

# COLLEGE OF ENGINEERING

- Chemical Engineering
- Civil and Environmental Engineering
- Electrical and Computer Engineering
- Materials Science and Engineering
- Mechanical Engineering
- Air Force ROTC

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 145). 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 (135 du Pont Hall, 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 which 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.

## ADVISEMENT

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.

## CURRICULUM ORGANIZATION

The 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 elective 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 PROGRAM

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. 22). Detailed guidelines, which include a list of courses which may be used to satisfy the program's requirements, may be obtained from the Office of the Dean of Engineering.

- 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 20) 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 (135 du Pont Hall, 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.

## CHEMICAL ENGINEERING

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

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

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

### DEGREE: BACHELOR OF CHEMICAL ENGINEERING MAJOR: CHEMICAL ENGINEERING

#### 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>st</sup>Fall of freshman year, 2<sup>nd</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 139-140: 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 22).

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>
MASC 302	Materials Science for Engineers	4 3 <sup>F</sup>
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 345	Chemical Engineering Laboratory I	3 3 <sup>S</sup>
CHEG 342	Heat and Mass Transfer	4 3 <sup>S</sup>
CHEG 443	Mass Transfer Operations	3 4 <sup>F</sup>
CHEG 445	Chemical Engineering Laboratory II	3 4 <sup>F</sup>
or		
CHEG 473	Chemical Engineering Projects	3 4 <sup>F</sup>

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 401	Chemical Process Dynamics and Control	4 4S
CHEG 432	Chemical Process Analysis	3 4S

### Technical Electives

#### General Technical Electives 9 2S,4FS

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.

**Note:** 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 selection of their Technical Elective courses. Students should select their technical electives during the spring of the sophomore year to avoid scheduling conflicts. 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 334	Organic Chemistry Lab II
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 181	Introduction to Computer Science
CISC 220	Data Structures
CISC 260	Machine Organization and Microcomputers
CISC 310	Logic and Programming
CISC 360	Computer Architecture
CISC 361	Operating Systems
CISC 640	Computer Graphics

### Electronic Materials (please note prerequisites)

CPEG 202	Introduction to Digital Systems
CPEG 210	Introduction to Combinatorial Logic
CPEG 211	Introduction to Sequential Circuits
ELEG 205	Linear Circuit Theory
ELEG 314	Electronics and Instrumentation
ELEG 340	Solid State Electronics
ELEG 423	Electrical Properties of Matter I

### Environmental Engineering

CIEG 432	Wastewater Engineering
CIEG 433	Hazardous Waste Management
CIEG 435	Industrial Wastes Management
CIEG 437	Water and Wastewater Quality

### Materials Science/Engineering

MASC 406	Corrosion and Protection
MASC 6xx	(except for courses that are cross-listed with CHEG)
MASC 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 361	Applied Engineering Analysis
MEEG 863	Engineering Analysis I
MEEG 864	Engineering Analysis II

### Mechanics

CIEG 301	Analysis of Structures
CIEG 311	Dynamics
MEEG 112	Statics
MEEG 214	Principles of Mechanics II
MEEG 313	Strength of Materials
MEEG 413	Advanced Mechanics of Materials
MEEG 415	Finite Element Analysis

### 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

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

### Chemical Engineering Technical Electives 9 4

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 in 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	Applied 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 27). 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 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 302.

**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) 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 443.

**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**

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. Areas concerned with pollution control, water supply, and water resource management are now considered to comprise the distinct discipline of *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. The Civil Engineering curriculum includes specialization options in structural engineering, geotechnical engineering, environmental engineering, hydraulic and ocean engineering, and transportation engineering as shown by the listed Technical Electives. The Environmental Engineering curriculum is focused on causes, control, and prevention of environmental contamination, environmental facilities design and construction, and pollution transport and control processes. Each of these degrees is described separately below.

**DEPARTMENTAL POLICIES**

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

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

**Civil Engineering**

**Admission to 300- and 400-level civil engineering and mechanics courses requires:**

- 1) A minimum grade of C- in MATH 241 and MATH 242.
- 2) A minimum grade of C- in CHEM 103 and CHEM 104.
- 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 MECH 305 and MECH 306.

**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>1S</sup>

**MAJOR REQUIREMENTS**

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

See pp. 139-140: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 22).

ENGL 410	Technical Writing	3 4S
CHEM 103	General Chemistry	4 1F
CHEM 104	General Chemistry	4 1S
CISC 106	General Computer Science for Engineers	3 2F
GEOL 107	General Geology I	4 2F
STAT 450	Statistics for the Engineering and Physical Sciences	3 3S
MATH 241	Analytic Geometry and Calculus A	4 1F
MATH 242	Analytic Geometry and Calculus B	4 1S
MATH 243	Analytic Geometry and Calculus C	4 2F
MATH 302	Ordinary Differential Equations	3 2S
PHYS 207	Fundamentals of Physics I	4 1S
PHYS 208	Fundamentals of Physics II	4 2S
EGGG 132	Engineering Graphics/Analysis	2 1F
MASC 302	Materials Science for Engineers	4 3F
MECH 305	Fluid Mechanics	3 3S
MECH 306	Fluid Mechanics Laboratory	1 3S
CIEG 125	Introduction to Engineering (CE)	2 1F
CIEG 211	Statics	3 2F
CIEG 212	Strength of Materials	3 2S
CIEG 213	Materials Laboratory I	1 2S
CIEG 233	Environmental Engineering Processes	3 3F
CIEG 301	Analysis of Structures	4 3F
CIEG 311	Dynamics	3 3F
CIEG 351	Transportation Engineering	3 3S
CIEG 381	Civil Engineering Analysis	3 3S
CIEG 420	Soil Mechanics	4 4F
CIEG 461	Senior Design Project	3 4S
CIEG 482	System Design and Operation	3 4F
CIEG 402	Steel Design	
or		
CIEG 403	Concrete Design	3 4F
CIEG 431	Water Supply Engineering	
or		
CIEG 432	Wastewater Engineering	3 4S
CIEG 441	Hydrology	
or		
CIEG 442	Hydraulic Engineering	3 4F
<b>Technical Electives</b>		12 3,4

Four courses giving a total of at least four 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..... 131**

### 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 Engineering.

In addition, four 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 223	Surveying
CIEG 401	Computer Methods of Structural Engineering

CIEG 402	Steel Design
CIEG 403	Concrete Design
CIEG 421	Foundations and Substructures
CIEG 431	Water Supply Engineering
CIEG 432	Wastewater Engineering
CIEG 441	Hydrology
CIEG 442	Hydraulic Engineering
CIEG 452	Transportation Facilities Design
CIEG 471	Introduction to Coastal Engineering
EGGG 432	Principles of Computer-Aided Drawing

#### Environmental Engineering

CIEG 403	Concrete Design
CIEG 421	Foundations and Substructures
CIEG 431	Water Supply Engineering
CIEG 432	Wastewater Engineering
CIEG 433	Hazardous Waste Management
CIEG 435	Industrial Wastes Management
CIEG 437	Water and Wastewater Quality
CIEG 441	Hydrology
CIEG 442	Hydraulic Engineering
BISC 371	Introduction to Microbiology
BISC 472	Principles of Infectious Diseases
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 413	Fundamentals of Well Logging
GEOL 421	Environmental and Applied Geology
GEOL 428	Hydrogeology
MEEG 307	Thermodynamics I

#### Hydraulic and Ocean Engineering

CIEG 441	Hydrology
CIEG 421	Foundations and Substructures
CIEG 422	Earth Structures Engineering
CIEG 431	Water Supply Engineering
CIEG 401	Computer Methods of Structural Engineering
CIEG 403	Concrete Design
CIEG 471	Introduction to Coastal Engineering
CIEG 442	Hydraulic Engineering
MEEG 361	Applied Engineering Analysis

#### Structures and Geotechnical Engineering

CIEG 223	Surveying
CIEG 401	Computer Methods of Structural Analysis
CIEG 402	Steel Design
CIEG 403	Concrete Design
CIEG 404	Prestressed Concrete Design
CIEG 405	Matrix Structural Analysis
CIEG 406	Structural Materials
CIEG 411	Structural Dynamics Design
CIEG 415	Reliability Design
CIEG 416	Random Vibration
CIEG 417	Advanced Structural Analysis
CIEG 418	Continuously Supported Structures
CIEG 421	Foundations and Substructures
CIEG 422	Earth Structures Engineering
CIEG 459	Railroad Engineering
CIEG 467	Introduction to Bridge Design

#### Transportation Engineering

CIEG 223	Surveying
CIEG 452	Transportation Facilities Design
CIEG 454	Urban Transportation Planning
CIEG 459	Railroad Engineering
CIEG 486	Engineering Management
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 page 27). 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, and before being admitted to the minor, the student must have successfully completed CHEM103, 104, MATH 242, 243, 302, PHYS 207 and 208. A grade point average of at least 2.0 is required in the 21 credits of engineering courses of the minor and in the mathematics and science courses listed above.

The required civil engineering and engineering mechanics courses are the following:

CIEG 211	Statics	3
CIEG 212	Strength of Materials, (lab optional)	3
CIEG 311	Dynamics	3
MECH 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 or higher level. 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 420 and CIEG 421; for those interested in the environment, CIEG 331 and 431; for those interested in urban topics, CIEG 331 and 351; for those with interests in construction and structures, CIEG 301, and 402 or 403; for those interested in the oceans, CIEG 442, and CIEG 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>
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#### MAJOR REQUIREMENTS

<b>General Education Program</b>	18 <sup>1-4</sup>
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See pp 139-140: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 22)

ENGL 410	Technical Writing	3 <sup>4S</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>
CHEM 120	Quantitative Chemistry II	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>
PHYS 208	Fundamentals of Physics II	4 <sup>2F</sup>
BISC 321	Environmental Biology	3 <sup>2S</sup>
CISC 106	General Computer Science for Engineers	3 <sup>2S</sup>
STAT 450	Statistics for Engineering	3 <sup>3F</sup>
CHEG 231	Chemical Engineering Thermodynamics	3 <sup>3F</sup>
CHEG 325	Chemical Engineering Thermodynamics	4 <sup>3S</sup>
MECH 305	Fluid Mechanics	3 <sup>3S</sup>
MECH 306	Fluid Mechanics Laboratory	1 <sup>3S</sup>
MEEG 438	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	Strength of Materials	3 <sup>2S</sup>
CIEG 213	Materials Laboratory I	1 <sup>2S</sup>
CIEG 233	Environmental Engineering Processes	3 <sup>2F</sup>
CIEG 337	Environmental Engineering Laboratory	1 <sup>3F</sup>
CIEG 431	Water Supply Engineering	3 <sup>3S</sup>
CIEG 432	Wastewater Engineering	3 <sup>3F</sup>
CIEG 437	Water & Wastewater Quality	3 <sup>4F</sup>
CIEG 436	Solid Waste Management	3 <sup>4S</sup>
CIEG 441	Hydrology	3 <sup>4F</sup>
CIEG 442	Hydraulic Engineering	3 <sup>4F</sup>
CIEG 461	Senior Design	1 <sup>4F</sup>
CIEG 461	Senior Design	2 <sup>4S</sup>

#### 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 .....132**

### 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

##### Core Technical Electives

CIEG 301	Analysis of Structures
CIEG 403	Concrete Design
CIEG 420	Soil Mechanics

##### Additional Related Technical Electives

CIEG 402	Steel Design
CIEG 404	Prestressed Concrete Design
CIEG 421	Foundations and Substructures
CIEG 486	Engineering Management
MASC 302	Materials Science

#### Pollution Transport and Control Processes

##### Core Technical Electives

CHEG 332	Chemical Engineering Kinetics
CHEG 342	Heat and Mass Transfer
CHEM 443	Physical Chemistry
CHEM 444	Physical Chemistry

##### Additional Related Technical Electives

CIEG 433	Hazardous Waste Management
CIEG 435	Industrial Waste Management
MEEG 424	Air Pollution Processes

**Additional Recommended Technical Electives**

BISC 371	Introduction to Microbiology
BREG 628	Land Application of Wastes
CHEM 331	Organic Chemistry
CIEG 482	Systems Design and Operation
GEOL 421	Environmental and Applied Geology
GEOL 446	General Geochemistry
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 27). 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 which 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 in an area of concentration; 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. In certain cases, the senior design course must be included among the technical electives.

The general education program must include courses from the humanities and from the social sciences, including courses at an advanced level. Electrical engineering students must include a course in microeconomics, two writing courses (ENGL 110 and ENGL 301), and a one-credit course in ethics (PHIL 341).

**DEPARTMENTAL REQUIREMENTS**

To qualify for sophomore standing, students must have satisfactorily completed MATH 242-243, CISC 181, PHYS 207, and CPEG 210-211 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 sequence outlined below.

**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. 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>S</sup>

**MAJOR REQUIREMENTS**

**General Education Program** ..... 18 1-4

See pp. 139-140: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 22). ECON 151 is also required within the General Education program.

ENGL 301	Expository Writing	3 3 <sup>F</sup>
PHIL 341	Ethics of Engineering Profession	1 4 <sup>F</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 341	Differential Equations with Linear Algebra I	3 2 <sup>F</sup>
MATH 342	Differential Equations with Linear Algebra II	3 2 <sup>S</sup>
CHEM 103	General Chemistry	4 1 <sup>F</sup>
PHYS 207	Fundamentals of Physics I	4 1 <sup>S</sup>
PHYS 208	Fundamentals of Physics II	4 2 <sup>F</sup>
CISC 105	Introduction to Computer Science I	3 1 <sup>F</sup>
CISC 181	Introduction to Computer Science II	3 1 <sup>S</sup>
CPEG 210	Introduction to Combinational Logic	2 1 <sup>F</sup>
CPEG 211	Introduction to Sequential Circuits	2 1 <sup>S</sup>
CPEG 220	Microprocessor Based Systems I	2 2 <sup>F</sup>
CPEG 221	Microprocessor Based Systems II	2 2 <sup>S</sup>
ELEG 205	Linear Circuit Theory	4 2 <sup>F</sup>
ELEG 302	Electrical Properties of Materials	3 2 <sup>S</sup>
ELEG 305	Signal Processing I	3 3 <sup>F</sup>
ELEG 306	Signal Processing II	3 3 <sup>S</sup>
ELEG 309	Electronic Circuit Analysis I	4 2 <sup>S</sup>
ELEG 310	Random Signals and Noise	3 3 <sup>S</sup>
ELEG 312	Electronic Circuit Analysis II	4 3 <sup>F</sup>
ELEG 320	Field Theory I	3 3 <sup>F</sup>
ELEG 340	Solid State Electronics	3 3 <sup>S</sup>
ELEG 413	Field Theory II	4 4 <sup>S</sup>
ELEG 418	Digital Control Systems	3 4 <sup>F</sup>
ELEG 433	Energy Systems	3 4 <sup>S</sup>

Note: ELEG 310 may be taken in the senior year(s) and ELEG 413 and/or ELEG 433 in the junior year(s) when appropriate to a plan for a technical concentration.

**Design Requirement** ..... 4 4

In addition to the design content of the normal program, every student must take at least one course in the senior year in which one design project is at least 50% of the coursework. Regularly offered courses that presently meet this requirement are ELEG 420, CPEG 422, ELEG 450 and CPEG 464. Other special courses are offered that will meet this requirement. The design requirement may also be met with special projects carried out in conjunction with faculty research with the prior approval of the Departmental Undergraduate Representative. Students must consult with their advisors for the proper selection of design courses.

**Technical Electives**

21

Each student must select a concentration to structure his/her technical elective program. Three concentrations are defined (computer engineering, systems and signals engineering, and electronic devices and materials engineering). Each Electrical Engineering student must take seven courses totalling a minimum of 21 credits in technical electives within the chosen concentration. Students with a special interest may define their own concentrations in conjunction with their advisor. With some exceptions, upper-level engineering, computer science, physics, science and mathematics courses are acceptable technical electives. However, students planning their own programs of concentration should realize that there must be a theme holding together at least most of the courses chosen. Any special concentrations must be approved by the Departmental Undergraduate Representative prior to the start of the senior year.



Each of the three regular concentrations specifies 5 of the 7 technical elective courses. Students should note that the requirement for a senior design project will, in some cases, further constrain the choice of technical electives.

The technical electives must be chosen from an area of concentration. 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. The three concentrations follow:

#### Technical Electives—Concentration in Computer Engineering

CISC 220 Data Structures  
CPEG 323 Intro. Computer System Engineering  
CPEG 324 Computer System Design I

Two additional Technical Program Electives  
and at least one of:

CPEG 419 Computer Communication Networks  
CPEG 421 Compiler Design  
CISC 361 Operating Systems

and at least one design course:

CPEG 464 VLSI Systems  
CPEG 422 Computer System Design II

#### Technical Electives—Concentration in Systems and Signals

CISC 220 Data Structures  
MATH 426 Numerical Analysis  
ELEG 403 Communications Systems  
ELEG 428 System Analysis and Control

Two additional Technical Program Electives  
and at least one design course:

ELEG 420 Electronic Circuit Design  
CPEG 422 Computer System Design II  
CPEG 464 VLSI Systems

#### Technical Electives—Concentration in Devices and Materials

PHYS 209 Fundamentals of Physics III  
PHYS 313 Physical Optics  
ELEG 423 Electronic Properties of Matter  
ELEG 440 Opto-electronics  
ELEG 450 Semiconductor Device Design and Fabrication

Two additional Technical Program Electives

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

### 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 27). 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. 1<sup>F</sup>fall of freshman year, 2<sup>S</sup>spring of sophomore year, etc.

#### CURRICULUM

CREDITS

#### UNIVERSITY REQUIREMENTS

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

#### MAJOR REQUIREMENTS

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

See pp. 139-140: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 22). ECON 151 is also required within the General Education program.

ENGL 301 Expository Writing ..... 3<sup>3F</sup>  
PHIL 341 Ethics in the Engineering Profession ..... 1<sup>4F</sup>

MATH 210 Discrete Mathematics ..... 3<sup>1F</sup>  
MATH 242 Analytical Geometry and Calculus B ..... 4<sup>1F</sup>  
MATH 243 Analytical Geometry and Calculus C ..... 4<sup>1S</sup>  
MATH 341 Differential Equations & Linear Alg I ..... 3<sup>2F</sup>  
MATH 342 Differential Equations & Linear Alg II ..... 3<sup>2S</sup>

Students not prepared to start with MATH 242 should start in MATH 241 and use the winter and/or summer terms to get caught up before the sophomore year.

PHYS 207 General Physics ..... 4<sup>1S</sup>  
PHYS 208 General Physics ..... 4<sup>2F</sup>

CISC 105 General Computer Science ..... 3<sup>1F</sup>  
CISC 181 Introduction to Computer Science II ..... 3<sup>1F</sup>  
CISC 220 Data Structures ..... 3<sup>2S</sup>  
CISC 361 Operating Systems ..... 3<sup>3S</sup>

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. Students taking CISC 105 must take the C language section.

CPEG 210 Introduction to Combinational Logic ..... 2<sup>1F</sup>  
CPEG 211 Introduction to Sequential Circuits ..... 2<sup>1S</sup>  
ELEG 205 Linear Circuit Theory ..... 4<sup>2F</sup>  
CPEG 220 Microprocessor Based Systems I ..... 2<sup>2F</sup>  
ELEG 309 Electronic Circuit Analysis I ..... 4<sup>2S</sup>  
CPEG 221 Microprocessor Based Systems II ..... 2<sup>2S</sup>  
ELEG 305 Signal Processing ..... 3<sup>3F</sup>  
ELEG 312 Electronic Circuit Analysis ..... 4<sup>3F</sup>  
ELEG 320 Field Theory ..... 3<sup>3F</sup>  
CPEG 323 Introduction to Computer System Engineering ..... 3<sup>3F</sup>  
ELEG 306 Signal Processing II ..... 3<sup>3S</sup>  
ELEG 310 Random Signals and Noise ..... 3<sup>3S</sup>  
CPEG 324 Computer Systems Design I ..... 3<sup>3S</sup>  
ELEG 413 Field Theory II ..... 4<sup>4S</sup>  
ELEG 418 Digital Control Systems ..... 3<sup>4F</sup>  
CPEG 422 Computer Systems Design II ..... 4<sup>4S</sup>

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

Every student must take at least one course in their senior year in which one design project is at least 50% of the coursework. Regularly offered courses that presently meet this requirement are CPEG 422, ELEG 450 and CPEG 464. Other special courses are offered which will meet this requirement. The design requirement may also be met with special projects carried out in conjunction with faculty research with the prior approval of the Department Undergraduate Representative. Students must consult with the advisors for the proper selection of design courses.

**Technical Electives** ..... 15

Each student must take five technical elective courses totaling a minimum of 15 credits. The choice of technical program electives must have the approval of the student's advisor and must include at least three of the following courses:

CPEG 464 VLSI Systems  
CPEG 419 Computer Communications Systems  
CPEG 421 Compiler Design  
ELEG 428 Systems Analysis and Control

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 selection of their Technical Elective courses.

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

### 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 27). 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.

### 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. MASC 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 nevertheless 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 course 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 involving the use of state-of-the-art instrumentation, electronics and networked computers.

### TECHNICAL ELECTIVE PROGRAM

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 four suggested major areas of concentration, Aerospace Engineering, Fluids and Thermal Engineering, Solid Mechanics and Materials, and Design, Dynamics 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.

### 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. <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>1S</sup>

#### MAJOR REQUIREMENTS

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

See pp. 139-140: College General Education Program. One of the General Education courses must fulfill the University multicultural requirement (see p. 22)

CHEM 103	General Chemistry	4 <sup>1F</sup>
MATH 242	Analytic Geometry and Calculus B	4 <sup>1F</sup>
MATH 243	Analytic Geometry and Calculus C	4 <sup>2S</sup>
MATH 351	Engineering Mathematics I	3 <sup>2F</sup>
MATH 352	Engineering Mathematics II	3 <sup>2S</sup>
MATH 353	Numerical Methods	3 <sup>2S</sup>
STAT 450	Statistics	3 <sup>2F</sup>
PHYS 207	Fundamentals of Physics I	4 <sup>1S</sup>
PHYS 210	Introduction to Thermal Physics	3 <sup>3F</sup>
PHYS 345	Introduction to Electricity and Electronics	4 <sup>2F</sup>
MASC 302	Materials Science for Engineers	4 <sup>2S</sup>
MEEG 101	Introduction to Mechanical Engineering	3 <sup>1F</sup>
MEEG 112	Statics	3 <sup>1S</sup>
MEEG 202	CAE Design Lab	3 <sup>2S</sup>
MEEG 211	Dynamics	3 <sup>2F</sup>
MEEG 215	Mechanics of Solids	4 <sup>2F</sup>
MEEG 3xx	Kinematics	3 <sup>3F</sup>
MEEG 3xx	Machine Design	3 <sup>3S</sup>
MEEG 3xx	Vibration/Control	4 <sup>3F</sup>
MEEG 3xx	Materials Engineering	3 <sup>3F</sup>
MEEG 3xx	Fluids I	4 <sup>3F</sup>
MEEG 3xx	Fluids II	3 <sup>3S</sup>
MEEG 3xx	Heat Transfer	3 <sup>3S</sup>
MEEG 3xx	Thermodynamics	3 <sup>3S</sup>
MEEG 3xx	Thermodynamics Laboratory	1 <sup>3S</sup>
MEEG 4xx	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 ..... 121**

### 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 27) Graduate courses approved for this purpose by the department may be counted as Honors courses.

### 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.

## 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. All students under contract receive approximately \$1,500 tax free annually.

**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. During the summer preceding entry into the two-year program, all candidates must complete a six-week field training session at a designated Air Force base.

**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: The Development of Air Power I/II—AFSC 100 (fall) and AFSC 101 (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.

Sophomore year: The Air Force Today I/II—AFSC 200 (fall) and AFSC 201 (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.

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 one-and-a-half hours each week.

### Professional Officer Course (POC)

Junior year: Leadership and Management I/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.

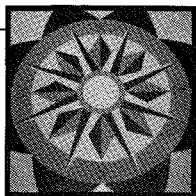
Senior year: National Security Forces in U.S. Society I/II—AFSC 410 (fall) and AFSC 411 (spring). Each of these three-credit courses consists of two-and-a-half hours of academic classes each week. These courses focus on our national security policy—its evolution, actors, processes, and current issues. 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 one-and-a-half hours each week.

**Scholarships Available.** The AFROTC College Scholarship Program provides four- to eight-semester scholarships to students on a competitive basis. Scholarships are available in technical and non-technical fields and are based on the whole-person concept and certain age restrictions. Any University of Delaware student may apply for these scholarships. Opportunity for scholarship selection is enhanced by enrolling in AFROTC. Those selected may receive full tuition, lab expenses, incidental and textbook fees, plus a \$150 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 \$850 per semester towards tuition, plus \$150 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.



# ARTS AND SCIENCE – ENGINEERING CURRICULA

- Chemical Engineering
- Civil Engineering
- Computer Engineering

- Electrical Engineering
- Environmental Engineering
- Mechanical Engineering

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.

## 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

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>1S</sup>
Three credits in an approved course or courses stressing multicultural, ethnic, and/or gender-related content (see p. 22).	3 <sup>1-4</sup>

These credits may also fulfill some of the breadth requirements

### ARTS AND SCIENCE COLLEGE REQUIREMENTS

**Writing:** (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 69.)

**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 0-12

**Breadth Requirements** (See page 70)

*Group A* ..... 12  
Understanding and appreciation of the creative arts and humanities.  
Twelve credits representing at least two areas.

*Group B* ..... 12  
The study of culture and institutions over time. Twelve credits represent-  
ing at least two areas.

*Group C* ..... 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 Col-  
lege 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 concen-  
trating 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 Col-  
lege of Engineering General Education Program. Requirements for  
degrees in each of the engineering disciplines are described in the Col-  
lege of Engineering section.

**CREDITS TO TOTAL A MINIMUM OF ..... 151-162**

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