



COLLEGE OF ENGINEERING

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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 encourages a strong tradition of applying its distinguished scholarship, research, and educational resources to serve the local, state, and national communities through collaborative efforts with individuals, industry, and government. 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 189). 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. The program begins with a pre-freshman Summer Academy and continues to graduation. Interested individuals should contact the Assistant Dean and Director of the RISE Program at 302-831-6315.

ADVISEMENT

Undergraduate student advisement begins during New Student Orientation and continues through graduation. All engineering students are assigned faculty advisors, and students are required to consult with their advisors during the advanced registration periods. Students must also obtain approval from their advisor for courses taken during the Winter or Summer Sessions and when adding or dropping courses. Students are also encouraged to meet with their engineering faculty advisors at other times to learn more about undergraduate academic options, the engineering profession, and graduate school opportunities.

The College Undergraduate Affairs Office provides advisement to students who experience academic difficulties or who require additional guidance. The Assistant Dean for Undergraduate Affairs conducts a preliminary degree checkout with each engineering student early in his or her senior year to help identify any impediments to graduation.

CURRICULUM ORGANIZATION

The undergraduate curriculum in each engineering major consists of a core of required courses, a group of elective technical classes, and a group of breadth requirement courses. The core group includes courses in mathematics, chemistry, physics, computer science, and engineering. The technical elective courses allow students to investigate the sciences in more depth and to develop a concentration within their engineering discipline. Most of the breadth requirement courses are taken from the humanities and social sciences to provide a well-rounded education. The College's breadth requirements are described in the following section. Additional requirements specified by individual engineering departments are given in the appropriate departmental sections.

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 interdepartmental majors 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 six courses (minimum of 18 credits) be chosen from the humanities and social sciences subject to the constraints listed below and the approval of the student's advisor. The courses selected must provide both breadth and depth and not be limited to a selection of unrelated introductory courses. The University's multicultural course requirement may be included in this set of six courses. 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:

<http://www.engr.udel.edu/adsup/advise/advise.html>.

1. At least two courses (minimum of six credits) must be in the humanities. Humanities include courses in areas such as Art History, English Literature, Foreign Languages other than the student's native language, History, and Philosophy.
2. At least two courses (minimum of six credits) must be in the social sciences. The social sciences include courses in areas such as Economics, Political Science, Psychology, and Sociology.
3. At least two courses (minimum of six credits) must be above the introductory level. These courses must build upon the content of a previous course, as approved by the faculty advisor. Courses which fulfill this requirement are normally at the 300-level or above.
4. At least two of the six courses (minimum of six credits) must be thematically related. Courses which fulfill this requirement are typically in the same department or program.

Courses in mathematics, science, or engineering may not be used to satisfy any 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 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
www.udel.edu/afrotc

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 in 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.

ONE-YEAR PROGRAM

The one-year program is sometimes offered to senior or graduate students pursuing specific degrees. The academic requirements for this program are the same as the last two years of the four-year program, but are compressed into one year. Students in this program will normally attend field training after graduation.

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 scholarships include a yearly book stipend and a tax-free monthly allowance. Students who accept these scholarships enter the AFROTC program as a contract cadet and incur a four-year active duty service commitment.

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

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 programs 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.

CHEMICAL ENGINEERING

To request further information about our Department and our undergraduate program, contact:

Sharon Anderson
Telephone: (302) 831-2427
E-mail: anderson@che.udel.edu
www.che.udel.edu

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

The Educational Objectives of our Department are:

- To provide students with the breadth of educational opportunities in the chemical and biological sciences and in engineering that will enable them to pursue productive careers.
- To maintain an environment that enables students to identify and pursue their personal and professional goals within an innovative educational program that is rigorous and challenging as well as flexible and supportive.
- To educate graduates who will be able to apply their knowledge of chemical engineering, including their problem solving, analytical, design, and communication skills, in the private or public sectors and/or in the pursuit of more advanced degrees.
- To cultivate graduates who will actively seek to provide technical, educational, public sector and/or business leadership in a rapidly changing, increasingly technological, global society and who recognize their professional responsibility toward the betterment of our community.

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

The Department of Chemical Engineering also offers a minor in Biochemical Engineering designed for those students with special interest in the pharmaceutical and biotechnology industries. The Biochemical Engineering minor's curriculum consists of a sequence of courses in the biological and biochemical sciences and their engineering applications (see description below). A student can fulfill the requirements of both the Bachelor in Chemical Engineering and a minor in Biochemical Engineering in four academic years.

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

DEGREE: BACHELOR OF CHEMICAL ENGINEERING
MAJOR: CHEMICAL ENGINEERING

CURRICULUM**CREDITS**

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

UNIVERSITY REQUIREMENTS

ENGL 110	Critical Reading and Writing (minimum grade C-)	3 ^{1F}
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MAJOR REQUIREMENTS**Breadth Requirements** 21^{1,4}

See p. 180: College of Engineering Breadth Requirements. Three of the breadth requirement 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 Sciences may not be used to fulfill this requirement. One of the breadth requirement courses must fulfill the University multicultural requirement. A list of current breadth requirement courses can be obtained at:

<http://www.engr.udel.edu/adsup/advise/gen-ed-req.html>

CHEM 111	General Chemistry	3 ^{1F}
CHEM 119	Quantitative Chemistry I	2 ^{1F}
CHEM 112	General Chemistry	3 ^{1S}
CHEM 331	Organic Chemistry	3 ^{2F}
CHEM 333	Organic Chemistry Laboratory I (lecture only)	1 ^{2F}
CHEM 445	Physical Chemistry Laboratory I	1 ^{2S}

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 ^{2S}
CHEM 332	Organic Chemistry	
or		
CHEM 527	Introductory Biochemistry	3 ^{3S}
MATH 242	Analytic Geometry and Calculus B	4 ^{1F}
MATH 243	Analytic Geometry and Calculus C	4 ^{1S}
MATH/CHEG 305	Applied Math for Chemical Engineering	3 ^{2F}
PHYS 207	Fundamentals of Physics I	4 ^{1S}
PHYS 208	Fundamentals of Physics II	4 ^{2F}
MSEG 302	Materials Science for Engineers	3 ^{2S}
CHEG 009	Chemical Engineering Freshman Seminar	0 ^{1F}
CHEG 112	Introduction to Chemical Engineering	3 ^{1S}
CHEG 231	Chemical Engineering Thermodynamics	3 ^{2F}
CHEG 325	Chemical Engineering Thermodynamics	3 ^{2S}
CHEG 332	Chemical Engineering Kinetics	3 ^{3F}
CHEG 341	Fluid Mechanics	3 ^{3F}
CHEG 320	Engineering Economics and Risk Assessment	3 ^{3S}
CHEG 342	Heat and Mass Transfer	3 ^{3S}
CHEG 345	Chemical Engineering Laboratory I	3 ^{3S}
CHEG 401	Chemical Process Dynamics and Control	3 ^{4F}
CHEG 443	Mass Transfer Operations	3 ^{4F}
CHEG 445	Chemical Engineering Laboratory II	

or		
CHEG 473	Chemical Engineering Projects	3 ^{4F}

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 ^{4S}
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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^{2S,4FS}

The purpose of the technical electives is to advance the scientific or engineering background of the chemical engineers. The technical electives program consists of a minimum of 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 12-9^{4FS}

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 125**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 generic University requirements for the Honors Degree (see page 45). 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).

CHEMICAL ENGINEERING CURRICULUM - MASTER'S - BACHELOR'S PROGRAM

Under unusual circumstances, a highly qualified student may earn a Bachelor of Chemical Engineering and a Master of Chemical Engineering in four years. This program assumes that the student enters with advanced sophomore standing and is able to cope with at least one term of a substantial overload. Interested students should contact the department for further information and a sample schedule. It should be noted that, in order to ensure a broad educational experience, the Department does not admit Delaware undergraduates to its Ph.D. program unless they have at least three years of industrial experience or have earned a master's degree at another institution.

CIVIL AND ENVIRONMENTAL ENGINEERING

Telephone: (302) 831-2442
www.ce.udel.edu

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 CIEG 305 and CIEG 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. ^{1F}fall of freshman year, ^{2S}spring of sophomore year, etc.

UNIVERSITY REQUIREMENTS

ENGL 110	Critical Reading and Writing (minimum grade C-)	3 ^{1F}
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MAJOR REQUIREMENTS

Breadth Requirements 18¹⁻⁴

See p. 180: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 62-65).

ENGL 410	Technical Writing	3 ^{2F}
COMM 212	Oral Communications in Business	3 ^{3F}
CHEM 103	General Chemistry	4 ^{1F}
CISC 105	General Computer Science for Engineers	3 ^{2S}
MATH 241	Analytic Geometry and Calculus A	4 ^{1F}
MATH 242	Analytic Geometry and Calculus B	4 ^{1S}
MATH 243	Analytic Geometry and Calculus C	4 ^{2F}
MATH 351	Engineering Mathematics I	3 ^{2S}
MATH 353	Engineering Mathematics III	3 ^{3F}
PHYS 207	Fundamentals of Physics I	4 ^{1S}
CHEM 104	General Chemistry	4 ^{2F}
or		
GEOL 107	General Geology I	
or		
PHYS 208	Fundamentals of Physics II	
or		
PHYS 245	Introduction to Electricity and Electronics	
or		
BISC 207	Introductory Biology I	
or		
BISC 208	Introductory Biology II	
MSEG 302	Materials Science for Engineers	3 ^{2S}
CIEG 125	Introduction to Civil Engineering	2 ^{1F}
CIEG 126	Introduction to Surveying and Computer Aided Drafting	3 ^{1S}
CIEG 211	Statics	3 ^{2F}
CIEG 212	Solid Mechanics	3 ^{2S}
CIEG 213	Civil Engineering Materials Laboratory	1 ^{2S}
CIEG 301	Structural Analysis	4 ^{2F}
CIEG 302	Structural Design	4 ^{3S}
CIEG 305	Fluid Mechanics	3 ^{3F}
CIEG 306	Fluid Mechanics Laboratory	1 ^{3S}
CIEG 311	Dynamics	3 ^{2S}
CIEG 315	Probability and Statistics for Engineers	3 ^{3S}
CIEG 320	Soil Mechanics	3 ^{3F}
CIEG 321	Geotechnical Engineering	3 ^{3S}
CIEG 323	Soil Mechanics Laboratory	1 ^{3F}
CIEG 331	Environmental Engineering	3 ^{3S}
CIEG 351	Transportation Engineering	3 ^{3S}
CIEG 440	Water Resources Engineering	3 ^{4F}
CIEG 451	Transportation Engineering Laboratory	1 ^{4F}
CIEG 461	Senior Design Project	4 ^{4F 4S}
CIEG 486	Construction Methods and Management	3 ^{4F}
Technical Electives		9 ^{4F 4S}

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

CREDITS TO TOTAL A MINIMUM OF 126

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

TECHNICAL ELECTIVES

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

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

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

General Civil Engineering

CIEG 401	Introduction to the Finite Element Method
CIEG 407	Building Design
CIEG 409	Forensic Engineering
CIEG 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 452	Transportation Facilities Design
CIEG 454	Urban Transportation Planning
CIEG 459	Railroad Engineering
GEOG 328	Transportation Geography
STAT 420	Data Analysis and Nonparametric Statistics

HONORS BACHELOR OF CIVIL ENGINEERING

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

1. All requirements for the Bachelor of Civil Engineering degree.
2. All generic University requirements for the Honors Degree (see p. 45). Graduate courses approved for this purpose by the department may be counted as Honors courses.
3. The Honors Thesis must be within the disciplines of Civil and Environmental Engineering. It must be supervised by a faculty member from the Department of Civil and Environmental Engineering and successfully presented orally in front of a committee approved by the department Undergraduate Committee.

MINOR IN CIVIL ENGINEERING

A minor in civil engineering may be earned by a student in any University bachelor's degree program through successful completion of a minimum of 21 credits in civil engineering and engineering mechanics. Before beginning the civil

engineering courses, the student must meet the required mathematics and physics prerequisites. A grade of C- or better is required in all of the courses completed for the minor.

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

CIEG 211	Statics	3
CIEG 212	Solid Mechanics (Lab optional)	3
CIEG 311	Dynamics	3
CIEG 305	Fluid Mechanics (Lab optional)	3

Further, an additional 9 credits (3 courses) in civil engineering must be taken of which at least 6 credits must be at the 300-level or higher. Those courses shall be selected with the specific advice of an advisor in the Civil and Environmental Engineering Department to meet each student's objectives. For students oriented toward earth sciences these might include CIEG 320, 323 and 321; for those interested in the environment, CIEG 233 and 331; for those interested in urban topics, CIEG 331 and 351; for those with interests in construction and structures, CIEG 301 and 302; for those interested in the oceans, CIEG 440 and 471

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

DEGREE: BACHELOR OF ENVIRONMENTAL ENGINEERING

MAJOR: ENVIRONMENTAL ENGINEERING

CURRICULUM

CREDITS

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

UNIVERSITY REQUIREMENTS

ENGL 110	Critical Reading and Writing (minimum grade C-)	3 ^{1F}
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MAJOR REQUIREMENTS

Breadth Requirements 18^{1,4}
See p. 180: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 62-65).

ENGL 410	Technical Writing	3 ^{2F}
CHEM 111	General Chemistry	3 ^{1F}
CHEM 119	Quantitative Chemistry I	2 ^{1F}
CHEM 112	General Chemistry	3 ^{1S}
MATH 241	Analytic Geometry and Calculus A	4 ^{1F}
MATH 242	Analytic Geometry and Calculus B	4 ^{1S}
MATH 243	Analytic Geometry and Calculus C	4 ^{2F}
MATH 302	Ordinary Differential Equations	3 ^{2S}
PHYS 207	Fundamentals of Physics I	4 ^{1S}
BISC 321	Environmental Biology	3 ^{2S}
CISC 105	General Computer Science for Engineers	3 ^{2S}
CHEG 231	Chemical Engineering Thermodynamics	3 ^{3F}
CHEG 325	Chemical Engineering Thermodynamics	4 ^{3S}
CIEG 135	Introduction to Environmental Engineering	1 ^{1F}
CIEG 211	Statics	3 ^{2F}
CIEG 212	Solid Mechanics	3 ^{2S}
CIEG 213	Civil Engineering Materials Laboratory	1 ^{2S}
CIEG 233	Environmental Engineering Processes	3 ^{2F}
CIEG 305	Fluid Mechanics	3 ^{3F}
CIEG 306	Fluid Mechanics Laboratory	1 ^{3S}
CIEG 315	Probability and Statistics for Engineers	3 ^{3S}
CIEG 337	Environmental Engineering Laboratory	3 ^{3S}
CIEG 434	Air Pollution Control	3 ^{4S}
CIEG 436	Solid Waste Management	3 ^{4S}
CIEG 437	Water & Wastewater Quality	3 ^{4S}
CIEG 438	Water and Wastewater Engineering	3 ^{3F}
CIEG 440	Water Resources Engineering	3 ^{4F}
CIEG 461	Senior Design Project	2 ^{4F}
CIEG 461	Senior Design Project	2 ^{4S}

Earth Science Elective 3^{3S}
One course taken from geology, soil science, hydrology, or as approved by the faculty advisor.

Technical Electives 18^{3,4}
Six courses chosen from the current list of approved technical electives.

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

CREDITS TO TOTAL A MINIMUM OF 125

TECHNICAL ELECTIVES

Six courses, totaling eighteen credit hours, are provided to allow the student flexibility at the intermediate and advanced levels of the program. An area of concentration is first determined, defined by a set of specific core technical electives as given below. The remaining technical electives can then be chosen to further pursue this direction of study, or to provide a more diversified environmental engineering education. All technical electives must be upper level courses in engineering, the sciences, computer science, or mathematics. Students should select their area of concentration and desired technical electives with the assistance of their academic advisor. It is advisable to select these courses in the spring of the sophomore year to avoid scheduling conflicts and to insure that prerequisite courses are taken. The core technical electives and additional technical electives for the environmental engineering concentrations are shown below.

Environmental Facilities Design and Construction Required Technical Electives

CIEG 301	Structural Analysis
CIEG 302	Structural Design
CIEG 320	Soil Mechanics
CIEG 323	Soil Mechanics Laboratory

Pollution Transport and Control Processes Required Technical Electives

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

Environmental Biotechnology Required Technical Electives

CHEM 331	Organic Chemistry
CHEM 333	Organic Chemistry Lab
PLSC 319	Environmental Soil Microbiology
BISC 300	Introduction to Microbiology
CHEM 342	Introduction to Biochemistry

Additional Recommended Technical Electives

CHEM 444	Physical Chemistry
CIEG 321	Geotechnical Engineering
CIEG 407	Building Design
CIEG 433	Hazardous Waste Management
CIEG 482	Systems Design and Operation
GEOL 421	Environmental and Applied Geology
GEOL 446	General Geochemistry
MEEG 424	Air Pollution Processes
MSEG 302	Materials Science
PLSC 608	Soil Chemistry
BISC 301	Molecular Biology of Cells
BISC 311	Molecular Biology for Engineers
BISC 641	Microbial Ecology
CIEG 636	Biological Aspects of Environmental Engineering
PLSC 619	Soil Microbiology

Note: This list is not exhaustive. Consult your advisor

HONORS BACHELOR OF ENVIRONMENTAL ENGINEERING

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

1. All requirements for the Bachelor of Environmental Engineering degree.
2. All generic University requirements for the Honors Degree (see page 45). Graduate courses approved for this purpose by the department may be counted as Honors courses.
3. The Honors Thesis must be within the disciplines of Civil and Environmental Engineering and successfully presented orally in front of a committee approved by the department Undergraduate Committee.

MINOR IN ENVIRONMENTAL ENGINEERING

A minor may be earned by a student in any University bachelor's degree program through the successful completion of a minimum of 18 credits as described below. Before beginning the environmental engineering courses, the student must meet the required mathematics, physics, and other prerequisites for each course. A grade of C- or better is required in all of the courses completed for the minor.

One chemistry course is required (4 credits):

CHEM 104* General Chemistry 4

*Can be replaced with CHEM 112

Two environmental engineering courses (6 credits) are required:

CIEG 223* Environmental Engineering Processes 3

CIEG 305** Fluid Mechanics (Lab optional) 3

*Can be replaced with CIEG 331 or CHEG 112

**Can be replaced with MEEG 331 or CHEG 341

Further, an additional 9 credits (3 courses) in environmental engineering must be taken from the following:

CIEG 430 Water Quality Modeling 3

CIEG 433 Hazardous Waste Management 3

CIEG 434 Air Pollution Control 3

CIEG 436 Solid Waste Management 3

CIEG 438* Water and Wastewater Engineering 3

CIEG 440 Water Resources Engineering 3

CIEG 498 Groundwater Flow and Containment Transport 3

*Will not count if CIEG 331 is taken in place of CIEG 233

Courses shall be selected from the above list with the specific advice of an advisor in the Civil and Environmental Engineering Department to meet each student's objectives. Other courses in civil and environmental engineering may be included in the above list with prior approval of a representative from the Department of Civil and Environmental Engineering. For inquiries about the environmental engineering minor contact Prof. Pei Chiu at 831-3104 (pei@ce.udel.edu).

Civil and chemical engineering majors would be able to pursue the minor by selecting their required technical and science electives appropriately. No additional credits beyond what is required by their major would be necessary to obtain an environmental engineering minor for these students. Mechanical engineering students would need to select their required technical electives appropriately and take one additional course - CHEM 104.

ELECTRICAL AND COMPUTER ENGINEERING

Telephone: (302) 831-2405

E-mail: dnelson@udel.edu

www.ece.udel.edu

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. ^{1F}fall of freshman year, ^{2S}spring of sophomore year, etc.

UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing
(minimum grade C-) 3^{1S}

MAJOR REQUIREMENTS

Breadth Requirements 18^{1,4}

See p. 180: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 62-65). 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 ^{1F}
MATH 242	Analytic Geometry and Calculus B	4 ^{1S}
MATH 243	Analytic Geometry and Calculus C	4 ^{2F}
MATH 341	Differential Equations with Linear Algebra I	3 ^{2S}
MATH 342	Differential Equations with Linear Algebra II	3 ^{3F}
CHEM 103	General Chemistry	4 ^{1F}
PHYS 207	Fundamentals of Physics I	4 ^{1S}
PHYS 208	Fundamentals of Physics II	4 ^{2F}

CISC 105	Introduction to Computer Science I	3 ^{1F}
CISC 181	Introduction to Computer Science II	3 ^{1S}
CISC 220	Data Structures	3 ^{2S}
CPEG 202	Introduction to Digital Systems	4 ^{1F}
CPEG 222	Microprocessor Based Systems	4 ^{2S}
ELEG 205	Analog Circuits I	4 ^{2F}
ELEG 212	Signals and Communications	4 ^{2F}
ELEG 240	Physical Electronics	3 ^{3F}
ELEG 305	Signal Processing I	4 ^{3F}
ELEG 309	Electronic Circuit Analysis I	3 ^{3S}
ELEG 310	Random Signals and Noise	3 ^{3F}
ELEG 340	Solid State Electronics	4 ^{3S}
ELEG 370	Engineering Electromagnetics	4 ^{1F}
ELEG 490	Career Skills for Engineers	4 ⁴

Design Requirement

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 ELEG or CPEG courses.

CREDITS TO TOTAL A MINIMUM OF 125**HONORS BACHELOR OF ELECTRICAL ENGINEERING**

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

1. All requirements for the Bachelor of Electrical Engineering degree.
2. All generic University requirements for the Honors Degree (see page 45). 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. ^{1F}fall of freshman year, ^{2S}spring of sophomore year, etc.

UNIVERSITY REQUIREMENTS

ENGL 110	Critical Reading and Writing (minimum grade C-)	3 ^{1S}
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MAJOR REQUIREMENTS

Breadth Requirements 18¹⁻⁴
See p. 180: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 62-65). 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	Analytical Geometry and Calculus A	4 ^{1F}
MATH 242	Analytical Geometry and Calculus B	4 ^{1S}
MATH 243	Analytical Geometry and Calculus C	4 ^{2F}
MATH 341	Differential Equations & Linear Alg I	3 ^{2S}
MATH 342	Differential Equations & Linear Alg II	3 ^{3F}
PHYS 207	Fundamentals of Physics	4 ^{1S}
PHYS 208	Fundamentals of Physics	4 ^{2F}
CHEM 103	General Chemistry	4 ^{1F}
CISC 105	General Computer Science	3 ^{1F}
CISC 181	Introduction to Computer Science II	3 ^{1S}
CISC 220	Data Structures	3 ^{2S}
CISC 361	Operating Systems	3 ^{3S}

Students with adequate programming experience may substitute the CISC 181, CISC 220 and CISC 280 sequence for the CISC 105, CISC 181 and CISC 220 sequence.

CPEG 202	Introduction to Digital Systems	4 ^{1F}
CPEG 222	Microprocessor Systems	4 ^{2S}
CPEG 323	Introduction to Computer System Engineering	3 ^{3F}
CPEG 324	Computer Systems Design I	3 ^{3S}
CPEG 490	Career Skills for Engineers	1 ^{4F}
ELEG 205	Linear Circuit Theory	4 ^{2F}
ELEG 212	Signals and Communications	4 ^{2F}
ELEG 240	Physical Electronics	4 ^{2S}
ELEG 305	Signal Processing	3 ^{3F}
ELEG 309	Electronic Circuit Analysis I	4 ^{3F}
ELEG 310	Random Signals and Noise	3 ^{3S}
ELEG 370	Engineering Electromagnetics	4 ^{3S}

Design Requirement 4⁴

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

Technical Electives 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) Of the 14 technical elective credits, at least 8 must be in CPEG or ELEG courses. (4) Of the 8 credits in ELEG or CPEG, at least 6 must be in 400-level or above ELEG or CPEG courses.

CREDITS TO TOTAL A MINIMUM OF 125**HONORS BACHELOR OF COMPUTER ENGINEERING**

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

1. All requirements for the Bachelor of Computer Engineering degree.
2. All generic University requirements for the Honors Degree (see page 45). Graduate courses approved for this purpose by the department may be counted as Honors courses.

MATERIALS SCIENCE AND ENGINEERING

Telephone: (302) 831-2062
E-mail: matsci@udel.edu
www.udel.edu/mse

Although the Materials Science and Engineering Department offers no degrees at the undergraduate level, undergraduate students study the basic concepts associated with the engineering properties of materials in undergraduate courses taught by the Materials Science and Engineering faculty. In addition, the department offers a minor in materials science and engineering. 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.

MINOR IN MATERIALS SCIENCE AND ENGINEERING

A minor in materials science and engineering requires the completion of 15 credits with a minimum grade of C- in all courses. MSEG 302 is a required course, and the remaining may be drawn from a wide variety of materials science, engineering, physics, and chemistry courses up to the 600-level. All courses used to fulfill the requirements of the minor must be approved by a materials science advisor. A listing of commonly offered courses is maintained by the Chair of the Materials Science and Engineering Department. Other materials courses may be approved as appropriate. For further information, contact Professor Ismat Shah at 302-831-1618; Ismat@udel.edu.

MECHANICAL ENGINEERING

Telephone: (302) 831-2421
E-mail: info@me.udel.edu
www.me.udel.edu

The Department of Mechanical Engineering offers an ABET-accredited program leading to the Bachelor of Mechanical Engineering, including a University of Delaware Honors Degree Option. Mechanical engineers receive one of the broadest educations of any of the modern engineering disciplines and consequently are well prepared to apply basic engineering principles to a wide variety of society's needs.

In order to prepare the mechanical engineers of the future to take their places in this profession and to be fully consistent with the published University and College Mission Statements, the UD Department of Mechanical Engineering has developed an undergraduate program that is both intellectually challenging and broad in scope.

The overall Educational Objectives of the UD BME program are the following:

- Produce graduates with a strong foundation in engineering fundamentals for employment in industry, government, and non-profit sectors.
- Produce graduates who satisfy the needs for mechanical engineers of our local constituent industries.
- 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, biomechanics, controls, design and systems, robotics, energy, and fluids.

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

TECHNICAL ELECTIVES

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

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, there are three suggested focus areas: Fluids and Thermal Engineering, Solid Mechanics and Materials, and Design (Dynamic Design and Manufacturing). 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. ^{1F}fall of freshman year, ^{2S}spring of sophomore year, etc.

UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C-) 3^{1F}

MAJOR REQUIREMENTS**Breadth Requirements** 18¹⁴

See p. 180: College Breadth Requirements. One of these courses must fulfill the University multi-cultural requirement (see p. 62-65)

CHEM 103	General Chemistry	4 ¹
MATH 241	Analytic Geometry and Calculus A	4 ^{1F}
MATH 242	Analytic Geometry and Calculus B	4 ^{1S}
MATH 243	Analytic Geometry and Calculus C	4 ^{2F}
MATH 351	Engineering Mathematics I	3 ^{2F}
MATH 352	Engineering Mathematics II	3 ^{2S}
MATH 353	Engineering Mathematics III	3 ^{2S}
PHYS 207	Fundamentals of Physics I	4 ¹
PHYS 245	Introduction to Electricity and Electronics	4 ^{2S}
PHYS 310	Introduction to Thermal Physics	3 ^{2S}
MSEG 302	Materials Science for Engineers	3 ^{2S}
MEEG 101	Introduction to Mechanical Engineering	3 ^{1F}
MEEG 102	Intro to Mechanical Engineering Laboratories	1 ^{1S}
MEEG 112	Statics	3 ^{1S}
MEEG 202	Computer-Aided Engineering Design	3 ^{2S}
MEEG 211	Dynamics	3 ^{2F}
MEEG 215	Mechanics of Solids	4 ^{2F}
MEEG 301	Machine Design - Kinematics and Kinetics	3 ^{2F}
MEEG 304	Machine Design - Elements	3 ^{2S}
MEEG 311	Vibration and Control	4 ^{3F}
MEEG 321	Materials Engineering	3 ^{3F}
MEEG 331	Fluid Mechanics I	4 ^{3F}
MEEG 332	Fluid Mechanics II	3 ^{3S}
MEEG 342	Heat Transfer	3 ^{3S}
MEEG 344	Thermodynamics	3 ^{3S}
MEEG 346	Thermal Lab	1 ^{3S}
MEEG 401	Senior Design	6 ^{4F}
Technical Electives		12 ⁴

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

CREDITS TOTAL A MINIMUM OF 122

DEGREE: BACHELOR OF MECHANICAL ENGINEERING
MAJOR: 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**CREDITS****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	Biomaterials and Tissue Engineering	3
MEEG 612	Biomechanics of Human Movement	3

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

DEGREE: BACHELOR OF MECHANICAL ENGINEERING
MAJOR: MECHANICAL ENGINEERING
CONCENTRATION: AEROSPACE 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 Aerospace 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 12 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	CREDITS
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MAJOR REQUIREMENTS

Required Course

All students must take the following course:

MEEG 432 Aerodynamics	3
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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 423 Vibrations	3
MEEG 441 Combustion	3
MEEG 481 Computer Solution of Engineering Problems	3
MEEG 624 Control of Dynamic Systems	3
CIEG 401 Introduction to the Finite Element Method	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. 45). 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
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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. ¹fall of freshman year, ²spring of sophomore year, etc

UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C-)	3 ^{1S}
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Three credits in an approved course or courses stressing multi-cultural, ethnic, and/or gender-related course content (see p. 62-65) 3¹⁴
 These credits may also fulfill some of the breadth requirements.

ARTS AND SCIENCES COLLEGE REQUIREMENTS

Writing: (minimum grade C-)	3
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A three-credit writing course involving significant writing experience including two papers with a combined minimum of 3,000 words to be submitted for extended faculty critique of both composition and content. These credits may also fulfill some of the breadth requirements.

(See list of courses approved for second writing requirement, page 91-93.)

Foreign Language: Completion of the intermediate level course (107 or 112) in a given language. Students with four or more years of high school work in a single foreign language may attempt to fulfill the requirement in that language by taking an exemption examination	0-12
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BREADTH REQUIREMENTS (See page 93-98)

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