The mission of the College of Engineering at the University of Delaware is to cultivate both learning and the advancement of knowledge in the engineering sciences. To this end, we provide all of our students with outstanding undergraduate, graduate, and continuing education programs so that they will know how to reason critically and independently yet cooperate productively. Our graduates should understand our culture, communicate clearly in writing and speech, and develop into informed citizens and leaders. The College of Engineering at the University of Delaware recognizes the increasing diversity of its students and faculty and, therefore, strives to create an atmosphere in which all people feel welcome to learn and participate in the free exchange of ideas.

The College of Engineering offers baccalaureate degrees in chemical, civil, environmental, electrical, computer, and mechanical engineering and minors in biochemical engineering, civil engineering, environmental engineering, and materials science and engineering. The College of Engineering and the College of Arts and Sciences 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 Sciences (see page 187). Additionally, the College of Engineering and the College of Business and Economics offer a joint five-year program that 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 (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 groups who are underrepresented in engineering and others. The program begins with a pre-freshman Summer Enrichment Program and continues to graduation. Interested individuals should contact the Assistant Dean and Director of the RISE Program at 302-831-6315.
DEAN’S SCHOLAR PROGRAM

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

COLLEGE BREADTH REQUIREMENTS

The College of Engineering requires that 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 courses. Detailed guidelines, which include a list of courses that may be used to satisfy the program’s requirements, may be obtained from the Assistant Dean for Undergraduate Affairs and from the College of Engineering academic advisement website:

1. At least 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.

2. At least six credits must be in the social sciences. The social sciences include courses in areas such as Economics, Political Science, Psychology, and Sociology.

3. At least 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.

4. At least 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 Breadth Requirement. Students must consult their faculty advisors and the guidelines published by the College of Engineering for the proper classification of breadth requirement 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 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. Credit from courses taken pass/fail cannot be used to complete any engineering degree requirement, unless the course is only offered pass/fail in the engineering curriculum.

TRANSFER STUDENTS

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

Students at the University of Delaware who wish to transfer into a major within the College of Engineering must make a formal request to the appropriate engineering department. This request may be made through the Student Information System using a web-based form.

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.

AIR FORCE ROTC

Telephone: (302) 831-2863
http://www.udel.edu/afrotc
Faculty Listing: http://www.udel.edu/afrotc/cadre/index.htm

The Air Force Reserve Officer Training Corps (AFROTC) program trains qualified college students to earn commissions as second lieutenants in the United States Air Force while completing their university course requirements. Commissioning follows the award of a university bachelor’s degree. Those who have a bachelor’s degree and are enrolled in graduate courses are also eligible. 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 obligation to the Air Force and may elect to discontinue the program at any time. The final two years, the POC, concentrate on developing leadership and management skills and on a study of American defense policy. Students must compete for entry into the POC. If accepted, they must attend field training at a designated Air Force base during the summer following their sophomore year of college. When they return to the university in the fall, they are placed under contract with the Air Force to complete the program and serve a minimum of four years on active duty. Pilot and navigator candidates incur an additional obligation because of specialized training following commissioning.

Students in any major with less than four years, but more than two remaining until graduation may join the program. These students will enter the appropriate GMC class based on their projected graduation date.

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. This option may not be available to students in all academic degrees.

GENERAL REQUIREMENTS FOR POC ACCEPTANCE

Students competing for acceptance as POC cadets must 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

ACADEMIC COURSES
Freshman year: The Foundations of the USAF I and II AFSC 110 (fall) and AFSC 111 (spring). Each of these one-credit courses consists of approximately one hour of academic class each week. In combination, these two courses survey the history and organization of the Air Force, its benefits and opportunities, and leadership skills.

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

GMC courses are open to all freshman and sophomore students.

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

Senior year: National Security Affairs I and II—AFSC 410 (fall) and AFSC 411 (spring). Each of these three-credit courses consists of three 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 LABORATORY
Leadership laboratory is open to students who are members of the Air Force Reserve Officer Training Corps or are eligible to pursue a commission as determined by the Professor of Aerospace Studies. Leadership laboratory is scheduled for two hours per week for GMC and for three hours per week for POC.

PHYSICAL FITNESS
Members of the Air Force Reserve Officer Training Corps are required to maintain certain physical fitness standards. Physical training activities are scheduled twice a week for one hour each. In order to participate, members must have a valid DoDMERB physical or sports physical. Forms to document the sports physical are available at the detachment and on-line.

SCHOLARSHIPS AVAILABLE
Air Force ROTC scholarships are available to qualified students in all majors and are based on the whole-person concept. Scholarships are awarded in varying amounts and may be used towards tuition and some mandatory fees. All Air Force ROTC scholarships include a yearly book stipend and a tax-free monthly allowance. Amounts and may be used towards tuition and some mandatory fees. All Air Force ROTC scholarships are based on the whole-person concept. Scholarships are awarded in varying amounts and may be used towards tuition and some mandatory fees. All Air Force ROTC scholarships include a yearly book stipend and a tax-free monthly allowance.

The University of Delaware also offers scholarships to students enrolled in the AFROTC program. These scholarships may be used towards tuition or room and board charges and are offered each semester to qualified students in all majors based on merit.

Contact the unit’s admission officer for current details.

AIR FORCE ROTC NURSING PROGRAM
Air Force ROTC makes it possible for qualified nursing school students to enroll in its program and, upon completion of all academic requirements, receive a commission as a second lieutenant in the United States Air Force in the nursing career field. Scholarships are available to qualified applicants.

DEGREE: BACHELOR OF CHEMICAL ENGINEERING

MAJOR: CHEMICAL ENGINEERING

Chemical Engineering

Sharon Anderson
Telephone: (302) 831-2427
E-mail: anderson@che.udel.edu
http://www.che.udel.edu
Faculty Listing: http://www.che.udel.edu/faculty.jsp

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.
CHEM 111 General Chemistry .......................... 3 S
CHEM 119 Quantitative Chemistry I .......................... 3 S
CHEM 122 General Chemistry II .......................... 3 S
CHEM 331 Organic Chemistry .......................... 3 S
CHEM 333 Organic Chemistry Laboratory I (lecture only) .......................... 1 S
CHEM 445 Physical Chemistry Laboratory I .......................... 1 S

The student has the option of taking two credits of CHEM333 Organic Chemistry Laboratory (laboratory and lecture) and not taking CHEM445 Physical Chemistry Lab. I.

Core Courses

CHEM 444 Physical Chemistry .......................... 3 S

or

CHEM 527 Introductory Biochemistry .......................... 3 S
MATH 242 Analytic Geometry and Calculus B .......................... 4 S
MATH 243 Analytic Geometry and Calculus C .......................... 4 S
MATH/CHEM 305 Applied Math for Chemical Engineering .......................... 3 S
PHYS 207 Fundamentals of Physics I .......................... 4 S
PHYS 208 Fundamentals of Physics II .......................... 4 S
MSEG 302 Materials Science for Engineers .......................... 3 S

CHEG 009 Chemical Engineering Freshman Seminar .......................... 0 S

CHEG 112 Introduction to Chemical Engineering .......................... 3 S
CHEG 231 Chemical Engineering Thermodynamics .......................... 3 S
CHEG 232 Chemical Engineering Thermodynamics .......................... 3 S
CHEG 322 Chemical Engineering Kinetics .......................... 3 S
CHEG 341 Fluid Mechanics .......................... 3 S
CHEG 320 Engineering Economics and Risk Assessment .......................... 3 S
CHEG 342 Heat and Mass Transfer .......................... 3 S
CHEG 345 Chemical Engineering Laboratory I .......................... 3 S
CHEG 401 Chemical Process Dynamics and Control .......................... 3 S
CHEG 443 Mass Transfer Operations .......................... 3 S
CHEG 445 Chemical Engineering Laboratory II .......................... 3 S

or

CHEG 473 Chemical Engineering Projects .......................... 3 S

Can be substituted for CHEG 445 with advisor's approval. This option is only available for students who received a minimum grade of B in CHEG 345.

Note that UNIV 401-402 is equivalent to CHEG 473-474.

CHEG 432 Chemical Process Analysis .......................... 3 S

TECHNICAL ELECTIVES

The student must take four General Technical Electives (12 credits) and four Chemical Engineering Technical Electives (12 credits) or take five General Technical Electives (15 credits) and three Chemical Engineering Technical Electives (9 credits). In either case the student must complete a minimum of 24 credits of Technical and Chemical Engineering Elective courses. Of the set of Technical Electives, no more than 6 credits can be lower level technical courses (2xx or below) from a list compiled by the department.

General Technical Electives .......................... 12-15 S

The purpose of the technical electives is to advance the student's scientific engineering background of the chemical engineers. The technical electives program consists of a minimum of twelve credits taken from the College of Engineering and the College of Arts and Sciences (see below). At least three of these courses (nine credits) must be at the intermediate level (generally 300-600). Students should select their technical electives in the spring of sophomore year to avoid scheduling conflicts. Students should formulate an academic plan for their technical and chemical engineering electives with the assistance of their academic advisor.

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

Chemical Engineering Technical Electives .......................... 12 S

The curriculum provides three chemical engineering technical electives in the senior year. In addition, the student can exchange one of the General Technical Electives provided in the senior year for a Chemical Engineering Technical Elective after consultation with the academic advisor. These courses are intended to provide some flexibility in selecting a chemical engineering program at the advanced level. Students should decide with the assistance of their advisor if they should conduct a program of independent research and then choose their course elective(s).

Chemical engineering technical electives are defined as follows:

Any Chemical Engineering course numbered 466 to 474; UNIV 401-UNIV 402

Senior Thesis (directed by a Chemical Engineering Faculty); any 600- or 800-level course in Chemical Engineering. Courses at the 600 and 800-level are graduate courses open, with the consent of the instructor, to students with senior standing.

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

CONCENTRATIONS

The technical electives and the chemical engineering electives can be coupled to provide a more intense concentration in an area of interest. The grouping below is an example of this approach.

CHEMISTRY

CHEM 457 Inorganic Chemistry
CHEM 527 Introductory Biochemistry
CHEG 606 Introduction to Catalysis
CHEG 616 Chemistry and Physics of Surfaces and Interfaces
CHEG 617 Colloid Science and Engineering

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 general University requirements for the Honors Degree (see p. 48).

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. Please read the course descriptions for the specific prerequisites and corequisites.

GRADUATION REQUIREMENTS:

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

MINOR IN BIOCHEMICAL ENGINEERING

A minor in Biochemical Engineering may be earned by a student in any University bachelor's degree program through successful completion of a minimum of 19 credits as described below. This degree provides students with an opportunity to study new advances in biochemistry and the biological sciences integrated with engineering analysis. Before beginning these courses the student must meet the required course prerequisites. A minimum grade of C- is required in all of the courses completed for the minor. To obtain a minor in Biochemical Engineering the student must take the following four required courses:

BISC207 Introductory Biology I
BISC401 Molecular Biology of the Cell
CHEM527 Introduction to Biochemistry
CHEG620 Biochemical Engineering

AND the students must take any TWO of the following courses:

CHEG621 Metabolic Engineering
CHEG650 Biomedical Engineering
CHEM645 Protein Structure and Function
CHEM649 Molecular Biophysics
CHEM646 DNA-Protein Interactions
CHEM644 Mechanisms of Enzyme Catalysis
CHEM648 Membrane Biochemistry
MEEG684 Biomaterials and Tissue Engineering

Other courses in Chemical Engineering, Chemistry or Biology can be included in the list with the prior approval of a representative from the Department of Chemical Engineering. For inquiries about the Biochemical Engineering Minor contact Prof. Anne Robinson at 831-0550 (robinson@che.udel.edu).

CIVIL AND ENVIRONMENTAL ENGINEERING

Telephone: (302) 831-2442
http://www.ce.udel.edu
Faculty Listing: http://www.ce.udel.edu/directories/faculty.html
The Civil and Environmental Engineering Department offers programs which lead to the degrees of Bachelor of Civil Engineering and Bachelor of Environmental Engineering, both with Honors Degree options, as well as a minor in Civil Engineering.

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

The Educational Objectives of the Civil Engineering degree program are as follows:
1. Graduates will be prepared with a solid foundation in mathematics, sciences, and technical skills needed to analyze and design civil infrastructure systems.
2. Graduates will possess strong written, oral, and graphical communications skills, and will be able to function on multi-disciplinary teams.
3. Graduates will be familiar with current and emerging socioeconomic issues and the global context in which civil engineering is practiced.
4. Graduates will have an understanding of professional ethics and their societal responsibilities as a practicing engineer.
5. Graduates will have the ability to obtain professional licensure, will recognize the need for engaging in life-long learning, and will have the ability to assume leadership roles in and outside of the profession.
6. Graduates will have the necessary qualifications for employment in civil engineering and related professions and for entry into advanced studies.

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

The Educational Objectives of the Environmental Engineering degree program are as follows:
1. Graduates will be prepared with a solid foundation in mathematics, sciences, and technical skills needed to analyze and design civil infrastructure systems.
2. Graduates will possess strong written and oral communications skills.
3. Graduates will be familiar with current and emerging environmental engineering and global issues, and have an understanding of ethical and societal responsibilities.
4. Graduates will have the ability to obtain professional licensure, and will recognize the need for engaging in life-long learning.
5. Graduates will have the necessary qualifications for employment in environmental engineering and related professions, for entry into advanced studies, and for assuming eventual leadership roles in their professions.

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:
- A minimum grade of C- in MATH 241 and MATH 242.
- A minimum grade of C- in CHEM 103.
- A minimum grade of C- in PHYS 207.

ENVIRONMENTAL ENGINEERING

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

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

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

Admission to CHEG 332 requires:
- A minimum grade of C- in CHEG 325.
- A minimum grade of C- in MATH 302.

Admission to CHEG 342 requires:
- A minimum grade of C- in CHEG 305 and CHEG 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. fall of freshman year, spring of sophomore year, etc.

UNIVERSITY REQUIREMENTS

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>ENGL 110</td>
<td>Critical Reading and Writing</td>
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</tr>
<tr>
<td>First Year Experience</td>
<td>see p. 64</td>
<td>0.4</td>
</tr>
<tr>
<td>Discovery Learning Experience</td>
<td>see p. 64</td>
<td>3</td>
</tr>
</tbody>
</table>

MAJOR REQUIREMENTS

Breadth Requirements

See p. 178: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 64-66).

ENGL 410 | Technical Writing | 3 |
| COMM 212 | Oral Communications in Business | 3 |
| CHEM 103 | General Chemistry | 4 |
| CISC 105 | General Computer Science for Engineers | 3 |
| MATH 241 | Analytic Geometry and Calculus A | 4 |
| MATH 242 | Analytic Geometry and Calculus B | 4 |
| MATH 243 | Analytic Geometry and Calculus C | 4 |
| MATH 351 | Engineering Mathematics I | 3 |
| MATH 353 | Engineering Mathematics III | 3 |
| PHYS 207 | Fundamentals of Physics I | 4 |
| CHEM 104 | General Chemistry | 4 |
| or | General Geology I | 4 |
| or | Fundamentals of Physics II | 4 |

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PHYS 245 Introduction to Electricity and Electronics
or
BISC 207 Introductory Biology I
or
BISC 209 Introductory Biology II
MSEG 302 Materials Science for Engineers                   3
CIEG 125 Introduction to Civil Engineering                  2
CIEG 126 Introduction to Surveying and Computer Aided Drafting 3
CIEG 211 Statics                                            3
CIEG 212 Solid Mechanics                                    3
CIEG 213 Civil Engineering Materials Laboratory            1
CIEG 301 Structural Analysis                               4
CIEG 302 Structural Design                                 4
CIEG 305 Fluid Mechanics                                   3
CIEG 306 Fluid Mechanics Laboratory                        1
CIEG 311 Dynamics                                          3
CIEG 315 Probability and Statistics for Engineers           3
CIEG 320 Soil Mechanics                                     3
CIEG 321 Geotechnical Engineering                          3
CIEG 322 Soil Mechanics Laboratory                         1
CIEG 331 Environmental Engineering                         3
CIEG 351 Transportation Engineering                        3
CIEG 440 Water Resources Engineering                       3
CIEG 451 Transportation Engineering Laboratory             1
CIEG 461 Senior Design Project                              4
CIEG 486 Construction Methods and Management               3
Technical Electives                                        9

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

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

Note: Students who begin in MATH 242 but do not have credit for MATH 241 may use four free elective credits in place of the four credits for MATH 241.

TECHNICAL ELECTIVES

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

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

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

General Civil Engineering
CIEG 401 Introduction to the Finite Element Method
CIEG 407 Building Design
CIEG 409 Forensic Engineering
CIEG 452 Transportation Facilities Design
CIEG 471 Introduction to Coastal Engineering

Environmental and Water Resource Engineering
CIEG 407 Building Design
CIEG 433 Hazardous Waste Management
CIEG 437 Water and Wastewater Quality
BISC 371 Introduction to Microbiology
BISC 641 Microbial Ecology
BREG 628 Land Application of Wastes
CHEM 213 Elementary Organic Chemistry
CHEM 214 Elementary Biochemistry
CHEM 220 Quantitative Analysis
CHEM 418 Introduction to Physical Chemistry
ELEG 681 Remote Sensing in Environment
GEOL 421 Environmental and Applied Geology
GEOL 428 Hydrogeology

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

Structures and Geotechnical Engineering
CIEG 401 Introduction to the Finite Element Method
CIEG 405 Matrix Structural Analysis
CIEG 407 Building Design
CIEG 408 Introduction to Bridge Design
CIEG 409 Forensic Engineering
CIEG 410 Experimental Mechanics of Composite Materials
CIEG 411 Structural Dynamics Design
CIEG 417 Advanced Structural Analysis
CIEG 418 Continuously Supported Structures
CIEG 422 Earth Structures Engineering
CIEG 425 Geoenvironmental Engineering
CIEG 459 Railroad Engineering

Transportation and Construction Engineering
CIEG 412 Traffic Design
CIEG 454 Urban Transportation Planning
CIEG 459 Railroad Engineering
GEOL 328 Transportation Geography
STAT 420 Data Analysis and Nonparametric Statistics

HONORS BACHELOR OF CIVIL ENGINEERING

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

1. All requirements for the Bachelor of Civil Engineering degree.
2. All generic University requirements for the Honors Degree (see p. 48).
3. Graduate courses approved for this purpose by the department may be counted as Honors courses.
4. The Honors Thesis must be within the disciplines of Civil and Environmental Engineering. It must be supervised by a faculty member from the Department of Civil and Environmental Engineering and successfully presented orally in front of a committee approved by the department Undergraduate Committee.

MINOR IN CIVIL ENGINEERING

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

Further, an additional 9 credits (3 courses) in civil engineering must be taken of which at least 6 credits must be at the 300-level or higher. Those courses shall be selected with the specific advice of an advisor in the Civil and Environmental Engineering Department to meet each student’s objectives. For students interested in environmental topics, CIEG 331 and 351; for those interested in urban topics, CIEG 331 and 351; for those with interests in construction and structures, CIEG 301 and 302; for those interested in the oceans, CIEG 440 and 471.

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

UNIVERSITY, COLLEGE, AND MAJOR REQUIREMENTS

CREDITS

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 110</td>
<td>Critical Reading and Writing</td>
<td>3†</td>
</tr>
</tbody>
</table>

First Year Experience (see p. 64) ........................................... 0-4

Discovery Learning Experience (see p. 64) .................................. 3

COLLEGE REQUIREMENTS

Breadth Requirements .......................................................... 18^4

See p. 178: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 64-66).

MAJOR REQUIREMENTS

Core Courses for the Major:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>ENGL 410</td>
<td>Technical Writing</td>
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<tr>
<td>MATH 241</td>
<td>Analytic Geometry and Calculus</td>
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</tr>
<tr>
<td>MATH 242</td>
<td>Analytic Geometry and Calculus B</td>
<td>4†</td>
</tr>
<tr>
<td>MATH 243</td>
<td>Analytic Geometry and Calculus C</td>
<td>4†</td>
</tr>
<tr>
<td>MATH 302</td>
<td>Ordinary Differential Equations</td>
<td>3†</td>
</tr>
<tr>
<td>PHYS 207</td>
<td>Fundamentals of Physics</td>
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<tr>
<td>BISC 302</td>
<td>General Ecology</td>
<td>3†</td>
</tr>
<tr>
<td>CHEM 231</td>
<td>Chemical Engineering Thermodynamics</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 126</td>
<td>CAD, GIS, Surveying</td>
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</tr>
<tr>
<td>CIEG 135</td>
<td>Introduction to Environmental</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 211</td>
<td>Statics</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 212</td>
<td>Solid Mechanics</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 213</td>
<td>Civil Engineering Materials Laboratory</td>
<td>1†</td>
</tr>
<tr>
<td>CIEG 233</td>
<td>Environmental Engineering Processes</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 305</td>
<td>Fluid Mechanics</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 306</td>
<td>Fluid Mechanics Laboratory</td>
<td>1†</td>
</tr>
<tr>
<td>CIEG 313</td>
<td>Probability and Statistics for Engineers</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 337</td>
<td>Environmental Engineering Laboratory</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 434</td>
<td>Air Pollution Control</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 436</td>
<td>Solid Waste Management</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 437</td>
<td>Water &amp; Wastewater Quality</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 438</td>
<td>Water and Wastewater Engineering</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 440</td>
<td>Water Resources Engineering</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 461</td>
<td>Senior Design Project</td>
<td>2†</td>
</tr>
<tr>
<td>CIEG 461</td>
<td>Senior Design Project</td>
<td>2†</td>
</tr>
</tbody>
</table>

Beyond these core courses, a concentration must also be chosen. The concentration determines which chemistry sequence is needed and which technical electives should be taken as a core group. For the chemistry courses, entering students are advised to take the CHEM 111/112/119, but CHEM 103/104 is acceptable for most concentrations.

Each concentration also requires eight technical elective courses, totaling twenty-five credit hours, to provide the desired focus at the intermediate and advanced levels. Beyond the set of specific core technical electives for the concentration, 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 are initially admitted to Environmental Engineering in the concentration "Contaminant Transport and Control Processes,” since the sequence of courses in this concentration allows students to change to any other concentration following the sophomore year. Students may choose a different concentration at any time with the approval of their advisor, but changes should be made before the junior year to avoid scheduling conflicts and to insure that prerequisite courses are taken. The chemistry courses and the core technical electives are listed below for each concentration.

CREDITS TO TOTAL A MINIMUM OF ........................................... 125

DEGREE: BACHELOR OF ENVIRONMENTAL ENGINEERING

MAJOR: ENVIRONMENTAL ENGINEERING

CONCENTRATION: ENVIRONMENTAL FACILITIES DESIGN AND CONSTRUCTION

Engineering and constructing the systems for air, water, and wastewater purification. Students should select this concentration before enrolling for third-year courses.

CURRICULUM CREDITS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 103</td>
<td>General Chemistry</td>
<td>4†</td>
</tr>
<tr>
<td>CHEM 104</td>
<td>General Chemistry</td>
<td>4†</td>
</tr>
<tr>
<td>CIEG 301</td>
<td>Structural Analysis</td>
<td>4†</td>
</tr>
<tr>
<td>CIEG 302</td>
<td>Structural Design</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 320</td>
<td>Soil Mechanics</td>
<td>3†</td>
</tr>
<tr>
<td>CIEG 323</td>
<td>Soil Mechanics Laboratory</td>
<td>1†</td>
</tr>
</tbody>
</table>

Additional technical electives, incl. 3 cr. Earth Science* ........................................... 13

*Advisor should be consulted to assure that Earth Science requirement is met through an appropriate technical elective.

DEGREE: BACHELOR OF ENVIRONMENTAL ENGINEERING

MAJOR: ENVIRONMENTAL ENGINEERING

CONCENTRATION: ENVIRONMENTAL BIOTECHNOLOGY

Biological and microbial aspects of contaminant behavior in natural and engineered systems. Students should select this concentration before enrolling for third-year courses.

CURRICULUM CREDITS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
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<tr>
<td>CHEM 103</td>
<td>General Chemistry</td>
<td>4†</td>
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<tr>
<td>CHEM 104</td>
<td>General Chemistry</td>
<td>4†</td>
</tr>
<tr>
<td>CHEM 331</td>
<td>Organic Chemistry</td>
<td>3†</td>
</tr>
<tr>
<td>CHEM 333</td>
<td>Organic Chemistry Lab</td>
<td>1†</td>
</tr>
<tr>
<td>PISC 319</td>
<td>Environmental Soil Microbiology</td>
<td>4†</td>
</tr>
<tr>
<td>BISC 300</td>
<td>Introduction to Microbiology</td>
<td>4†</td>
</tr>
</tbody>
</table>

Additional technical electives incl. 6 cr. Engg topics* ........................................... 10

*Advisor should be consulted to assure that Engineering Topic requirement is met through appropriate technical electives.

DEGREE: BACHELOR OF ENVIRONMENTAL ENGINEERING

MAJOR: ENVIRONMENTAL ENGINEERING

CONCENTRATION: WATER RESOURCES AND WATER QUALITY

Technical issues associated with providing, maintaining, and improving the supply and quality of surface and groundwaters. Students should select this concentration before enrolling for third-year courses.

CURRICULUM CREDITS

See text above for University and College requirements.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 103</td>
<td>General Chemistry</td>
<td>4†</td>
</tr>
<tr>
<td>CHEM 104</td>
<td>General Chemistry</td>
<td>4†</td>
</tr>
<tr>
<td>EGTE 321</td>
<td>Storm Water Management</td>
<td>4†</td>
</tr>
</tbody>
</table>
Additional technical electives

Electrical and Computer Engineering

Telephone: (302) 831-2405
E-mail: dnelson@udel.edu
http://www.ece.udel.edu
Faculty Listing: http://www.ece.udel.edu/people/faculty/

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

Both degrees strive to achieve four program Educational Objectives:

1. Graduates can apply a broad knowledge of mathematics, science, and computer/electrical engineering to engineering problems.
2. Graduates can communicate effectively and can work well with others.
3. Graduates can adapt to changes in engineering, technology, and society.
4. Graduates can assist the Electrical and Computer Engineering department in evaluating and improving its programs.

The first objective relates to the knowledge and skills obtained through the curriculum, the second to writing, speaking, and teamwork skills, the third to a strong preparation in basics of science and technology and an understanding of life-long learning opportunities, and the fourth to an expectation that graduates will “give back” and help improve the program for future students.

Coursework in electrical and computer engineering starts with the first term of the freshman year, with successive years building on prerequisite courses and including an unusually high number of courses with laboratories.

There are three basic parts to the Delaware curriculum in engineering: (1) a core group of courses, (2) an elective group of technical courses, and (3) a “breadth” component that includes six courses in the humanities and social sciences and two in written communications.

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

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

The breadth component must include courses from the humanities and from the social sciences, including courses at an advanced level. Electrical and Computer Engineering students must include a course in microeconomics and two writing courses (ENGL 110 and one from a list of four upper level English courses). Any deviation from these requirements must be approved by the ECE Department Chair or his/her designee.
DEPARTMENTAL REQUIREMENTS

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

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. “fall of freshman year,” “spring of sophomore year,” etc.

UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing
(minimum grade C) .................................................. 3
First Year Experience (see p. 64) .................................. 0.4
Discovery Learning Experience (see p. 64) .................... 3

MAJOR REQUIREMENTS

Breadth Requirements ........................................... 18
See p. 178: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 64-66). ECON 151 is also required within the Breadth Requirements.

One of the following four courses must be taken:
ENGL 301 Expository Writing
ENGL 312 Written Communications in Business
ENGL 410 Technical Writing
ENGL 415 Writing for the Professions

MATH 241 Analytic Geometry and Calculus A ........................................ 4
MATH 242 Analytic Geometry and Calculus B ........................................ 4
MATH 243 Analytic Geometry and Calculus C ........................................ 4
MATH 341 Differential Equations with Linear Algebra I ........................... 3
MATH 342 Differential Equations with Linear Algebra II ........................ 3
CHEM 103 General Chemistry ........................................ 4
PHYS 207 Fundamentals of Physics I ........................................ 4
PHYS 208 Fundamentals of Physics II ........................................ 4
CISC 105 Introduction to Computer Science I .................................... 3
CISC 181 Introduction to Computer Science II ................................ 3
CISC 220 Data Structures ........................................ 3
CPEG 222 Microprocessor Based Systems .................................... 4
ELEG 205 Analog Circuits I ........................................ 4
ELEG 212 Signals and Communications ................................ 4
ELEG 240 Physical Electronics ........................................ 4
ELEG 305 Signal Processing I ........................................ 3
ELEG 309 Electronic Circuit Analysis I .................................... 4
ELEG 310 Random Signals and Noise ................................ 3
ELEG 340 Solid State Electronics ....................................... 3
ELEG 370 Engineering Electromagnetics .................................. 4
ELEG 490 Career Skills for Engineers .................................. 1

Design Requirement ........................................... 4
In addition to the content of the normal program, every student must take at least four credits in ELEG courses designated as “design.” Regularly offered design courses include ELEG 410, ELEG 430, ELEG 438, and ELEG 450. Other courses may be offered irregularly which satisfy the design requirement. Students should consult with their advisors before selecting their design course or courses.

Technical Electives ........................................... 20
In addition to the design requirement, each student, in consultation with their advisor, must select a program of technical electives satisfying the following: (1) With some exceptions, technical electives consist of 300-level or above engineering, mathematics, natural sciences, and computer science courses. With the permission of the student’s advisor, certain 200-level courses, such as PHYS 209, are permitted. (2) At least 20 technical elective credits must be taken. (3) Of the 20 technical elective credits, at least 14 must be in CPEG or ELEG courses. (4) Of the 14 credits in ELEG or CPEG, at least 6 must be in 400-level or above CPEG or ELEG courses.

CREDITS TO TOTAL A MINIMUM OF ......................... 125

HONORS BACHELOR OF ELECTRICAL ENGINEERING

A recipient of the Honors Bachelor of Electrical Engineering must satisfy the following:
1. All requirements for the Bachelor of Electrical Engineering degree.
2. All generic University requirements for the Honors Degree (see p. 48). Graduate courses approved for this purpose by the department may be counted as Honors courses.

DEGREE: BACHELOR OF COMPUTER ENGINEERING
MAJOR: COMPUTER ENGINEERING

CURRICULUM CREDITS

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

UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing
(minimum grade C) .................................................. 3
First Year Experience (see p. 64) .................................. 0.4
Discovery Learning Experience (see p. 64) .................... 3

MAJOR REQUIREMENTS

Breadth Requirements ........................................... 18
See p. 178: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 64-66). ECON 151 is also required within the Breadth Requirements.

One of the following four courses must be taken:
ENGL 301 Expository Writing
ENGL 312 Written Communications in Business
ENGL 410 Technical Writing
ENGL 415 Writing for the Professions

MATH 241 Analytic Geometry and Calculus A ........................................ 4
MATH 242 Analytic Geometry and Calculus B ........................................ 4
MATH 243 Analytic Geometry and Calculus C ........................................ 4
MATH 341 Differential Equations & Linear Alg I ................................... 3
MATH 342 Differential Equations & Linear Alg II ................................ 3
PHYS 207 Fundamentals of Physics ........................................ 4
PHYS 208 Fundamentals of Physics ........................................ 4
CHEM 103 General Chemistry ........................................ 4
CISC 105 Introduction to Computer Science I .................................... 3
CISC 181 Introduction to Computer Science II ................................ 3
CISC 220 Data Structures ........................................ 3
CISC 361 Operating Systems ........................................ 3
CISC 222 Microprocessor Based Systems .................................... 4
CISC 232 Introduction to Computer System Engineering ........................................ 4
CISC 234 Computer Systems Design I .................................... 3
CPEG 490 Career Skills for Engineers .................................. 1
ELEG 205 Circuit Analysis I ........................................ 4
ELEG 212 Signals and Communications ................................ 4
ELEG 240 Physical Electronics ........................................ 4
ELEG 305 Signal Processing ........................................ 3
ELEG 309 Electronic Circuit Analysis I .................................... 4
ELEG 310 Random Signals and Noise ................................ 3
ELEG 370 Engineering Electromagnetics .................................. 4

Design Requirement ........................................... 4
In addition to the content of the normal program, every student must take at least four credits in a CPEG course designated as “design.” Regularly offered CPEG design courses include CPEG 410, CPEG 422, and CPEG 460. Other courses may be offered irregularly which satisfy the design requirement. Students should consult with their advisors before selecting their design course or courses.

Technical Electives ........................................... 14
In addition to the design requirement, each student, in consultation with their advisor, must select a program of technical electives satisfying the following: (1) With some exceptions, technical electives consist of 300-level or above engineering, mathematics, natural sciences, and computer science courses. With the permission of the student’s advisor, certain 200-level courses, such as PHYS 209, are permitted. (2) At least 14 technical elective credits must be taken. (3)
the following:

b. Produce graduates who satisfy the needs for mechanical engineers of our local constituent industries.

c. Produce graduates who continue in post-baccalaureate studies.

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

The degree program is designed to serve not only those students who go into industry or government directly after the B.M.E. degree, but also those who go on to a graduate program in engineering or continue their education in other professions such as medicine, law or business administration. Undergraduates are encouraged to participate in research projects with faculty and graduate students which may involve the use of state-of-the-art instrumentation, electronics and networked computers.

TECHNICAL ELECTIVES

Technical electives in the senior year of the Bachelor of Mechanical Engineering curriculum provide the student with an opportunity to pursue areas of particular interest. The technical electives are taken after much of the basic engineering science has been mastered and comprise four coordinated courses (a minimum of 12 credits). Although the majority of the available electives are drawn from the Mechanical Engineering department, courses from other departments and colleges can be selected with the approval of the departmental faculty.

Students can choose towards the end of sophomore or early junior year to pursue one of two concentrations: Aerospace or Biomedical Engineering to focus their upperclass studies. For those pursuing the degree without a concentration, other suggested focus areas include: materials and composites, fluids and thermal engineering, energy engineering (including fuel cell technologies), robotics and controls, manufacturing, and design. However, the technical elective program can also 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. “fall of freshman year,” “spring of sophomore year,” etc.

UNIVERSITY REQUIREMENTS

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

First Year Experience (see p. 64) ................................................................. 0.4

Discovery Learning Experience (see p. 64) ......................................................... 3

MAJOR REQUIREMENTS

Breath Requirements .................................................................................................................. 18

See p. 178: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 64-66).

CHEM 103 General Chemistry ................................................................................................. 4

MATH 241 Analytic Geometry and Calculus A .......................................................................... 4

MATH 242 Analytic Geometry and Calculus B .......................................................................... 4

MATH 243 Analytic Geometry and Calculus C .......................................................................... 4

MATH 351 Engineering Mathematics I ..................................................................................... 3

MATH 352 Engineering Mathematics II ................................................................................... 3

MATH 353 Engineering Mathematics III .................................................................................. 3

PHYS 207 Fundamentals of Physics I ....................................................................................... 4
Three of the following three-credit courses must also be taken:*

- Advanced courses in Aerospace Engineering

All students must take the following course:

- Technical elective requirements for the BME degree.

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

**CURRICULUM**

**MAJOR REQUIREMENTS**

**Basic Biology Courses**

- All students must take two courses in basic biology such as:
  - HESC 220 Anatomy and Physiology ........................................ 3
  - HESC 420 Functional Human Anatomy ........................................ 4

**Advanced courses in Biomedical Engineering**

- Two of the following three-credit courses must also be taken:*
  - MEEG 483 Orthopedic Biomechanics ........................................ 3
  - MEEG 482 Clinical Biomechanics ............................................. 3
  - MEEG 484 Biomechanics of Musculoskeletal Systems .................... 3
  - MEEG 612 Biomechanics of Human Movement .............................. 3
  - ELEG 471 Intro to Biomedical Engineering ................................. 3

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

**DEGREE: BACHELOR OF MECHANICAL ENGINEERING**

**CONCENTRATION: BIOMEDICAL ENGINEERING**

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

**CURRICULUM**

**MAJOR REQUIREMENTS**

**Required Courses**

- All students must take the following course:
  - MEEG 432 Aerodynamics ...................................................... 3

**Advanced courses in Aerospace Engineering**

- Three of the following three-credit courses must also be taken:*
  - MEEG 411 Structural Mechanics for Mechanical and Aerospace Engineering .................................................. 3
  - MEEG 419 Mechanics of Materials and Structures ................... 3
  - MEEG 423 Vibrations ............................................................ 3

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

**HONORS BACHELOR OF MECHANICAL ENGINEERING**

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

1. All requirements for the Bachelor of Mechanical Engineering degree.
2. All generic University requirements for the Honors Degree (see p. 48).

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

**ARTS AND SCIENCES - ENGINEERING DOUBLE DEGREE**

Telephone: (302) 831-8659
E-mail: boulet@udel.edu

The Arts and Sciences–Engineering program is a five-year curriculum which leads to a Bachelor of Arts from the College of Arts and Sciences 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 Sciences courses. Students must complete the college-level requirements of the College of Arts and Sciences and earn 15 credits of electives in an Arts and Sciences 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 Sciences degrees.

Students who wish to pursue the five-year Arts and Sciences–Engineering program must initially be 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 Sciences major for which they are academically qualified.

**AREA OF CONCENTRATION.** The 15 credit hours which compose the Arts and Sciences 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 Sciences department. An Arts-Engineering student whose Arts and Sciences 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 Sciences. With careful planning, however, it is sometimes possible to obtain a second major in Arts and Sciences 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., *fall of freshman year, spring of sophomore year, etc.*

UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C-) 3\textsuperscript{1/2}

First Year Experience [see p. 64] 0-4

Discovery Learning Experience [see p. 64] 3

Three credits in an approved course or courses stressing multi-cultural, ethnic, and/or gender-related course content [see p. 64-66] 3\textsuperscript{1/4}

These credits may also fulfill some of the breadth requirements.

ARTS AND SCIENCES 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, pages 89-91.)

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

BREADTH REQUIREMENTS [See pages 91-97]

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 representing 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 Breadth Requirements of the College of Engineering. This requires careful course selection in order to have courses that satisfy both curricula simultaneously.

AREA OF CONCENTRATION REQUIREMENTS

Area of Concentration: 15

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

Art and Science Requirements: 45-51

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

ENGINEERING COLLEGE REQUIREMENTS

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

CREDITS TO TOTAL A MINIMUM OF 152-156

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