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. The College also offers minors in biochemical engineering, bioelectrical engineering, biomedical engineering, civil engineering, environmental engineering, materials science and engineering, and nanoscale materials. 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 196). 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.

Engineering freshmen have the choice of being admitted directly into one of our six majors or of entering the first fall semester as Engineering Undecided (EGU). Students who choose the EGU option begin their studies in the fall by taking a special set of courses called the Common Fall Semester. This set of courses has been designed to permit EGU freshmen to choose any of the six majors in their spring semester. The Introduction to Engineering course taught in the fall semester lays out the nature of each engineering discipline so that students may make an informed choice of major during the latter part of the semester as they begin registration for the spring. Successful completion of the Common Fall Semester permits students to finish any engineering major in the normal four years, provided that they are on track with the calculus sequence for the chosen major.

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. Individuals should contact the Program Manager 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 registration periods. Students must also obtain approval from their advisors 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 technical elective courses, and a group of breadth requirement courses. The core group includes courses in mathematics, chemistry, physics, computer science, and engineering. The technical electives courses allow students to investigate the sciences in more depth and to develop a concentration within their engineering discipline. 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.

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 undergraduate programs website:

http://www.engr.udel.edu/advise/undergrad_programs.html.

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.

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 Assistant Dean, Dean's Scholars design an imaginative and rigorous individual plan of study to meet the total credit hours required for graduation. Contact the Assistant Dean or go to:

www.udel.edu/deansscholar for more information and the application.

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.

CHANGING MAJOR OR TRANSFERRING TO ENGINEERING

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

Students at the University of Delaware who wish to change 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 a major within 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 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.

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 required for students who are members of the Air Force Reserve Officer Training Corps and 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 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 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

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

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

The 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. 1Ffall of freshman year, 2Sspring of sophomore year, etc.

UNIVERSITY REQUIREMENTS

ENGL 110 Critical Reading and Writing (minimum grade C-) . . . . . 3[1F]

First Year Experience (see page 68) 0-4

Discovery Learning Experience (see page 68) 3

MAJOR REQUIREMENTS

Breadth Requirements . . . . . 18[1-4]

See page 186: 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 (see pages 69-71).** A list of current breadth requirement courses can be obtained at:
http://www.engr.udel.edu/adsup/advise/gen-ed-req.html

Core Courses

CHEM 111 General Chemistry. . . . . 3[1F]
CHEM 112 General Chemistry . . . . . 3[1S]
CHEM 119 Quantitative Chemistry I. . . . . 3[2F]
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.

CHEM 444 Physical Chemistry. . . . . 3[2S]
CHEM 332 Organic Chemistry
or CHEM 527 Introductory Biochemistry . . . . . 3[3S]

CISC 106 Introduction to Programming . . . . . 3[1F]
EGGG 101 Introduction to Engineering . . . . . 2[1F]
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 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 . . . . . 4[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]

TECHNICAL ELECTIVES

The student must take four General Technical Electives (12 credits) and three Chemical Engineering Technical Electives (9 credits) OR, upon approval by her/his academic advisor, take three General Technical Electives (9 credits) and four Chemical Engineering Technical Electives (12 credits). In either case the student must complete a minimum of 21 credits of General Technical and Chemical Engineering Elective courses.

General Technical Electives . . . . . 12-9[2S,3F,4F-S]

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 . . . . . 9-12[4F-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 generic University requirements for the Honors Degree (see page 52). 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's 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 PhD 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
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 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]

First Year Experience (see page 68) 0-4

Discovery Learning Experience (see page 68) 3

MAJOR REQUIREMENTS

Breadth Requirements . . . . . 18[1-4]
See page 186: College Breadth Requirements. **One of these courses must fulfill the University multi-cultural requirement (see pages 69-71).**

ENGL 410 Technical Writing . . . . . 3[3F]
COMM 212 Oral Communications in Business . . . . . 3[2F]
CHEM 103 General Chemistry . . . . . 4[1F]
CISC 106 General Computer Science for Engineers . . . . . 3[1F]
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[2F]
CHEM 104 General Chemistry . . . . . 4[1S]
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]
EGGG 101 Introduction to 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[3F]
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 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
CIEG 443 Watershed Engineering, Planning and Design
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 407 Building Design
CIEG 408 Introduction to Bridge Design
CIEG 409 Forensic Engineering
CIEG 410 Experimental Mechanics of Composite Materials
CIEG 421 Foundation Engineering
CIEG 422 Earth Structures Engineering
CIEG 427 Deep Foundations
CIEG 428 Ground Improvement Methods

Transportation and Construction Engineering
CIEG 452 Transportation Facilities Design
CIEG 453 Roadway Geometric Design
CIEG 454 Urban Transportation Planning
GEOG 328 Transportation Geography
STAT 420 Data Analysis and Nonparametric Statistics

HONORS BACHELOR OF CIVIL ENGINEERING

A recipient of the Honors Bachelor of Civil Engineering must satisfy the following:
1. All requirements for the Bachelor of Civil Engineering degree.
2. All generic University requirements for the Honors Degree (see page 52). 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.

UNIVERSITY, COLLEGE, AND MAJOR REQUIREMENTS FOR ALL ENVIRONMENTAL ENGINEERING BACHELORS DEGREE CONCENTRATIONS

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}
First Year Experience (see page 68)		0-4
Discovery Learning Experience (see page 68)		3

COLLEGE REQUIREMENTS

Breadth Requirements . . . . . 18^{1-4}
See page 186: College Breadth Requirements. **One of these courses must fulfill the University multi-cultural requirement (see pages 69-71).**

MAJOR REQUIREMENTS

Core Courses for the Major:

ENGL 410	Technical Writing	3^{2f}
MATH 241	Analytic Geometry and Calculus	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	4^{1S}
BISC 302	General Ecology	3^{2S}
CISC 106	General Computer Science for Engineers	3^{1F}
CHEG 231	Chemical Engineering Thermodynamics	3^{3F}
CIEG 126	CAD, GIS, Surveying	3^{2S}
EGGG 101	Introduction to Engineering	2^{1F}
CIEG 211	Statics	3^{2F}
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^{4F}
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}

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: CONTAMINANT TRANSPORT AND CONTROL PROCESSES

Physical and chemical processes for pollutant transport and remediation. Students should select this concentration as soon as possible in the curriculum.

CURRICULUM CREDITS

See text above for University and College requirements.

CHEM 111	General Chemistry†	3^{1F}
CHEM 119	Quantitative Chemistry I†	3^{2F}
CHEM 112	General Chemistry†	3^{1S}
CHEG 325	Chemical Engineering Thermodynamics	3^{3S}
CHEG 332	Chemical Engineering Kinetics	3^{4F}
CHEG 342	Heat and Mass Transfer	3^{4S}
CHEG 443	Physical Chemistry 1	3^{3F}
Additional technical electives, incl. 3 cr. Earth Science*		12

†The alternative coursework CHEM 103/104/220 is also acceptable.
*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 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

See text above for University and College requirements.

CHEM 103	General Chemistry	4^{1F}
CHEM 104	General Chemistry	4^{1S}
CIEG 212	Solid Mechanics	3^{2S}
CIEG 213	Solid Mechanics Lab	1^{2S}
CIEG 301	Structural Analysis	4^{3F}
CIEG 302	Structural Design	4^{3s}
CIEG 320	Soil Mechanics	3^{4F}
CIEG 323	Soil Mechanics Laboratory	1^{4F}
Additional technical electives, incl. 3 cr. Earth Science*		9

*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
See text above for University and College requirements.		
CHEM 103	General Chemistry	4[1F]
CHEM 104	General Chemistry	4[1S]
CHEM 331	Organic Chemistry	3[3F]
CHEM 333	Organic Chemistry Lab	1[3F]
PLSC 319	Environmental Soil Microbiology	4[3S]
BISC 300	Introduction to Microbiology	4[4F]
CHEM 342	Introduction to Biochemistry	3[4S]
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.		
CHEM 103	General Chemistry	4[1F]
CHEM 104	General Chemistry	4[1S]
EGTE 321	Storm Water Management	4[4F]
CIEG 468	Principles of Water Quality Criteria	3[4F]
CIEG 498	Groundwater Flow and Contaminant Transport	3[4S]
CIEG 430	Water Quality Modeling	3[4S]
Additional technical electives		12

TECHNICAL ELECTIVES

Additional Recommended Technical Electives
Students in any of the concentrations should consider the technical electives listed for the other concentrations. In addition, the following courses qualify as technical electives.

BISC 301	Molecular Biology of Cells
BISC 311	Molecular Biology for Engineers
BISC 641	Microbial Ecology
CHEM 444	Physical Chemistry
CIEG 321	Geotechnical Engineering
CIEG 407	Building Design
CIEG 433	Hazardous Waste Management
CIEG 482	Systems Design and Operation
CIEG 636	Biological Aspects of Environmental Engineering
GEOL 421	Environmental and Applied Geology
GEOL 446	General Geochemistry
MEEG 434	Air Pollution Processes
MSEG 302	Materials Science
PLSC 608	Soil Chemistry
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 52). 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 inquires 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

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Faculty Listing: http://www.ece.udel.edu/people/faculty.php

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, sci-

ence, 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 four basic parts to the Delaware curriculum in engineering: (1) a core group of courses, (2) a group of foundation electives, (3) an elective group of technical courses, and (4) 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^{1F}

First Year Experience (see page 68) 0-4

Discovery Learning Experience (see page 68) 3

MAJOR REQUIREMENTS

Breadth Requirements . . . . . 18^{1-4}
See page 186: College Breadth Requirements. **One of these courses must fulfill the University multi-cultural requirement (see pages 69-71).**

One of the following four courses must be taken: . . . . . 3^{3F}
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 106 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 . . . . . 3^{1S}
CPEG 222 Microprocessor Based Systems . . . . . 4^{2F}
ELEG 205 Analog Circuits I . . . . . 4^{2F}
ELEG 212 Signals and Communications . . . . . 4^{2S}
ELEG 309 Electronic Circuit Analysis I . . . . . 4^{2S}
ELEG 310 Random Signals and Noise . . . . . 3^{3S}
ELEG 320 Field Theory I . . . . . 4^{3F}
ELEG 340 Solid State Electronics . . . . . 3^{3F}
ELEG 491 Ethics and Impacts of Engineering . . . . . 2^{4S}

Four of the following six foundation elective courses must be taken: 12
ELEG 305 Signal Processing
ELEG 312 Electronic Circuit Analysis II
ELEG 341 Solid State Electronics II
ELEG 413 Field Theory II
ELEG 428 System Analysis and Control
ELEG 403 Communication Systems Engineering

Design Requirement . . . . . 4^{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 advisor before selecting their design course or courses.

Technical Electives 15
In addition to the design requirement, each student, in consultation with their advisor, must select a program of technical electives satisfying the following: (1) With some exceptions, technical electives consist of 300-level or above engineering, mathematics, natural sciences, and computer science courses. With the permission of the student's advisor, certain 200-level courses, such as PHYS 209, are permitted. (2) At least 15 technical elective credits must be taken. (3) Of the 15 technical elective credits, at least 9 must be in CPEG or ELEG courses. (4) Of the 9 credits in ELEG or CPEG, at least 6 must be in 400-level or above ELEG or CPEG courses.

CREDITS TO TOTAL A MINIMUM OF 125

HONORS BACHELOR OF 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 52). 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^{1F}

First Year Experience (see page 68) 0-4

Discovery Learning Experience (see page 68) 3

MAJOR REQUIREMENTS

Breadth Requirements . . . . . 18[1-4]

See page 186: College Breadth Requirements. **One of these courses must fulfill the University multi-cultural requirement (see pages 69-71).**

One of the following four courses must be taken: . . . . . 3[3F]

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 106	Introduction to Computer Science I. . . . . 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. . . . . 3[1S]
CPEG 222	Microprocessor Systems . . . . . 4[2F]
CPEG 323	Introduction to Computer System Engineering . . . . . 3[3F]
CPEG 324	Computer Systems Design I. . . . . 3[3S]
CPEG 419	Computer Communications Networks. . . . . 3[4F]
ELEG 205	Analog Circuits I . . . . . 4[2F]
ELEG 212	Signals and Communications . . . . . 4[2S]
ELEG 309	Electronic Circuit Analysis I. . . . . 4[2S]
ELEG 310	Random Signals and Noise . . . . . 3[3S]
ELEG 320	Field Theory I . . . . . 4[3F]
ELEG 491	Ethics and Impacts of Engineering . . . . . 2[4S]

Two of the following five foundation elective courses must be taken: 6

ELEG 413	Field Theory II
ELEG 305	Signal Processing
ELEG 312	Electronic Circuit Analysis II
ELEG 428	System Analysis and Control
ELEG 403	Communication Systems Engineering

Design Requirement . . . . . 4[4]

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 410, CPEG 422, and CPEG 460. Other courses may be offered irregularly which satisfy the design requirement. Students should consult with their advisor before selecting their design course or courses.

Technical Electives 12

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 12 technical elective credits must be taken. (3) Of the 12 technical elective credits, at least 6 must be in CPEG or ELEG 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 52). Graduate courses approved for this purpose by the department may be counted as Honors courses.

MINOR IN BIOELECTRICAL ENGINEERING

A minor in Bioelectrical Engineering may be earned by a student in any University bachelor's degree program. This minor provides students with an opportunity to integrate physiology and biological sciences with engineering aspects in signal measurement and processing. To qualify for a Minor in Bioelectrical Engineering, students must complete a minimum of 21 credits as described below with a minimum grade of C- in each course.

CURRICULUM		CREDITS
Course Requirements		
(1) All students must take the following three courses:		
BISC 207[a]	Introductory Biology I	4
MATH 242	Analytic Geometry and Calculus B	4
PHYS 202[b]	Introductory Physics II.	4
or		
PHYS 208[b]	Introductory Physics II.	4
(2) And one of the following courses:		
BISC 306	General Physiology	3
ELEG 471	Introduction to Biomedical Engineering	3
(3) And two of the following courses[c]:		
ELEG 470	Biophysics of Excitable Membranes	3
ELEG 473	Signal Processing in Neural Systems	3
ELEG 475	Image Processing with Biomedical Applications	3
ELEG 478	Introduction to Nano and Biophotonics	3
ELEG 479	Introduction to Medical Imaging Systems	3
ELEG 676	Bioinformatics and Biosystems Analysis I	3
ELEG 680	Immunology for Engineers	3
BISC 627	Neuroscience II	3
HESC 688	Electromyographic Kinesiology	3
TOTAL CREDITS		21

(a) BISC 208 cannot be substituted for BISC 2007.
(b) It is understood that PHYS 201/207 is taken before PHYS 202/208.
(c) The listed 400 and 600-level courses are open to any student who has completed requirements (1) and (2) and the necessary prerequisites (or obtained permission of instructor).

Further inquiries about the Bioelectrical Engineering Minor can be made to Professor Takashi Buma at 831-8447 or buma@ece.udel.edu.

MATERIALS SCIENCE AND ENGINEERING

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http://www.mseg.udel.edu/
Faculty Listing: http://www.mseg.udel.edu/directories/index.php

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 minors in materials science and engineering, and nanoscale materials. 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 Masters 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.

MINOR IN NANOSCALE MATERIALS

The Minor in Nanoscale Materials requires completion of 15 credits with a minimum grade of C-. MSEG 302 is a required course, and the remainder may be drawn from a wide variety of courses in nanoscience and engineering with the consent of the MSEG Nanoscale Materials minor coordinator. Courses from 300-level to the 600-level qualify. A course may be used only once between the

Nanoscale Materials minor and the Materials Science minor. Commonly offered courses that are acceptable for the Minor in Nanoscale Materials are listed below. This list is not exhaustive, and other courses may be approved as appropriate after discussion. A maximum of 3 credits of undergraduate research or independent study may be counted. For further information, contact Professor Ismat Shah at 302-831-1618; Ismat@udel.edu.

MSEG 441/641 Nanomaterials and Thin Film Processes
MSEG 442/642 Semiconductors for Micro- and Nano- Technology
MSEG 446 Senior Research: Approval by the minor coordinator required.
MSEG 603 Analytical Techniques in Materials Science
MSEG 624 Practical Electron Microscopy
CHEG 608 Particle Design and Processing
CHEG/MSEG 616 Physics and Chemistry of Surfaces and Interfaces
CHEG 617 Colloid Science and Engineering
CHEM 671 Quantum Chemistry
ELEG 421/621 Solid State Nanotechnology
ELEG 422/622 Electronic Materials Processing
ELEG 442/642 Biomedical Nanotechnology
ELEG 449/649 Nanotechnology & Applications
Additional appropriate courses may be approved by the faculty.

MECHANICAL ENGINEERING

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http://www.me.udel.edu
Faculty Listing: http://www.me.udel.edu/People/people.html

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 objective of the undergraduate Mechanical Engineering Program at the University of Delaware is to produce graduates with a strong foundation in engineering fundamentals enabling them to lead a successful career in industry or government and/or obtain an advanced degree, and contribute to engineering knowledge, the profession, and the community.

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 Bachelor of Mechanical Engineering curriculum provide the student with an opportunity to pursue areas of particular interest. Because of the breadth of technical areas in which mechanical engineers work, at least 3 of these credits must be in a basic science. The remaining technical elective credits demonstrate technical depth and are typically courses at or above the 400 level which are taken after much of the basic engineering science has been mastered and comprise a minimum of 12 credits. Although the majority of the technical depth electives are drawn from the Mechanical Engineering department, courses from other departments and colleges can be selected with the approval of the departmental advisor.

Students can choose towards the end of sophomore or early junior year to pursue a concentration in Aerospace 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. Students with an interest in bioengineering are encouraged to consider the Minor in Biomedical Engineering that is offered by the Mechanical Engineering Department as a focus for their technical electives. 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]
First Year Experience (see page 68)		0-4
Discovery Learning Experience (see page 68)		3

MAJOR REQUIREMENTS

Breadth Requirements		18[1-4]

See page 186: College Breadth Requirements. **One of these courses must fulfill the University multi-cultural requirement (see pages 69-71).**

CHEM 103	General Chemistry	4[1]
CISC 106	General Computer Science for Engineers	3[1F]
EGGG 101	Introduction to Engineering	2[1F]
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]
MSEG 302	Materials Science for Engineers	3[2S]
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[3F]
MEEG 304	Machine Design - Elements	3[3S]
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 341	Thermodynamics	3[3F]
MEEG 342	Heat Transfer	3[3S]
MEEG 346	Thermal Lab	1[3S]
MEEG 401	Senior Design	6[4F]
Technical Electives		15[3,4]

Courses in engineering, science or mathematics selected by the student with the approval of their advisor.

CREDITS TOTAL A MINIMUM OF 123

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

MAJOR REQUIREMENTS

Required Course
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 Mechanical Behavior of Materials and Structures 3
MEEG 423 Vibrations 3
MEEG 481 Computer Solution of Engineering Problems 3
MEEG 616 Composite Materials Structures 3
MEEG 624 Control of Dynamic Systems 3
MEEG 636 Fluid Mechanics Measurements 3
MEEG 655 Principles of Composite Manufacturing 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 page 52). Graduate courses approved for this purpose by the department may be counted as Honors courses.

MINOR IN BIOMEDICAL ENGINEERING

This minor is offered through the Department of Mechanical Engineering. To enroll in this minor program, the student must have permission of the Chair of Mechanical Engineering, who will assign the student a minor advisor. To qualify for a Minor in Biomedical Engineering, students must complete at least 21 credits in accord with the requirements specified below. Additional courses for satisfying these requirements may be approved by the Department. A minimum grade of C- must be achieved in each course qualifying for the minor.

CURRICULUM CREDITS

Course Requirements
(1) All students must take the following three courses:
BISC 207 Introductory Biology I 4
or
BISC 208 Introductory Biology II (by advanced placement or transfer credit only) 4
MATH 243 Analytic Geometry and Calculus C 4
PHYS 201 Introductory Physics I 4
or
PHYS 207 Fundamentals of Physics I 4
(2) And one of the following courses:
BISC 306 General Physiology 3
BISC 401 Molecular Biology of the Cell 3
HESC 220 Anatomy and Physiology 3

(3) And two of the following courses (note: these courses may have prerequisites beyond those required for the minor)*:
MEEG 482 Clinical Biomechanics 3
MEEG 483 Orthopaedic Biomechanics 3
MEEG 484 Biomaterial and Tissue Engineering 3
MEEG 485 Control of Human Movement 3
MEEG 486 Cell and Tissue Transport 3
MEEG 612 Biomechanics of Human Movement 3
ELEG 471 Introduction to Biomedical Engineering 3

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

SUSTAINABLE ENERGY TECHNOLOGY

Telephone: (302) 831-1261
E-mail: lobo@udel.edu

The College of Engineering offers an interdepartmental minor in Sustainable Energy Technology. This minor provides students with the basic knowledge and skills necessary to compare and select optimal technologies for energy production based on engineering, economic, and local and global criteria.

The minor is available to all majors, although the courses that have been selected require, in many cases, an elementary knowledge of thermodynamics or the economic sciences. All courses in the minor are aimed at undergraduates. It has been traditional in the engineering departments, as well as many others, for undergraduates to take senior-year technical electives that are 600-level; therefore, 600-level courses are among the options that students may choose.

MINOR IN SUSTAINABLE ENERGY TECHNOLOGY

A minor in Sustainable Energy Technology may be earned by a student in any University bachelor's degree program through successful completion of a minimum of 15 credits as described below. Before beginning these courses, the student must meet the required course prerequisites. A minimum grade of C- is required in all courses completed for the minor.

To receive a Minor in Sustainable Energy Technology the student must take three (9 credits or more) out of the following set of courses:
CHEG616 Chemistry and Physics of Surfaces and Interfaces
CHEG625 Green Engineering
CIEG351 Transportation Engineering
MEEG425 Automotive Powertrain Theory.
MEEG442 Introduction to Fuel Cells
MEEG435 Wind Power Engineering
EGTE456 Fundamentals of Heating, Ventilation and Air Conditioning
ELEG420 Solar Electric Systems
ELEG415/615 Electric Power and Renewable Energy Systems
ELEG467/667 Low Power Electronics and Lighting
CHEG612 Applied Process Heat Transfer
CHEG614 Special Topics in Energy (course number is being processed)
Undergraduate Research in Energy (3 credits)

Students must also take the following required course (3 credits):
UAPP625 Energy Policy and Administration

and take one course from the following list (3 or more credits):

GEOG622 Resources, Development and the Environment
GEOG236 Conservation: Global Issues
MAST675 Economics of Natural Resources
MAST628 Offshore Wind Power: Science, engineering, and policy
GEOG617 Seminar in Climate Change
Other courses may be included upon approval of the minor administration committee. For inquiries about the Sustainable Energy Technology Minor, contact Professor Raul Lobo at 831-1261 (lobo@udel.edu).

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

UNIVERSITY REQUIREMENTS

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

First Year Experience (see page 68) 0-4

Discovery Learning Experience (see page 68) 3
Three credits in an approved course or courses stressing multi-cultural, ethnic, and/or gender-related course content (see pages 69-71) . . . . . 3^{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 93-95.)

Foreign Language: Completion of the intermediate 0-12
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 95-99)

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 153-156

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