
BISC 641	Microbial Ecology
BREG 628	Land Application of Wastes
CHEM 213	Elementary Organic Chemistry
CHEM 214	Elementary Biochemistry
CHEM 220	Quantitative Analysis
CHEM 418	Introduction to Physical Chemistry
ELEG 681	Remote Sensing in Environment
GEOL 421	Environmental and Applied Geology
GEOL 428	Hydrogeology

**Hydraulic and Ocean Engineering**

CIEG 401	Introduction to the Finite Element Method
CIEG 407	Building Design
CIEG 422	Earth Structures Engineering
CIEG 437	Water and Wastewater Quality
CIEG 471	Introduction to Coastal Engineering
MEEG 361	Applied Engineering Analysis

**Structures and Geotechnical Engineering**

CIEG 401	Introduction to the Finite Element Method
CIEG 405	Matrix Structural Analysis
CIEG 407	Building Design
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. 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.

## 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. <sup>1F</sup>fall of freshman year, <sup>2S</sup>spring of sophomore year, etc.

### UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C-) ..... 3<sup>1F</sup>

### MAJOR REQUIREMENTS

**General Education Program** ..... 18<sup>1-4</sup>

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

ENGL 410 Technical Writing ..... 3<sup>2F</sup>

CHEM 111 General Chemistry ..... 3<sup>1F</sup>

CHEM 119 Quantitative Chemistry I ..... 2<sup>1F</sup>

CHEM 112 General Chemistry ..... 3<sup>1S</sup>

MATH 241 Analytic Geometry and Calculus A ..... 4<sup>1F</sup>

MATH 242 Analytic Geometry and Calculus B ..... 4<sup>1S</sup>

MATH 243 Analytic Geometry and Calculus C ..... 4<sup>2F</sup>

MATH 302 Ordinary Differential Equations ..... 3<sup>2S</sup>

PHYS 207 Fundamentals of Physics I ..... 4<sup>1S</sup>

BISC 321 Environmental Biology ..... 3<sup>2S</sup>

CISC 106 General Computer Science for Engineers ..... 3<sup>2S</sup>

MATH 450 Statistics for Engineering and Physical Sciences ..... 3<sup>3S</sup>

CHEG 231 Chemical Engineering Thermodynamics ..... 3<sup>3F</sup>

CHEG 325 Chemical Engineering Thermodynamics ..... 4<sup>3S</sup>

CIEG 305 Fluid Mechanics ..... 3<sup>3F</sup>

CIEG 306 Fluid Mechanics Laboratory ..... 1<sup>3S</sup>

CIEG 434 Air Pollution Control ..... 3<sup>4S</sup>

CIEG 135 Introduction to Environmental Engineering ..... 1<sup>1F</sup>

CIEG 211 Statics ..... 3<sup>2F</sup>

CIEG 212 Solid Mechanics ..... 3<sup>2S</sup>

CIEG 213 Solid Mechanics Laboratory ..... 1<sup>2S</sup>

CIEG 233 Environmental Engineering Processes ..... 3<sup>2F</sup>

CIEG 337 Environmental Engineering Laboratory ..... 3<sup>3S</sup>

CIEG 438 Water and Wastewater Engineering ..... 3<sup>3F</sup>

CIEG 437 Water & Wastewater Quality ..... 3<sup>4S</sup>

CIEG 436 Solid Waste Management ..... 3<sup>4S</sup>

CIEG 440 Water Resources Engineering ..... 3<sup>4F</sup>

CIEG 461 Senior Design Project ..... 2<sup>4F</sup>

CIEG 461 Senior Design Project ..... 2<sup>4S</sup>

Earth Science Elective ..... 3<sup>3S</sup>

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

**Technical Electives** ..... 18<sup>3,4</sup>

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

CHEG 332 Chemical Engineering Kinetics  
CHEG 342 Heat and Mass Transfer  
CHEM 443 Physical Chemistry I

### Additional Recommended Technical Electives

BISC 371 Introduction to Microbiology  
CHEM 331 Organic Chemistry  
CHEM 444 Physical Chemistry  
CIEG 321 Geotechnical Engineering  
CIEG 407 Building Design  
CIEG 433 Hazardous Waste Management  
CIEG 482 Systems Design and Operation  
GEOL 421 Environmental and Applied Geology  
GEOL 446 General Geochemistry  
MEEG 424 Air Pollution Processes  
MSEG 302 Materials Science  
PLSC 608 Soil Chemistry

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 academic 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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## DEGREE: BACHELOR OF ELECTRICAL ENGINEERING MAJOR: ELECTRICAL ENGINEERING

### CURRICULUM

### CREDITS

Superior figures indicate semester (fall or spring) and/or year or years in which the course should be taken, i.e. <sup>1</sup>Fall of freshman year, <sup>2</sup>Spring of sophomore year, etc.

### UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C-) ..... 3 <sup>1</sup>S

### MAJOR REQUIREMENTS

**General Education Program** ..... 18 <sup>1-4</sup>

See pp. 161-162: 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 <sup>3</sup> F
MATH 241	Analytic Geometry and Calculus A	4 <sup>1</sup> F
MATH 242	Analytic Geometry and Calculus B	4 <sup>1</sup> S
MATH 243	Analytic Geometry and Calculus C	4 <sup>2</sup> F
MATH 341	Differential Equations with Linear Algebra I	3 <sup>2</sup> S
MATH 342	Differential Equations with Linear Algebra II	3 <sup>3</sup> F
CHEM 103	General Chemistry	4 <sup>1</sup> F
PHYS 207	Fundamentals of Physics I	4 <sup>1</sup> S
PHYS 208	Fundamentals of Physics II	4 <sup>2</sup> F
CISC 105	Introduction to Computer Science I	3 <sup>1</sup> F
CISC 181	Introduction to Computer Science II	3 <sup>1</sup> S
CISC 220	Data Structures	3 <sup>2</sup> S
CPEG 202	Introduction to Digital Systems	4 <sup>1</sup> F
CPEG 222	Microprocessor Based Systems	4 <sup>2</sup> F
ELEG 205	Analog Circuits I	4 <sup>2</sup> F
ELEG 212	Signals and Communications	4 <sup>2</sup> S
ELEG 240	Physical Electronics	4 <sup>2</sup> S
ELEG 305	Signal Processing I	3 <sup>3</sup> F
ELEG 309	Electronic Circuit Analysis I	4 <sup>3</sup> F

ELEG 310	Random Signals and Noise	3 <sup>3</sup> S
ELEG 340	Solid State Electronics	3 <sup>3</sup> F
ELEG 370	Engineering Electromagnetics	4 <sup>3</sup> S

**Design Requirement** ..... 4 <sup>4</sup>

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 450. 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** ..... 21

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. With the permission of the student's advisor, certain 200-level courses, such as PHYS 209, are permitted. (2) At least 21 technical elective credits must be taken. (3) Of the 21 technical elective credits, at least 12 must be in CPEG or ELEG courses. (4) Of the 12 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 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. <sup>1</sup>Fall of freshman year, <sup>2</sup>Spring of sophomore year, etc.

### CURRICULUM

### CREDITS

### UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C-) ..... 3 <sup>1</sup>S

### MAJOR REQUIREMENTS

**General Education Program** ..... 18

See pp. 161-162: 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 <sup>3</sup> F
MATH 241	Analytical Geometry and Calculus A	4 <sup>1</sup> F
MATH 242	Analytical Geometry and Calculus B	4 <sup>1</sup> S
MATH 243	Analytical Geometry and Calculus C	4 <sup>2</sup> F
MATH 341	Differential Equations & Linear Alg I	3 <sup>2</sup> S
MATH 342	Differential Equations & Linear Alg II	3 <sup>3</sup> F
PHYS 207	Fundamentals of Physics	4 <sup>1</sup> S
PHYS 208	Fundamentals of Physics	4 <sup>2</sup> F
CHEM 103	General Chemistry	4 <sup>1</sup> F
CISC 105	General Computer Science	3 <sup>1</sup> F
CISC 181	Introduction to Computer Science II	3 <sup>1</sup> S
CISC 220	Data Structures	3 <sup>2</sup> S
CISC 361	Operating Systems	3 <sup>3</sup> S

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.

CPEG 202	Introduction to Digital Systems	4 <sup>1</sup> F
CPEG 222	Microprocessor Systems	4 <sup>2</sup> F
CPEG 323	Introduction to Computer System Engineering	3 <sup>3</sup> F
CPEG 324	Computer Systems Design I	3 <sup>3</sup> S
ELEG 205	Linear Circuit Theory	4 <sup>2</sup> F
ELEG 212	Signals and Communications	4 <sup>2</sup> S
ELEG 240	Physical Electronics	4 <sup>2</sup> S
ELEG 305	Signal Processing	3 <sup>3</sup> F
ELEG 309	Electronic Circuit Analysis I	4 <sup>3</sup> F
ELEG 310	Random Signals and Noise	3 <sup>3</sup> S
ELEG 370	Engineering Electromagnetics	4 <sup>3</sup> S



**Design Requirement** 44

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** 15

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. With the permission of the student's advisor, certain 200-level courses, such as PHYS 209, are permitted. (2) At least 15 technical elective credits must be taken. (3) Of the 15 technical elective credits, at least 9 must be in CPEG or ELEG courses. (4) 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 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.

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**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 networked 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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**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. 1<sup>F</sup>fall of freshman year, 2<sup>S</sup>spring of sophomore year, etc.

**UNIVERSITY REQUIREMENTS**

ENGL 110 Critical Reading and Writing (minimum grade C-) 3 1<sup>F</sup>

**MAJOR REQUIREMENTS**

**General Education Program** 18 1-4

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<sup>F</sup>

MATH 241 Analytic Geometry and Calculus A 4 1<sup>F</sup>

MATH 242 Analytic Geometry and Calculus B 4 1<sup>S</sup>

MATH 243 Analytic Geometry and Calculus C 4 2<sup>F</sup>

MATH 351 Engineering Mathematics I 3 2<sup>F</sup>

MATH 352 Engineering Mathematics II 3 2<sup>S</sup>

MATH 353 Engineering Mathematics III 3 2<sup>S</sup>

PHYS 207 Fundamentals of Physics I 4 1<sup>S</sup>

PHYS 245 Introduction to Electricity and Electronics 4 2<sup>S</sup>

PHYS 310 Introduction to Thermal Physics 3 3<sup>F</sup>

MSEG 302 Materials Science for Engineers 4 2<sup>S</sup>

MEEG 101 Introduction to Mechanical Engineering 3 1<sup>F</sup>

MEEG 112 Statics 3 1<sup>S</sup>

MEEG 202 Computer-Aided Engineering Design Laboratory 3 2<sup>S</sup>

MEEG 211 Dynamics 3 2<sup>F</sup>

MEEG 215 Mechanics of Solids 4 2<sup>F</sup>

MEEG 301	Machine Design - Kinematics and Kinetics	3 <sup>3F</sup>
MEEG 304	Machine Design - Elements	3 <sup>3S</sup>
MEEG 311	Vibration and Control	4 <sup>3F</sup>
MEEG 321	Materials Engineering	3 <sup>3F</sup>
MEEG 331	Incompressible Fluids	4 <sup>3F</sup>
MEEG 332	Compressible Fluids	3 <sup>3S</sup>
MEEG 342	Heat Transfer	3 <sup>3S</sup>
MEEG 344	Thermodynamics	3 <sup>3S</sup>
MEEG 346	Thermal Lab	1 <sup>3S</sup>
MEEG 401	Senior Design	6 <sup>4F</sup>

**Technical Electives** ..... 12<sup>4</sup>

400-level or above courses in engineering, science or mathematics selected by the student with the approval of their advisor

**CREDITS TOTAL A MINIMUM OF ..... 122**

### 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

Superior figures indicate semester (fall or spring) and/or year or years in which the course should be taken, i.e. 1<sup>F</sup>fall of freshman year, 2<sup>S</sup>spring of sophomore year, etc.

#### CREDITS

#### UNIVERSITY REQUIREMENTS

ENGL 110	Critical Reading and Writing (minimum grade C-)	3 <sup>1S</sup>
Three credits in an approved course or courses stressing	multicultural, ethnic, and/or gender-related content (see p. 57)	3 <sup>1-4</sup>
These credits may also fulfill some of the breadth requirements.		

#### ARTS AND SCIENCE COLLEGE REQUIREMENTS

<b>Writing:</b> (minimum grade C-)	3
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.)	

**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 exemption examination

#### Breadth Requirements (See page 85)

<b>Group A</b>	12
Understanding and appreciation of the creative arts and humanities. Twelve credits representing at least two areas	
<b>Group B</b>	12
The study of culture and institutions over time. Twelve credits representing at least two areas	
<b>Group C</b>	12
Empirically based study of human beings and their environment. Twelve credits representing at least two areas	

The above groups differ from the General Education groups of the College of Engineering. This requires careful course selection in order to have courses that satisfy both curricula simultaneously.

#### AREA OF CONCENTRATION REQUIREMENTS

**Area of Concentration:** 15  
Fifteen credits of Arts and Science electives to be used for acquiring some depth of knowledge in a field chosen in consultation with an Arts and Science advisor. These credits may also fulfill some of the breadth requirements.

Art and Science Requirements 45-51  
The liberal arts component is listed as 51 credit hours. The absolute minimum required to satisfy the requirements listed above is 45; this assumes that the foreign language requirement is satisfied from high school work, the writing course is in one of the Groups A, B, or C, and that nine credits of the Area of Concentration are also from one of the Groups A, B, or C. Thus, students without language skills and concentrating in science or mathematics will need more than 51 credit hours to complete all of these requirements.

#### 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