College of Engineering

- Materials Science Program
- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Mechanical Engineering
- Department of Air Force ROTC

Engineering is a profession which combines mathematics and science with creativity and design to serve the technological needs of our society. The solutions provided by engineers must be technically sound, economically viable, and socially responsible. Thus, the training engineers receive is extensive and rigorous.

A sound high school preparation in mathematics, science, and English is an essential foundation for any undergraduate engineering curriculum. Prospective engineering students should take advantage of high school honors and advanced placement courses when they are available and seek to apply mathematics and computer programming in their science courses. Students considering chemical engineering or the environmental area of civil engineering should take advanced courses in the biological sciences. All engineers must be skilled in reading and composition. Therefore, students should begin the study of engineering with a good high school preparation in critical reading and writing. Additionally, although a foreign language is not required for an engineering major, proficiency in a foreign language can be valuable in an engineering profession, and there are opportunities to continue foreign language study in an engineering curriculum.

Engineering Programs

The standard four-year undergraduate curricula of the College of Engineering lead to the degrees of Bachelor of Chemical Engineering, Bachelor of Civil Engineering, Bachelor of Electrical Engineering, and Bachelor of Mechanical Engineering. 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 201.) Additionally, the College of Engineering and the College of Business and Economics offer a joint 5 1/2-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. Admission to this program is by application to the Dean of Engineering during the third year of engineering study. All engineering programs are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). 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 stu-
dents from minority groups which are underrepresented
in engineering. The program begins with a pre-freshman
Summer Academy and continues to graduation. Inter-
ested individuals should contact the RISE Program
Director in the Office of the Dean of Engineering.

CURRICULUM ORGANIZATION
The curriculum in each engineering major consists of
three basic parts: (1) a core group of technical courses,
(2) an elective group of technical courses, and, (3) an
elective group of general education courses.
The core group generally includes courses in mathe-
matics, chemistry, physics, computer science, and engineer-
ing. The engineering courses begin in the first year and
cumulate in design-oriented courses in the senior year.
Because the technical courses build upon one another, it is
very important that a good foundation is established in pre-
requisite mathematics, science, and engineering courses
before the follow-on technical courses are attempted.
The technical elective courses allow students to inves-
tigate the sciences in more depth and to develop a con-
centration within their own discipline. Technical electives
also allow students to broaden their perspective in relat-
ed areas outside their primary field of study.
The general education courses are chosen from the
liberal arts to provide a well-rounded education. The
complete general education program consists of 24 or 25
credit hours that include the University freshman writing
and multicultural course requirements, the College of
Engineering requirement for 18 credits chosen from the
humanities and social sciences, and 3 or 4 additional
credits required by the individual engineering depart-
ments. The College’s humanities and social sciences
requirements are described in the following section. The
specific requirements of each engineering department
are given in the appropriate departmental section.

COLLEGE GENERAL
EDUCATION PROGRAM
A broad outline of the College of Engineering General
Education Program is given below. 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.
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 faculty adviser. 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 page 26)
 a) At least two courses (minimum of six credits) must be
in the humanities. Humanities include Art History,
English (except ENGL 110 and other writing skills
courses), Foreign Languages and Literatures (except
introductory skills courses), Foreign Languages
(except the student’s native language and introducto-
ry skills courses), History, Music (except skills and
performance courses), Philosophy, and Theatre
(except skills and performance courses).
b) At least two courses (minimum of six credits) must
be in the social sciences. The social sciences include
Economics (EE majors require ECON 151 or anot-
er approved course), Linguistics (except introducto-
ry skills courses), Political Science, Psychology,
and Sociology.
c) At least two courses (minimum of six credits) must
be above the introductory level, and each must
build upon the content of a previous course, as
approved by the faculty adviser.
d) At least two of the six courses (minimum of six cred-
its) must be thematically related, typically in the same
department or program. (Chemical Engineering
majors have an additional requirement.)
Courses classified as “Group D” (mathematics and
science) by the College of Arts and Science may not be
used to satisfy any General Education Program require-
ment. Students must consult their faculty advisers and the
guidelines published by the College of Engineering for
the proper classification of general education courses.

COLLEGE REGULATIONS
The College requires each engineering student to con-
sult with his or her academic adviser at least twice a year
during the designated University advanced registration
periods. Students must also obtain approval from their
advisers to take courses during the Winter or Summer
Sessions and when adding or dropping courses.
Each of the four engineering departments has estab-
lished minimum academic standards for certain courses
and for progression to the sophomore or junior level.
The specific standards for each department are given in
the appropriate departmental section.
To graduate, all students must satisfy the University’s writ-
ing and multicultural course requirements and attain a
cumulative index of at least a 2.0 in all University course
work. 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.
CLASS OPENINGS FOR NONMAJORS

Most courses in the College of Engineering are closed to nonmajors because of limited classroom and laboratory space. Nonmajors with special reasons for enrolling in engineering courses must contact the department chairperson (not the course instructor) to obtain permission to enroll in closed courses. Students who successfully complete closed engineering courses in which they have enrolled without the prior permission of the department chairperson will not automatically be admitted into the engineering major. No closed engineering course will be accepted for transfer without the prior approval of the department chairperson.

Some engineering courses are open to nonmajors. Students do not need special permission to take engineering courses that are part of their curriculum. Students minoring in Civil Engineering are admitted to a large number of civil engineering courses. The requirements for this minor are described in the Civil Engineering section of this chapter.

TRANSFER STUDENTS

The College of Engineering admits a small number of transfer students each year during the fall and spring semesters. Because enrollment in engineering courses is normally restricted to departmental majors, prospective transfer students may not register for engineering courses without prior approval from the chairperson of the appropriate engineering department. The need to control class size and total enrollment in each of the departments frequently requires that nonmajors be administratively removed from class lists following the registration period. Students who transfer into other colleges at the University without prior approval from the chairperson of the appropriate engineering department must be included in the application.

Some engineering courses are open to nonmajors. Students do not need special permission to take engineering courses that are part of their curriculum. Students minoring in Civil Engineering are admitted to a large number of civil engineering courses. The requirements for this minor are described in the Civil Engineering section of this chapter.

MATERIALS SCIENCE PROGRAM

Although the Materials Science Program offers no degrees at the undergraduate level, undergraduate students study the basic concepts associated with the engineering properties of materials in courses taught by the Materials Science Program faculty. The introductory course MASC 302 is required by chemical civil and mechanical engineering majors and is a prerequisite for the interdepartmental advanced offerings that are available as technical electives. Students in mechanical engineering may elect a Solid Mechanics and Materials option that consists of twelve credits in the area of mechanics and materials. In addition, 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.

CHEMICAL ENGINEERING

Chemical engineering is particularly identified with applied chemistry, materials science, and engineering courses taken during their last year as a full-time student.

University of Delaware students who wish to transfer into a department of the College of Engineering must make a formal request to the appropriate chairperson 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 that 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.

All students who wish to transfer into the College of Engineering must contact the Assistant Dean (135 du Pont Hall, (302) 831-8659) to discuss curriculum requirements and transfer policies before beginning the application process.
involved include process development, product development, manufacturing, research and development, process design, and sales. Many research opportunities, however, require an advanced degree.

Chemical engineering analysis is creative, quantitative, applied, and specific. A high degree of creativity is needed to express problems in chemical engineering in ways that give new and effective solutions. It is quantitative, with solutions that state "how much," "how many," and "at what cost." Chemical engineering is applied in that the work product almost always is aimed toward problems that are to be solved within five years and typically lead to commercial products. Chemical engineering models apply to a specific configuration of equipment or to a defined product.

Delaware’s curriculum in chemical engineering reflects a strong commitment to an early start in the profession. In the freshman year, the course CHEG 112 applies the student’s high school background in science and mathematics to the solution of several engineering problems. Physical Chemistry is introduced earlier than in many other schools, enabling much of the chemical engineering science background 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.

This early encounter with the discipline enables the student who has made an inappropriate choice to transfer out of chemical engineering. However, it also makes it difficult for students to transfer into this curriculum during their sophomore or junior years unless the science requirements, especially in chemistry, have been met. Students should note that the course CHEG 112 is a prerequisite for CHEG 231, which in turn is a prerequisite for the courses CHEG 325 and 341. These courses are available only in the semesters indicated in the curriculum outlined below.

**DEGREE: BACHELOR OF CHEMICAL ENGINEERING**

**MAJOR: CHEMICAL ENGINEERING**

**CURRICULUM**

**UNIVERSITY REQUIREMENTS**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 110 Critical Reading and Writing</td>
<td>3.15</td>
</tr>
<tr>
<td>Three credits in an approved course or courses stressing multicultural, ethnic, and/or gender-related content #</td>
<td>3.14</td>
</tr>
</tbody>
</table>

---

**COLLEGE REQUIREMENTS**

**General Education Program**

See page 186: College General Education Program.

**MAJOR REQUIREMENTS**

**External to the College**

**Chemistry**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 111 General Chemistry**</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEM 119 Quantitative Chemistry I</td>
<td>2.15</td>
</tr>
<tr>
<td>CHEM 112 General Chemistry</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEM 443 Physical Chemistry</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEM 444 Physical Chemistry</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEM 445 Physical Chemistry Laboratory I</td>
<td>1.25</td>
</tr>
<tr>
<td>CHEM 331 Organic Chemistry</td>
<td>3.35</td>
</tr>
<tr>
<td>CHEM 333 Organic Chemistry Laboratory I</td>
<td>1.35</td>
</tr>
<tr>
<td>CHEM 332 Organic Chemistry</td>
<td>3.35</td>
</tr>
</tbody>
</table>

**Mathematics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 242 Analytic Geometry and Calculus B</td>
<td>4.15</td>
</tr>
<tr>
<td>MATH 243 Analytic Geometry and Calculus C</td>
<td>4.15</td>
</tr>
<tr>
<td>MATH 302 Ordinary Differential Equations I</td>
<td>3.25</td>
</tr>
<tr>
<td>MATH 303 Ordinary Differential Equations Lab</td>
<td>1.25</td>
</tr>
<tr>
<td>MATH 305 Applied Math for Chemical Engineers</td>
<td>3.25</td>
</tr>
</tbody>
</table>

**Physics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 207 General Physics</td>
<td>4.15</td>
</tr>
<tr>
<td>PHYS 208 General Physics</td>
<td>4.15</td>
</tr>
</tbody>
</table>

**General Education Program**

An additional three-credit general education course must be taken in the humanities or social sciences. Furthermore, three of the general education courses (minimum of nine credits) must be in the same department or program, and at least one of these three courses must be above the introductory level.

Courses classified as "Group D" by the College of Arts and Science may not be used to fulfill this requirement.

**Within the College**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASC 302 Materials Science for Engineers</td>
<td>4.35</td>
</tr>
</tbody>
</table>

**Within the Department**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEG 009 Chemical Engineering Freshman Seminar</td>
<td>0.15</td>
</tr>
<tr>
<td>CHEG 112 Introduction to Chemical Engineering</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEG 231 Chemical Engineering Thermodynamics</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 325 Chemical Engineering Thermodynamics</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 332 Chemical Engineering Kinetics</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEG 341 Fluid Mechanics</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEG 320a Engineering Economics and Risk Assessment</td>
<td>2.35</td>
</tr>
<tr>
<td>CHEG 345 Chemical Engineering Laboratory I</td>
<td>3.35</td>
</tr>
<tr>
<td>CHEG 342b Heat and Mass Transfer</td>
<td>4.15</td>
</tr>
<tr>
<td>CHEG 445 Mass Transfer Operations</td>
<td>3.45</td>
</tr>
<tr>
<td>CHEG 445c Chemical Engineering Laboratory II</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEG 473 Chemical Engineering Projects</td>
<td>3.45</td>
</tr>
<tr>
<td>CHEG 401 Chemical Process Dynamics and Control</td>
<td>3.45</td>
</tr>
</tbody>
</table>

**Credits**

- CHEG 112 is first offered in term 96S.
- CHEG 325a is first offered in term 96S.
- CHEG 341 is first offered in term 96S.
- CHEG 342b is first offered in term 96S.
- CHEG 345c is first offered in term 96S.
- CHEG 445d is first offered in term 96S.
- CHEG 473 is first offered in term 96S.
- CHEG 473a is first offered in term 96S.

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*Superior figures indicate semester (fall or spring) and/or year or years in which the course should be taken, i.e. 1Sfall of freshman year, 2Sspring of sophomore year, etc.

#This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 26.

**Students may enter Chemical Engineering after completing the eight credit freshman Chemistry sequence, CHEM 103-104.

†MATH 242 is the first mathematics course in our regular program. It is the incoming student’s responsibility to assess his/her own Mathematics background and proficiency (using materials supplied by the Math Department). If you are not ready to start with MATH 242, you should start with MATH 241. In this case, it is easy to drop back to MATH 241 after a few weeks of MATH 242 if that is where you belong. If you need additional mathematics, at least one winter and/or summer session will be required to complete the four year program on schedule. To remain on schedule with the CHEG courses, you must be on schedule in mathematics by the start of your sophomore year.

"CHEG 325a is first offered in term 96S.

CHEG 341 is first offered in term 96S.

CHEG 342b is first offered in term 96S.

CHEG 345c is first offered in term 96S.

CHEG 445d is first offered in term 96S.

CHEG 473a is first offered in term 96S."
Any three-credit combination of CHEM 331 (1 credit when the 2 credit option is chosen), 332, 438, 446, and 458 may be used as an upper level technical elective.

**These courses are introductory.**

MATH 428 Algorithmic and Numerical Solution of Differential Equations

MATH 427 Approximation Theory

MATH 426 Introduction to Numerical Analysis and Computer Programming

MATH 349 Elements of Linear Systems

MATH 389 Graph Theory

CISC 361 Operating Systems

CISC 360 Computer Architecture

CISC 260 Machine Organization and Microcomputers

CISC 300 Introduction to Scientific Computation

CISC 310 Logic and Programming

Chemical Engineering Technical Electives

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.

Concentrations

The technical electives may be coupled with the Chemical Engineering Technical Electives to obtain a technical concentration.

Electronic Materials

(please note prerequisites)

ELEG 205 Linear Circuit Theory**

ELEG 210 Introduction to Combinatorial Logic**

ELEG 211 Introduction to Sequential Circuits**

ELEG 314 Electronics and Instrumentation

ELEG 340 Solid State Electronics

ELEG 623 Electrical Properties of Matter II

ELEG 626 Integrated Circuits

ELEG 629 Digital Structures

Materials Science/Engineering

MASC 406 Corrosion and Protection

MASC 6xx (except for courses that are cross-listed with CHEG)

MASC 8xx With approval of adviser

MEEG 516 Materials Engineering

MEEG 410 Experimental Mechanics for Composite Materials

MEEG 617 Composite Materials

Mechanics

CIEG 301 Analysis of Structures**

CIEG 311 Dynamics**

MEEG 213 Principles of Mechanics I**

MEEG 214 Principles of Mechanics II**

MEEG 313 Strength of Materials

MEEG 413 Advanced Mechanics of Materials

MEEG 415 Finite Element Analysis

Environmental Engineering

CIEG 432 Wastewater Engineering

CIEG 435 Industrial Wastes Management

CIEG 437 Water and Wastewater Quality

Statistics

STAT 450 Statistics for the Engineering and Physical Sciences

STAT 6xx Statistics course chosen with the approval of the adviser

CHEG 410 Experimental Mechanics for Composite Materials

MEEG 617 Composite Materials

MEEG 617 Composite Materials

**These courses are introductory.

†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 advisers 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.

‡Any three-credit combination of CHEM 331 (1 credit when the 2 credit option is chosen) 332, 438, 446, and 458 may be used as an upper level technical elective.
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) 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 452:
1) A minimum grade of C- in CHEG 320.
2) A minimum grade of C- in CHEG 332.
3) A minimum grade of C- in CHEG 443.

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

CREDITS TO TOTAL A MINIMUM OF 128

TRANSFER STUDENTS

Students within the University who wish to transfer as sophomores in the fall semester should make a formal request to the Chair by May 1. Unless the case is exceptional, a change-of-major application will only be considered after completion of the following minimum requirement:

1) An overall grade-point index of 2.0.
2) A minimum grade of C- in CHEG 112, Introduction to Chemical Engineering, is required if the course has been taken.
3) A minimum grade of C- in each of the following groups of courses: CHEM 111, CHEM 112, General Chemistry; MATH 242 and 243, Analytic Geometry and Calculus; and PHYS 207, General Physics.

Completion of these minimum requirements does not guarantee admission as a chemical engineering major.

Prospective students who contemplate beginning the program in Chemical Engineering in February, rather than in September, should consult with the Chemical Engineering Department.

Chemical Engineering courses designated by the CHEG prefix are closed to nonmajors. Students seeking exception should contact the Chemical Engineering Department.

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

This four-year program is designed to enable exceptional students with excellent high school backgrounds to obtain a Bachelor of Chemical Engineering degree and a Master of Chemical Engineering degree in four years. This allows students to take maximum advantage of their high school education, gives them a considerable jump over students going the normal bachelor’s degree-master’s degree route, including a year gained, and reduces redundancy in the total educational program. The program is designed for each individual; the following is considered typical.

The requirements and procedures of the program are:

1) The student is assumed to be qualified for a sufficient amount of credit by advanced placement to omit the entire freshman year on the basis of demonstrated ability in mathematics, chemistry, physics, English and humanities. Certification of the level of the advanced standing is made in the usual way on the basis of CEEB or departmental examinations. CHEG 112, Introduction to Chemical Engineering, is waived upon evidence of suitable self-study.
2) Formal admission to the program and provisional admission to graduate school are provided to students upon request at the end of their second year.
in the program, or to those who have attained the status of such students, provided an overall grade-point average of at least 3.25 has been attained.

3) If differences exist between graduate and undergraduate fees for a particular student, the undergraduate fee structure applies through the end of the first semester of the third year.

4) Credit toward the B.Ch.E. degree for two technical electives is provided by the graduate-level work. The omitted technical electives would normally be the two senior project (thesis) courses. Thus, the combined program represents a contraction of 9 credits from the normal sequence of a B.Ch.E. degree followed by enrollment in the usual 30-credit graduate program; 6 credits are saved by the student's carrying out only one thesis and the other 3 from waiving CHEG 112, as noted earlier.

5) The program involves a light course load in the final year to enable the student to meet the demands of the graduate thesis at that time.

6) It is desirable for purposes of professional registration that a student be graduated from an accredited undergraduate program and for this reason both degrees (B.Ch.E. and M.Ch.E.) are to be awarded. The student will receive the B.Ch.E. degree upon completion of the third year of the attached sample program with a grade-point average at least 2.0. (This program exceeds the normal credit requirements for a B.Ch.E. degree).

A student who elects to return to a standard B.Ch.E. program and to omit the M.Ch.E. degree will be awarded the B.Ch.E. upon completion of the regular requirements for that degree.

7) To obtain the M.Ch.E. degree the student must meet a grade-point average of at least 3.0 in the 30 credits of graduate work.

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**DEGREE: BACHELOR OF CHEMICAL ENGINEERING and MASTER OF CHEMICAL ENGINEERING**

**MAJOR: CHEMICAL ENGINEERING**

**CURRICULUM**

**UNIVERSITY REQUIREMENTS**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits *</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 110</td>
<td>Critical Reading and Writing</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEG 009</td>
<td>Chemical Engineering Freshman Seminar</td>
<td>3.01</td>
</tr>
<tr>
<td>CHEG 112</td>
<td>Introduction to Chemical Engineering Analysis</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEG 341</td>
<td>Fluid Mechanics</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 342</td>
<td>Chemical Engineering Thermodynamics</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 343</td>
<td>Chemical Engineering Dynamics</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 344</td>
<td>Chemical Engineering Heat and Mass Transfer</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 345</td>
<td>Chemical Engineering Laboratory I</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 346</td>
<td>Chemical Engineering Laboratory II</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 347</td>
<td>Chemical Engineering Laboratory III</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 348</td>
<td>Chemical Engineering Laboratory IV</td>
<td>3.25</td>
</tr>
</tbody>
</table>

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*Superior figures indicate semester (fall or spring) and/or year or years in which the course is normally taken, i.e., 1F: fall of freshman year, 3S: spring of sophomore year, etc.
#This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 20.
†This curriculum assumes that the following courses have been granted by advanced placement or the equivalent. It is necessary to have 28-30 credits of advanced placement to participate in the program outlined above. The schedule will be adjusted for the accomplishments of the student by the faculty adviser.
AP Chemistry—5 credits, AP Calculus—5 credits, AP Physics—4 credits, AP English—6 credits, AP Humanities—6 credits.

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**COLLEGE REQUIREMENTS**

**General Education Program**

See page 186: College General Education Program.

**MAJOR REQUIREMENTS**

**External to the College**

**Chemistry**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 443</td>
<td>Physical Chemistry</td>
<td>3.15</td>
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<tr>
<td>CHEM 444</td>
<td>Physical Chemistry</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEM 445</td>
<td>Physical Chemistry Laboratory I</td>
<td>1.15</td>
</tr>
<tr>
<td>CHEM 331</td>
<td>Organic Chemistry</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEM 332</td>
<td>Organic Chemistry Laboratory I</td>
<td>1.25</td>
</tr>
<tr>
<td>CHEM 333</td>
<td>Organic Chemistry Laboratory II</td>
<td>1.25</td>
</tr>
<tr>
<td>CHEM 334</td>
<td>Organic Chemistry Laboratory III</td>
<td>1.25</td>
</tr>
</tbody>
</table>

**Mathematics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 243</td>
<td>Analytic Geometry and Calculus C</td>
<td>4.1F</td>
</tr>
<tr>
<td>MATH 302</td>
<td>Ordinary Differential Equations</td>
<td>3.1S</td>
</tr>
<tr>
<td>MATH 303</td>
<td>Ordinary Differential Equations Laboratory</td>
<td>1.15</td>
</tr>
<tr>
<td>MATH 305</td>
<td>Applied Math for Chemical Engineers</td>
<td>3.25</td>
</tr>
</tbody>
</table>

**Physics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 208</td>
<td>General Physics</td>
<td>4.1F</td>
</tr>
</tbody>
</table>

**General Education Program**

3.5-4

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.

**Within the College**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASC 302</td>
<td>Materials Science for Engineers</td>
<td>4.25</td>
</tr>
<tr>
<td>MEEG 863</td>
<td>Engineering Analysis I</td>
<td>3.5F</td>
</tr>
<tr>
<td>MEEG 864</td>
<td>Engineering Analysis II</td>
<td>3.5S</td>
</tr>
</tbody>
</table>

**Within the Department**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEG 009</td>
<td>Chemical Engineering Freshman Seminar</td>
<td>0.13</td>
</tr>
<tr>
<td>CHEG 112</td>
<td>Introduction to Chemical Engineering Analysis</td>
<td>3.15</td>
</tr>
<tr>
<td>CHEG 231</td>
<td>Chemical Engineering Thermodynamics</td>
<td>3.1F</td>
</tr>
<tr>
<td>CHEG 325</td>
<td>Chemical Engineering Thermodynamics</td>
<td>3.1S</td>
</tr>
<tr>
<td>CHEG 341</td>
<td>Fluid Mechanics</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 342</td>
<td>Chemical Engineering Dynamics</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 343</td>
<td>Chemical Engineering Laboratory I</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 344</td>
<td>Chemical Engineering Laboratory II</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 345</td>
<td>Chemical Engineering Laboratory III</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 346</td>
<td>Chemical Engineering Laboratory IV</td>
<td>3.25</td>
</tr>
<tr>
<td>CHEG 347</td>
<td>Chemical Engineering Laboratory V</td>
<td>3.25</td>
</tr>
</tbody>
</table>

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*CHEG 320 first offered in term 96S.
*CHEG 868 Research can be substituted for CHEG 445 with adviser's approval. This option is only available for students who received a minimum grade of B in CHEG 545.
*Credit value for CHEG 432 changes from 3 to 4, effective in term 97F.
CIVIL ENGINEERING

Traditionally, civil engineering has been identified with the planning and design of constructed facilities such as dams, bridges, buildings, transportation networks, harbors, waterways, and tunnels. Students receive solid background for working in areas such as structural engineering, soil mechanics, and hydraulics. Modern civil engineering has expanded into a variety of other areas and deals with large proportions of the infrastructure of modern industrialized societies including cities, highways and traffic control, mass transportation systems, utilities networks, irrigation systems, water resources exploration and management, environmental protection facilities, coastal management and protection works, and offshore structures. Applying technical competence to problems that are central to society's environmental needs and concerns represents challenges and opportunities for civil engineers.

The Civil Engineering Department offers a program with a balanced content varying from the fundamental disciplines to practical engineering methods. Students during the first semester begin to solve civil engineering problems on computers using mathematics and science. Throughout the four year curriculum, the Department emphasizes the application of the methods of engineering science to civil engineering problems and gradually upgrades students’ analytical and computational skills to satisfy the needs of the engineering courses. This curriculum of required core courses provides a background in the entire field of civil engineering. The emphasis on developing a sound theoretical foundation also provides a basis for continual learning throughout students' professional careers.

In the junior and senior year, there is opportunity to gain a deeper insight into one of the civil engineering disciplines through a number of technical electives. A wide variety of courses are available for this part of the program. Below, under the heading of Technical Electives, are listed some courses that, together with the required course curriculum, will give an in-depth knowledge in each of the listed areas.

DEPARTMENTAL REGULATIONS

To be enrolled in 300- or 400-level civil engineering or mechanics courses, civil engineering majors must have attained at least a C grade in the following courses: CHEM 103, CHEM 104, MATH 241, MATH 242, and PHYS 207. If courses are retaken to meet this requirement, only the most recent grade received in any given course will be used in computing the average for the purposes of this requirement.

Students also must have a 2.0 grade-point average in all required courses in mathematics, the sciences, and engineering. If courses are retaken to meet this requirement, only the most recent grade received in any repeated course will be used by the department in computing the average.

In general, 300- and 400-level courses in civil engineering are open only to Civil Engineering majors. Students who have declared a Civil Engineering Minor and students enrolled in other departments in the College of Engineering who wish to take civil engineering courses as technical electives can, with the approval of their home department adviser, be enrolled in 300- or 400-level courses in the Civil Engineering Department. In some instances, others 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 Engineering Department.

DEGREE: BACHELOR OF CIVIL ENGINEERING

MAJOR: CIVIL ENGINEERING

CURRICULUM

UNIVERSITY REQUIREMENTS

ENG 110 Critical Reading and Writing 3 15

Three credits in an approved course or courses stressing multicultural, ethnic, and/or gender-related content #

COLLEGE REQUIREMENTS

See page 186: College General Education Program.

MAJOR REQUIREMENTS

External to the College

ENG 410 Technical Writing 3 45

Chemistry

CHEM 103 General Chemistry 4 15

CHEM 104 General Chemistry 4 15

CISC 106 General Computer Science for Engineers 3 28

GEOL 107 General Geology I 4 25

STAT 450 Statistics for the Engineering and Physical Sciences 3 35

Mathematics

MATH 241 Analytic Geometry and Calculus A 4 15

MATH 242 Analytic Geometry and Calculus B 4 15

MATH 243 Analytic Geometry and Calculus C 4 29

MATH 302 Ordinary Differential Equations 3 25

Physics

PHYS 207 General Physics 4 15

PHYS 208 General Physics 4 25

Within the College

CIEG 125 Introduction to Engineering (CE) 2 15

EGGG 132 Engineering Graphics/Analysis 2 17

MASC 302 Material Science for Engineers 4 29

MECH 305 Fluid Mechanics 3 35

MECH 306 Fluid Mechanics Laboratory 1 35

*Superior figures indicate semester (fall or spring) and/or year or years in which the course is normally taken, i.e., 15fall of freshman year, 25spring of sophomore year, etc. #This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 26.
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.

### TECHNICAL ELECTIVES

The Civil Engineering curriculum contains four technical elective courses that give students the opportunity to complete their education by concentrating in an area of special interest.

The required course curriculum provides the basis in mathematics, science, the applied engineering sciences, and engineering design that students need for future work and enhances their general education background. However, it only gives students an introduction to each of the major areas of civil engineering offered by the program: Structural Engineering and Soil Mechanics, Environmental Engineering and Water Resources, Hydraulics and Ocean Engineering, and Transportation Engineering.

The following are suggestions for courses to choose from if the student wants to concentrate in one of the above mentioned areas or wants a general civil engineering degree that further supports the breadth of the required course curriculum.

#### General Civil Engineering

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIEG 223</td>
<td>Surveying</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 401</td>
<td>Computer Methods of Structural Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 402</td>
<td>Steel Design</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 403</td>
<td>Concrete Design</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 421</td>
<td>Foundations and Substructures</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 451</td>
<td>Water Supply Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Technical Electives

Four courses: Four additional design points must be satisfied; see current department technical elective listing.

**CREDITS TO TOTAL A MINIMUM OF 131**

### TECHNICAL ELECTIVES

**Environmental Engineering**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIEG 403</td>
<td>Concrete Design</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 421</td>
<td>Foundations and Substructures</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 431</td>
<td>Water Supply Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 432</td>
<td>Wastewater Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 433</td>
<td>Hazardous Waste Management</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 435</td>
<td>Industrial Wastes Management</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 457</td>
<td>Water and Wastewater Quality</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 441</td>
<td>Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 442</td>
<td>Hydraulic Engineering</td>
<td>3</td>
</tr>
<tr>
<td>AGEC 628</td>
<td>Land Application of Wastes</td>
<td>3</td>
</tr>
</tbody>
</table>

**Hydraulic and Ocean Engineering**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIEG 441</td>
<td>Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 442</td>
<td>Hydraulic Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 444</td>
<td>Introduction to Coastal Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MEE 307</td>
<td>Applied Engineering Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

**Structures and Geotechnical Engineering**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIEG 223</td>
<td>Surveying</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 401</td>
<td>Computer Methods of Structural Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 402</td>
<td>Steel Design</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 403</td>
<td>Concrete Design</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 421</td>
<td>Foundations and Substructures</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 459</td>
<td>Railroad Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

**Transportation Engineering**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIEG 452</td>
<td>Transportation Facilities Design</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 454</td>
<td>Urban Transportation Planning</td>
<td>3</td>
</tr>
<tr>
<td>CIEG 459</td>
<td>Railroad Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

**BISC 371** | Introduction to Microbiology                      | 3       |

**BISC 472** | Principles of Infectious Diseases                 | 3       |

**CHEM 213** | Elementary Organic Chemistry                      | 3       |

**CHEM 214** | Elementary Biochemistry                           | 3       |

**CHEM 220** | Quantitative Analysis                             | 3       |

**CHEM 418** | Introduction to Physical Chemistry                | 3       |

**CIEG 416** | Random Vibration                                  | 3       |

**CIEG 417** | Advanced Structural Analysis                      | 3       |

**CIEG 418** | Continuously Supported Structures                 | 3       |

**CIEG 421** | Foundations and Substructures                    | 3       |

**CIEG 422** | Earth Structures Engineering                     | 3       |

**CIEG 442** | Hydraulic Engineering                            | 3       |

**MEE 307** | Applied Engineering Analysis                     | 3       |

**MEEG 361** | Applied Engineering Analysis                      | 3       |

**AGEG 628** | Land Application of Wastes                        | 3       |

**AGEG 632** | Land Application of Wastes                        | 3       |

**AGEG 634** | Land Application of Wastes                        | 3       |

**CIEG 482** | Introduction to Coastal Engineering               | 3       |

**CIEG 486** | Engineering Management                           | 3       |

**GEOL 328** | Transportation Geography                         | 3       |

**STAT 420** | Data Analysis and Nonparametric Statistics        | 3       |
TRANSFER STUDENTS

Students wishing to transfer into the Department of Civil Engineering from other colleges outside the University are considered along with freshman applicants unless it is judged that they have completed sufficient work to be able to finish their engineering program in three years or less. Candidates for admission as sophomores or juniors will be considered in competition with students transferring internally at the University of Delaware. Successful transfer applicants will have a good record, maintaining at least a "B" average overall and in math, science, and engineering courses taken during their last year as a full-time student.

Students wishing to transfer internally into the Department of Civil Engineering from other departments or colleges within the University of Delaware must have at least sophomore status and have completed MATH 241, 242, CHEM 103, 104 and PHYS 207 with a grade of "C" or better and must have maintained at least an overall average of "B" during their last year as a full-time student. To initiate a request for transfer, a change of major form must be turned in to the department prior to May 1 for fall admission and prior to December 1 for spring admission. Compliance with the minimum requirements does not guarantee acceptance for transfer.

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 in accord with the following list and requirements. In addition, before beginning the civil engineering courses, the student must have credit for MATH 241, 242 and PHYS 207; meet the usual course prerequisites; must complete successfully, CHEM 103, 104, MATH 243, 302 and PHYS 208 before being certified for the minor in civil engineering; and must have a 2.0 average in the 21 credits of the civil engineering minor and in the eight mathematics and science courses listed above.

The required engineering courses are:

- Statics, CIEG 211 ........................................... 3
- Strength of Materials, CIEG 212 (Lab optional) .. 3
- Dynamics, CIEG 311 ...................................... 3
- Fluid Mechanics, MECH 305 (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 adviser in the Civil 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 urban topics, CIEG 331 and 431; for those interested in the environment, CIEG 301, 303 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.

ELECTRICAL ENGINEERING

Electrical engineering involves energy and information and their control, transformation and distribution. It is based on the electrical and information sciences and the related field of materials science. Recognized as a profession since the development of telegraphy, it has since grown to include power systems, telephony, electronics, radio, communications systems, computers, microelectronics, lasers and fiber optics, solar electric energy, and many other related areas.

To prepare the student for the constantly changing scope and emphases of the discipline, the Delaware program emphasizes the basics; that is, basic mathematics and science and the equally important basic principles of engineering analysis and design. To the study of the basics, the Delaware electrical engineering program adds in-depth study of an area or areas of current practice.

Coursework in electrical 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 electrical engineering: (1) a core group of technical 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 includes four courses in mathematics (starting with the second calculus course, MATH 242), two in physics, one in chemistry, two in computer science, and sixteen in electrical engineering.

The technical electives must be chosen to form an area of concentration. Four examples of acceptable concentrations (emphasizing computer engineering, systems and signals, devices and materials, and power systems) are shown on the following pages. In planning their technical elective programs, students must also consider the requirement for a design course in the senior year in which one design project is at least 50% of the course work.
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 180-181, CHEM 103, PHYS 207, and ELEG 210-211 by the end of the summer session of their freshman year. With few exceptions, electrical engineering students are expected to complete the program in eight regular semesters. With electrical engineering courses being offered only once each year, it is imperative that students follow as closely as possible the course sequence outlined in the following pages.

DEGREE: BACHELOR OF ELECTRICAL ENGINEERING
MAJOR: ELECTRICAL ENGINEERING
CURRICULUM CREDITS*

UNIVERSITY REQUIREMENTS
ENGL 110 Critical Reading and Writing .............. 3 15
Three credits in an approved course or courses stressing 3 14
multicultural, ethnic, and/or gender-related content.

COLLEGE REQUIREMENTS
General Education Program 18 14
See page 186: College General Education Program.

MAJOR REQUIREMENTS
External to the College
ENGL 301 Problems in Composition .................. 3 14
PHIL 341 Ethics of Engineering Profession .......... 1 14

Mathematics
MATH 242 Analytic Geometry and Calculus B† ........ 4 15
MATH 243 Analytic Geometry and Calculus C ....... 4 15
MATH 341 Differential Equations with Linear Algebra I 3 24
MATH 342 Differential Equations with Linear Algebra II 3 24

Chemistry
CHEM 105 General Chemistry ........................ 4 18

Physics
PHYS 207 General Physics ............................ 4 18
PHYS 208 General Physics ............................ 4 20

Computer Science
CISC 180 Introduction to Computer Science I ....... 3 18
CISC 181 Introduction to Computer Science II ...... 3 18

Within the Department
ELEG 210 Introduction to Combinational Logic ........ 2 15
ELEG 211 Introduction to Sequential Circuits ...... 2 15
ELEG 205 Linear Circuit Theory ........................ 2 15
ELEG 220 Microprocessor Based Systems I .......... 2 24
ELEG 309 Electronic Circuit Analysis I .............. 4 24
ELEG 221 Microprocessor Based Systems II ......... 2 24
ELEG 302 Electrical Properties of Materials ....... 4 24
ELEG 306 Signal Processing I ............................. 3 24
ELEG 312 Electronic Circuit Analysis II .......... 4 24
ELEG 320 Field Theory I .............................. 3 24
ELEG 305 Signal Processing II .......................... 4 24
ELEG 310 Random Signals and Noise ................. 3 24
ELEG 340 Solid State Electronics ........................ 3 24
ELEG 417 Feedback Control Systems .................. 3 24
ELEG 413 Field Theory II .............................. 3 24
ELEG 433 Energy Systems .............................. 5 24

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
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, 422, 650 and 664. 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 Department Undergraduate Representative. Students must consult with their advisers for the proper selection of design courses.

Technical Electives
Technical Electives..... 21 24

Each student must select a concentration to structure his/her technical elective credits. Four concentrations are now defined (computer engineering, systems and signals engineering, electronic devices and materials engineering and power systems engineering). Students with a special interest may define their own concentration in conjunction with their adviser. 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 Department Undergraduate Representative prior to the start of the senior year.

Each of the four regular concentrations specifies 15, or more, of the 21 technical elective credits in the core program. 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 four concentrations follow:

Technical Electives—Computer Engineering
CISC 220 Data Structures .............................. 3 18
CISC 360 Computer Architecture ...................... 3 18

*Superior figures indicate semester (fall or spring) and/or year or years in which the course is normally taken, i.e, fall of freshman year, spring of sophomore year, etc.
†Math 242 is the first mathematics course in our regular program. It is the incoming student’s responsibility to assess his/her own mathematics background and proficiency (using materials supplied by our Math Department). If you are not ready to start with MATH 242, you must take MATH 241 (and possibly other earlier mathematics courses). If you have had some calculus, but are not certain that you are ready for MATH 242, start with MATH 241. In this case it is easy to drop back to MATH 241 after a few weeks of MATH 242 if this is where you belong.
‡This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 26.
§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 advisers before selecting courses and should be aware that a formal mechanism exists to provide additional flexibility in the selection of their technical elective courses.
**MECHANICAL ENGINEERING**

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. Challenging fields requiring the talents of mechanical engineers in both the design and development of new technology are energy, environmental engineering, manufacturing, materials engineering, medical technology, transportation, and exploration of the space environment and the oceans.

Since many technologies will reach their zenith and wane in less than the duration of an individual's career, mechanical engineers must have a firm foundation in the more basic and durable engineering sciences to be able to adapt and contribute to new and evolving fields. 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 at the 400 level and above from other departments and colleges can be selected with the adviser’s approval.

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 adviser early in the junior year and to develop an agreed selection of technical electives.

### DEGREE: BACHELOR OF MECHANICAL ENGINEERING

#### MAJOR: MECHANICAL ENGINEERING

<table>
<thead>
<tr>
<th>CURRICULUM</th>
<th>CREDITS*</th>
</tr>
</thead>
</table>

#### UNIVERSITY REQUIREMENTS

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 110 Critical Reading and Writing</td>
<td>3.15</td>
</tr>
<tr>
<td>Three credits in an approved course or courses stressing multicultural, ethnic, and/or gender-related content</td>
<td>3.1-4</td>
</tr>
</tbody>
</table>

#### COLLEGE REQUIREMENTS

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education Program</td>
<td>18.1-4</td>
</tr>
</tbody>
</table>

See page 186: College General Education Program.

#### MAJOR REQUIREMENTS

**External to the College**

An additional course (minimum of three credits) that can be either Air Force ROTC or a course outside the College of Engineering (not including mathematics or science or courses in the “Group D” classification of the College of Arts and Science).

**Chemistry**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 103 General Chemistry</td>
<td>4.1F</td>
</tr>
<tr>
<td>CHEM 104 General Chemistry</td>
<td>4.1F</td>
</tr>
</tbody>
</table>

**Computer and Information Sciences**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CISC 106 General Computer Science for Engineers</td>
<td>3.2B</td>
</tr>
</tbody>
</table>

**Mathematics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 241 Analytic Geometry and Calculus A</td>
<td>3.18</td>
</tr>
<tr>
<td>MATH 242 Analytic Geometry and Calculus B</td>
<td>3.18</td>
</tr>
<tr>
<td>MATH 245 Analytic Geometry and Calculus C</td>
<td>3.2F</td>
</tr>
<tr>
<td>MATH 302 Ordinary Differential Equations</td>
<td>3.25</td>
</tr>
</tbody>
</table>

**Physics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 207 General Physics</td>
<td>4.1F</td>
</tr>
<tr>
<td>PHYS 208 General Physics</td>
<td>4.2F</td>
</tr>
</tbody>
</table>

**Within the College**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGGG 132 Engineering Graphics/Analysis</td>
<td>2.15</td>
</tr>
<tr>
<td>MASC 302 Material Science for Engineers</td>
<td>3.25</td>
</tr>
<tr>
<td>MECH 305 Fluid Mechanics</td>
<td>3.3F</td>
</tr>
<tr>
<td>MECH 306 Fluid Mechanics Laboratory</td>
<td>3.3F</td>
</tr>
<tr>
<td>ELEG 314 Electronics and Instrumentation</td>
<td>4.1F</td>
</tr>
</tbody>
</table>

**Within the Department**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEEG 125 Introduction to Mechanical Engineering</td>
<td>6.15</td>
</tr>
<tr>
<td>MEEG 213 Principles of Mechanics I</td>
<td>8.25</td>
</tr>
<tr>
<td>MEEG 214 Principles of Mechanics II</td>
<td>8.25</td>
</tr>
<tr>
<td>MEEG 307 Thermodynamics I</td>
<td>8.3F</td>
</tr>
<tr>
<td>MEEG 308 Thermodynamics II</td>
<td>5.5F</td>
</tr>
<tr>
<td>MEEG 313 Strength of Materials</td>
<td>4.5F</td>
</tr>
<tr>
<td>MEEG 316 Materials Engineering</td>
<td>5.5F</td>
</tr>
<tr>
<td>MEEG 347 Mechanical Design I</td>
<td>5.5F</td>
</tr>
<tr>
<td>MEEG 348 Mechanical Design II</td>
<td>5.5F</td>
</tr>
<tr>
<td>MEEG 361 Applied Engineering Analysis</td>
<td>3.5F</td>
</tr>
<tr>
<td>MEEG 391 Engineering Science Laboratory I</td>
<td>4.5F</td>
</tr>
<tr>
<td>MEEG 336 Fluid Mechanics II</td>
<td>5.5F</td>
</tr>
<tr>
<td>MEEG 302 Heat Transfer</td>
<td>5.5F</td>
</tr>
<tr>
<td>MEEG 427 System Dynamics I</td>
<td>5.5F</td>
</tr>
<tr>
<td>MEEG 447 Design and Systems Synthesis I</td>
<td>5.5F</td>
</tr>
<tr>
<td>MEEG 448 Design and Systems Synthesis II</td>
<td>5.5F</td>
</tr>
</tbody>
</table>

#### Technical Electives

See page 186: College General Education Program.

**Technical Electives**

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

**CREDITS TOTAL A MINIMUM OF 131**

### TECHNICAL ELECTIVES

There are four suggested areas of concentration in the technical elective offerings. Students should select a minimum of 12 credits from the following courses or substitute other courses in consultation with their adviser.

#### I. Aerospace Engineering

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEEG 411 Structural Mechanics for Mechanical and Aerospace Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 413 Advanced Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 415 Finite Element Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 429 Aerodynamics</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 435 Propulsion</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 436 Fluid Machinery</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 445 Senior Research</td>
<td>3.5F</td>
</tr>
<tr>
<td>MEEG 616 Composite Materials Structures</td>
<td>3</td>
</tr>
</tbody>
</table>

#### II. Fluids and Thermal Engineering

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEEG 408 Power Generation System Design</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 432 Aerodynamics</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 435 Propulsion</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 436 Fluid Machinery</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 4xx Flow of Viscous Materials</td>
<td>5</td>
</tr>
<tr>
<td>MEEG 445 Senior Research</td>
<td>3.5F</td>
</tr>
<tr>
<td>MEEG 6xx Composite Manufacturing</td>
<td>3</td>
</tr>
</tbody>
</table>

#### III. Solid Mechanics and Materials

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEEG 411 Structural Mechanics for Mechanical and Aerospace Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 413 Advanced Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 415 Finite Element Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 4xx Flow of Viscous Materials</td>
<td>5</td>
</tr>
<tr>
<td>MEEG 445 Senior Research</td>
<td>3.5F</td>
</tr>
<tr>
<td>MEEG 6xx Composite Materials Structures</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 6xx Composite Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 6xx Structure of Materials</td>
<td>3</td>
</tr>
<tr>
<td>ASC 615 Mechanical Properties of Materials</td>
<td>3</td>
</tr>
</tbody>
</table>

---

*Superior figures indicate semester (fall or spring) and/or year or years in which the course is normally taken, i.e., fall of freshman year, spring of sophomore year, etc.

#This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 26.

†Students are encouraged to develop a technical elective program that meets their own interests and career plans, but all technical elective selections must be approved by an adviser.
COLLEGE OF ENGINEERING • AIR FORCE ROTC

The Air Force Reserve Officer Training Corps (AFROTC) provides a program for 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.

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 $1,000 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, and be in good academic standing.

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 and one-and-a-half hours of leadership laboratory 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 and one-and-a-half hours of leadership laboratory 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 Laboratory is open to students wishing to transfer into the department:

1. Completion of MATH 241, MATH 242, PHYS 207, CHEM 103I and CHEM 104I with a grade of C or better in each course.
2. An overall grade-point index above the median of the freshman class (currently 2.5).

These admission criteria are minimum standards, and more stringent requirements may be imposed by enrollment limitations. In any case, admission depends on there being enrollment openings in the class for which the student is applying. Generally, the guidelines specified by the College Transfer Policy will be followed to initiate and process transfer applicants (see page 187). This general transfer policy should be reviewed carefully by all applicants.

Students should also be aware that by taking MEEG courses beyond those listed as required for transfer, they are not guaranteed candidacy for the Bachelor of Mechanical Engineering. Control of class size and total enrollment in the department have, on occasion, required that nonmajors be administratively removed from class lists following the registration period. Faculty teaching junior and senior courses are instructed not to admit nonmajors during the drop/add period without consulting the chairperson.

TRANSFER STUDENTS

Students who wish to transfer into the Department of Mechanical Engineering from outside the college but within the University should apply to the chair by May 1 and complete a Change of College/Major/Degree form. Because of the large enrollment in the department, the following guidelines have been established for students wishing to transfer into the department:

1. Completion of MATH 241, MATH 242, PHYS 207, CHEM 103I and CHEM 104I with a grade of C or better in each course.
2. An overall grade-point index above the median of the freshman class (currently 2.5).

These admission criteria are minimum standards, and more stringent requirements may be imposed by enrollment limitations. In any case, admission depends on there being enrollment openings in the class for which the student is applying. Generally, the guidelines specified by the College Transfer Policy will be followed to initiate and process transfer applicants (see page 187). This general transfer policy should be reviewed carefully by all applicants.

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IV Design, Dynamics and Manufacturing

MEEG 408 Power Generation System Design ........................................... 3
MEEG 415 Finite Element Analysis ....................................................... 3
MEEG 415 Senior Research ................................................................. 3-6
MEEG 625 Vehicle Dynamics .............................................................. 3
MEEG 663 Computer Aided Design .................................................... 3
MEEG 6xx Composite Manufacturing .................................................. 3
MEEG 6xx Design with Composites ..................................................... 3
MEEG 6xx Design of Composites ......................................................... 3

DEPARTMENT OF AIR FORCE ROTC

The Air Force Reserve Officer Training Corps (AFROTC) provides a program for 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.

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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 and one-and-a-half hours of leadership laboratory 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 and one-and-a-half hours of leadership laboratory 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 Laboratory is open to stu-

‡CHEM 111, 112 and 119 are acceptable substitutes
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.

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 and two hours of leadership laboratory 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 and two hours of leadership laboratory 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 Laboratory is 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.

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. Any University of Delaware student may apply for these scholarships. Opportunity for scholarship selection is enhanced by enrolling in AFROTC. Those selected receive full tuition, lab expenses, incidental and textbook fees, plus a $100 monthly, nontaxable allowance during the school year. Students who accept a scholarship enter the AFROTC program as a contract cadet.

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.