COLLEGE OF ENGINEERING, COMPUTING AND APPLIED SCIENCES

The College of Engineering, Computing and Applied Sciences offers a broad range of rigorous and stimulating baccalaureate programs that provide unexcelled educational opportunities. The innovative combination of engineering and science disciplines that comprises the College, facilitates study and research in fields transcending the traditional disciplines. Students enjoy close interaction with a distinguished faculty committed to excellence in undergraduate education, as well as in research. Additional information on the College and its programs is available at *www.clemson.edu/ces*.

Minors

Engineering and science students can complement their majors by selecting minor concentrations of study. Available minors include International Engineering and Science, and one in each of the science majors (see acceptable minors at the end of this section).

International Programs

The world economy has become very tightly integrated, making it highly important that engineering and science students prepare themselves for this global environment. The College offers a minor in International Engineering and Science coupled with several programs that provide opportunities for students to gain international experience. These include study abroad at many locations around the world and EPIC (an international co-op program). In addition, engineering and science students are encouraged to pursue study of a modern language. A Certificate in International Engineering and Science, that combines language study and an international practicum, is also offered. Information is available in the Undergraduate Studies Office (107 Riggs Hall) and at *www.clemson.edu/ces/students/global.*

Modern Language Requirement

A number of Clemson University degree programs require the completion of a modern language through a specific course level. Modern languages taught at Clemson University or accepted for transfer credit include American Sign Language, Arabic, Chinese, French, German, Italian, Japanese, Latin, Portuguese, Russian and Spanish. While many degree programs accept any of these modern languages for the requirement, certain programs may have specific modern language requirements. Students should consult their program's curriculum map for details.

ENGINEERING PROGRAMS

The Bachelor of Science engineering degree programs in Bioengineering, Biosystems Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Environmental Engineering, Industrial Engineering, Materials Science and Engineering, and Mechanical Engineering are each accredited by the Engineering Accreditation Commission (EAC) of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone: (410) 347-7700.

All engineering programs have the common goal of producing engineering graduates who are able to:

- apply knowledge of math, science, and engineering
- identify, formulate, and solve engineering problems
- design and conduct experiments and analyze data
- design systems or components to meet needs within realistic constraints
- function on multidisciplinary teams
- communicate effectively
- conduct themselves professionally and ethically
- understand engineering's global, economic, environmental, and societal context
- understand contemporary engineering issues
- apply modern engineering methods and tools
- appreciate the need for life-long learning

Each engineering program has objectives specific to the discipline. All prepare students for a wide range of career opportunities and provide sound preparation for graduate study. Each curriculum provides opportunities for students to pursue individual areas of interest.

Admission Requirements

The University admission requirements are given under the section entitled *Admission*. Engineering applicants are strongly advised to include the following in their high school programs:

Mathematics—Four units, including geometry, trigonometry, and introductory calculus
Laboratory Science—At least three units, including both chemistry and physics
Computing—At least one unit, including introduction to a programming language. Applicants should have good keyboarding skills.

General Engineering Program

All new engineering students (including transfer students who have not completed all courses in the freshman engineering curriculum) are admitted into General Engineering. The General Engineering Program provides students an opportunity to explore various engineering fields while getting a sound academic preparation for engineering study.

Freshman Curriculum

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - General Education Requirement[2]
16

Second Semester

3 - ENGR 1410 Programming and Problem Solving[3,4]
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I
3-5 - Departmental Science or other Requirement(s)[5]
3 - General Education Requirement[2]
16-18

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on General Education Requirements for Engineering Curricula below.

[3]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[4]Students who plan to pursue a Chemical Engineering degree should consult an advisor for requirements.

[5]See advisor for specific engineering major requirements.

Admission into Engineering Degree Programs

To transfer into an engineering degree program, a student must have completed the following courses in the freshman engineering curriculum with a grade of C or better:

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
3 - ENGR 1410 Programming and Problem Solving[2,3]
4 - MATH 1060 Calculus of One Variable I
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[3]Chemical Engineering requirements vary; please see an advisor for details.

In addition, the student must have the minimum grade-point average specified by the engineering degree program for admission.

Students should initiate a change-of-major request prior to the registration period during the semester when they expect to complete the freshman curriculum. Students who fail to meet the requirements for admission into a degree program may remain in General Engineering until those requirements are met; however, General Engineering majors are not permitted to take 3000- or 4000-level engineering courses. Engineering departments may allow General Engineering majors to enroll in selected 2000-level engineering courses (policy varies by department). Students admitted into an engineering degree program will follow the curriculum in effect at the time of admission into General Engineering, unless otherwise approved by the specific engineering department.

General Education Requirements for Engineering Curricula

Engineers have an obligation to practice their profession in a socially responsible manner. The education of engineers must prepare them for this responsibility and make them aware of the constraints imposed by societal and cultural factors. Thus, the humanities and social sciences are an important component of the engineering curricula. Further, the program of study must include educational experiences addressing the intersection of science and technology with society and cross-cultural awareness.

In addition to the University General Education Requirements, some engineering majors are required to complete additional credit hours from a college approved list. Individual engineering curricula may have more specific requirements. For a complete list of acceptable courses, please speak with an advisor.

Electives for Engineering Curricula

Advisors must approve any course taken for elective credit in the Engineering curricula. Courses excluded for elective credit include PHYS 2000, 2070/2090, 2080/2100.

Registration Requirements

A cumulative grade-point average of 2.0 or higher is required for registration in engineering courses numbered 3000 or higher. Priority for registration in engineering courses is given to those majors for whom the course is a degree requirement. Exceptions to this requirement may be granted by the department offering the course.

Change of Major into General Engineering

Enrolled students who wish to change from their current non-engineering academic program to any engineering academic program must first change into the General Engineering (GE) program. Students cannot change directly into a specific engineering academic program. To obtain approval to change into GE, a student must first 1) meet with a GE advisor; 2) complete the following courses with a grade of C or better: MATH 1060 (or MATH 1040 + 1070); CH 1010, and ENGR 1020 (or ENGR 1050 + 1060); and 3) have a cumulative GPA of 2.0 or higher.

Graduation Requirements

In addition to other institutional requirements, candidates for a baccalaureate degree in Engineering are required to have a 2.0 or higher cumulative grade-point average in all engineering courses taken at Clemson. All courses with "Engineering" in the course designator (e.g., ENGR 1300, ME 4530, etc.) are used in this calculation.

The baccalaureate programs in Engineering are designed to be completed in four years (eight regular semesters). Taking a reduced load or participating in cooperative education will extend this time. On average, Clemson engineering students take about four and one-half years to complete the requirements for graduation.

BIOENGINEERING

Bachelor of Science

The undergraduate program in Bioengineering is built upon a rigorous engineering science foundation that is, in turn, based upon a broad curriculum of applied and life sciences, mathematics, electives in humanities, social science, and design. Students select a formal focus that concentrates in a subfield of interest in bioengineering: Bioelectrical Concentration or Biomaterials Concentration.

The curriculum provides undergraduates with a solid background in engineering and life sciences in preparation for advanced studies. Through the Bioengineering program, graduates acquire an understanding of biology, biochemistry, and physiology and the capability to apply advanced mathematics, including differential equations and statistics, science, and engineering, to solve the problems at the interface of engineering and biology. Graduates also have an ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and nonliving materials and systems.

Combined Bachelor's/Master's Plan

Bioengineering undergraduates may begin a Master of Science degree program or a Master of Engineering degree program while completing the Bachelor of Science degree and use a limited number of courses to satisfy the requirements of both the undergraduate and graduate degrees. Details are available from the Department of Bioengineering.

BIOELECTRICAL CONCENTRATION

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester

4 - CH 1020 General Chemistry
3 - ENGR 1410 Programming and Problem Solving[3]
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I[4]
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
1 - Biology Requirement[5]
18

Sophomore Year

First Semester

3 - BIOE 2010 Intro. to Biomedical Engineering
2 - ECE 2010 Logic and Computing Devices
3 - ECE 2020 Electric Circuits I
1 - ECE 2090 Logic and Computing Devices Lab.
1 - ECE 2110 Electrical Engineering Lab. I
4 - MATH 2060 Calculus of Several Variables
3 - PHYS 2210 Physics with Calculus II[4]
17

Second Semester

0 - BIOE 2000 Bioengineering Professional Development
3 - CE 2010 Statics
1 - ECE 2120 Electrical Engineering Lab. II
3 - ECE 2620 Electric Circuits II
2 - ENGR 2080 Engineering Graphics and Machine Design
4 - MATH 2080 Intro. to Ordinary Diff. Equations
3 - MSE 2100 Introduction to Materials Science
16

Junior Year

First Semester

4 - BIOL 3150 Functional Human Anatomy
3 - CH 2010 Survey of Organic Chemistry[4] *and*
1 - CH 2020 Survey of Organic Chemistry Lab.[4]
1 - ECE 3110 Electrical Engineering Lab. III
3 - ECE 3200 Electronics I
3 - ECE 3300 Signals, Systems, and Transforms
15

Second Semester

3 - BCHM 3050 Essential Elements of Biochem.
0 - BIOE 3000 Bioengineering Ethics and Entrepreneurship
3 - BIOE 3020 Biomaterials
3 - BIOE 3700 Bioinstrumentation and Bioimaging
3 - ECE 3800 Electromagnetics
3 - BIOE or ECE Technical Requirement[6]
15

Senior Year

First Semester

3 - BIOE 3200 Biomechanics
3 - BIOE 4010 Bioengineering Design Theory
3 - BIOL 4610 Cell Biology
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
3 - BIOE or ECE Technical Requirement[6]
15

Second Semester

1 - BIOE 4000 Bioengineering Leadership and MedTech Commercialization
3 - BIOE 4030 Applied Biomedical Design
3 - BIOE 4480 Tissue Engineering
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
6 - BIOE or ECE Technical Requirement[6]
16

128 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on Humanities and Social Sciences for Engineering Curricula. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.

[3]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[4]Students planning to enter medical school should take CH 2230/2270 instead of CH 2010/2020 and take CH 2240/2280 as an additional course sequence. Students planning to enter medical school should also take physics laboratories as additional courses ((PHYS 1220 course wih PHYS 1240 lab and PHYS 2210 course with PHYS 2230 lab).

[5]Select from BIOE 1010, BIOL 1030, 1040, 1100, 1110

[6]Students must take at least six credits from courses with a lecture designation. The other six credits may be selected from courses with the lecture or the non-lecture designation.

Lecture Courses—BIOE 3210, 4020, 4120, 4150, 4200, 4230, 4310, 4350, 4400, 4490, 4500, 4610, 4710, 4760, 4820, BMOL 4250, 4260, ECE 2720/2730, 3170, 3210/3120, 3710/3720, 3810, 4090, 4270, 4320, 4670, MATH 3650, MSE 4580, PHYS 4170

Non-Lecture Courses—BIOE 4510, 4600, 4690, 4900, 4910

Notes:

1. To transfer from General Engineering into the Bioengineering degree program, students must have a minimum cumulative grade-point average of 3.0 in courses taken at Clemson and must have earned a C or better in each course in the General Engineering freshman curriculum, including the Arts and Humanities/Social Science Requirements.
2. A student is allowed to enroll in ECE courses (excluding ECE 2070, 2080, 3080) only when all prerequisites have been passed with a grade of C or better.
3. All Bioelectrical Concentration students must have a cumulative engineering grade-point average of 2.0 to enroll in any 3000- or 4000-level ECE courses.
4. No student may exceed a maximum of two attempts, excluding a *W*, to complete successfully any ECE course.

BIOMATERIALS CONCENTRATION

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester
4 - CH 1020 General Chemistry
3 - ENGR 1410 Programming and Problem Solving[3]
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I[4]
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
1 - Biology Requirement[5]
18

Sophomore Year

First Semester
3 - BIOE 2010 Intro. to Biomedical Engineering
3 - CH 2010 Survey of Organic Chemistry[4]
1 - CH 2020 Survey of Organic Chemistry Lab.[4]
4 - MATH 2060 Calculus of Several Variables
3 - MSE 2100 Introduction to Materials Science
3 - PHYS 2210 Physics with Calculus II[4]
17

Second Semester
0 - BIOE 2000 Bioengineering Professional Development
3 - BIOE 3020 Biomaterials
3 - CE 2010 Statics
2 - ECE 2070 Basic Electrical Engineering
1 - ECE 2080 Basic Electrical Engineering Lab.
2 - ENGR 2080 Engineering Graphics and Machine Design
4 - MATH 2080 Intro. to Ordinary Diff. Equations
15

Junior Year

First Semester
3 - BIOE 3200 Biomechanics
4 - BIOL 3150 Functional Human Anatomy
3 - MSE 3190 Materials Processing I
3 - MSE 3260 Thermodynamics of Materials
3 - MSE 3270 Transport Phenomena
16

Second Semester
3 - BCHM 3050 Essential Elements of Biochem.
0 - BIOE 3000 Bioengineering Ethics and Entrepreneurship
3 - BIOE 3210 Biofluid Mechanics
3 - BIOE 3700 Bioinstrumentation and Bioimaging
3 - MATH 3020 Statistics for Science and Engr.
3 - Bioengineering Technical Requirement[6]
15

Senior Year

First Semester
3 - BIOE 4010 Bioengineering Design Theory
3 - BIOL 4610 Cell Biology
3 - MSE 4150 Intro. to Polymer Science and Engr.
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
3 - Bioengineering Technical Requirement[6]
15

Second Semester
1 - BIOE 4000 Bioengineering Leadership and MedTech Commercialization
3 - BIOE 4030 Applied Biomedical Design
3 - BIOE 4480 Tissue Engineering
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
6 - Bioengineering Technical Requirement[6]
16

128 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on Humanities and Social Sciences for Engineering Curricula. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.

[3]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[4]Students planning to enter medical school should take CH 2230/2270 instead of CH 2010/2020 and take CH 2240/2280 as an additional course sequence. Students planning to enter medical school should also take physics laboratories as additional courses (PHYS 1220 course wih PHYS 1240 lab and PHYS 2210 course with PHYS 2230 lab).

[5]Select from BIOE 1010, BIOL 1030, 1040, 1100, 1110

[6]Students must take at least six credits from courses with a lecture designation. The other six credits may be selected from courses with the lecture or the non-lecture designation.

Lecture Courses—BIOE 3210, 4020, 4120, 4150, 4200, 4230, 4310, 4350, 4400, 4490, 4500, 4610, 4710, 4760, 4820, BMOL 4250, 4260, ECE 2720/2730, 3170, 3210/3120, 3710/3720, 3810, 4090, 4100, 4270, 4320, 4670, MATH 3650, MSE 4580, PHYS 4170

Non-Lecture Courses—BIOE 4510, 4600, 4690, 4900, 4910

Note: To transfer from General Engineering into the Bioengineering degree program, students must have a minimum cumulative grade-point average of 3.0 in courses taken at Clemson and must have earned a C or better in each course in the General Engineering freshman curriculum including the Arts and Humanities/Social Science Requirements.

BIOSYSTEMS ENGINEERING

Bachelor of Science

Biosystems engineering is the field of engineering most closely allied with advances in biology. Biosystems engineers apply engineering design and analysis to biological systems and incorporate fundamental biological principles to engineering designs to achieve ecological balance.

The Biosystems engineering program emphasizes two main areas – sustainable bioprocess engineering, with its basis in microbiology, and ecological engineering, with its basis in ecology. Bioprocess engineering focuses on the sustainable production of biorefinery compounds - biofuels, nutraceuticals, bioactive molecules, and biomaterials - using metabolic pathways found in nature and green processing technologies. Ecological engineering focuses on the design of sustainable communities utilizing low-impact development strategies such as bioretention basins, rainwater harvesting, and bioswales for stormwater retention, treatment, and management. Both emphasis areas interface with ecologically-sound food and energy-crop and feedstock production systems.

Biosystems engineers lead teams to:
- Design bioprocesses and systems for biofuels (biodiesel, hydrogen, ethanol), biopharmaceutical, bioplastics, and food processing industries
- Develop ecological designs (permeable pavement, bioswales, green infrastructure) to integrate stormwater management into the landscape
- Integrate biological sustainability into energy, water and food systems
- Provide engineering expertise for agriculture, food processing, and manufacturing industries.

Biosystems engineering graduates are highly qualified to pursue graduate studies in biosystems engineering, biomedical engineering and ecological engineering fields, or medical and veterinary school. Those interested in medical school can fulfill premedical course requirements with the Biosystems Engineering BS degree.

Additional information is available from the departmental offices or at: *http://www.clemson.edu/majors/biosystems-engineering*.

Combined Bachelor's/Master's Program

Under this plan, students may reduce the time necessary to earn both degrees by applying graduate credits to both undergraduate and graduate program requirements.

Undergraduate students in Biosystems Engineering may begin a Master of Science Degree in Environmental Engineering and Science or Master of Science Degree in Biosystems Engineering while completing the BS degree.

Students are encouraged to obtain the specific requirements for the dual degree from the academic departments involved as early as possible in their undergraduate program. See *Academic Regulations* in this catalog for enrollment guidelines and procedures.

Freshman Year

First Semester
4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester
4 - CH 1020 General Chemistry
3 - ENGR 1410 Programming and Problem Solving[3]
2 - ENGR 2100 Computer-Aided Design and Engineering Applications
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I
16

Sophomore Year

First Semester
2 - BE 2120 Fundamentals of Biosystems Engr.
3 - CE 2010 Statics[4]
4 - MATH 2060 Calculus of Several Variables
3 - PHYS 2210 Physics with Calculus II
4 - Biology Requirement[5]
16

Second Semester
2 - BE 2100 Intro. to Biosystems Engineering
2 - CE 2080 Dynamics[4]
4 - MATH 2080 Intro. to Ordinary Diff. Equations
3 - ME 3100 Thermodynamics and Heat Transfer
4 - MICR 3050 General Microbiology
15

Junior Year

First Semester
3 - BE 3200 Principles and Practices of Geomatics
3 - BE 4100 Biol. Kinetics and Reactor Modeling
3 - BIOL 4410 Ecology
4 - CE 3410 Introduction to Fluid Mechanics
2 - ECE 2070 Basic Electrical Engineering
1 - ECE 2080 Basic Electrical Engineering Lab.
16

Second Semester
3 - BE 3220 Small Watershed Hydrology and Sedimentology
3 - BE 4120 Heat and Mass Transport in Biosystems Engineering
3 - BE 4150 Instrumentation and Process Control for Biosystems Engineering
3 - BE 4380 Bioprocess Engineering Design
3 - CH 2230 Organic Chemistry
1 - CH 2270 Organic Chemistry Laboratory
16

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]Students should choose courses to fulfill General Education requirements including Humanities, Social Science, Cross-Cultural Awareness and Science and Technology in society components. See *Undergraduate Announcements* and academic advisor for details.

[3]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[4]ME 2010 may be substituted for CE 2010 and 2080

[5]BIOL 1030/1050 or 1100

BIOPROCESS ENGINEERING EMPHASIS AREA

Senior Year

First Semester
3 - BCHM 3050 Biochemistry
3 - BE 4280 Biochemical Engineering
2 - BE 4740 Biosystems Engr. Design/Project Mgt.
2 - BE 4750 Biosystems Engr. Capstone Design
2 - BIOL 4340 Biol. Chemical Lab. Techniques
4 - CE 2060 Structural Mechanics
16

Second Semester
9 - Arts and Humanities Requirement[2] *or*
9 - Social Science Requirement[2]
3 - Engineering Requirement[6]
3 - Global Sustainability Requirement[7]
15

126 Total Semester Hours

[6]Select from BE 3140, 4080, 4140, 4170, 4220, 4400, 4640, 4730, 4840, CE 3210, 3520, 4020, 4060, 4820, EES 4010, 4020, 4100, 4300, 4800, 4840, 4850, 4860, GEOL 4210, IE 3840, or any 3000–4000-level ENGR course.

[7]Select any course from Sustainability Minor course list.

ECOLOGICAL ENGINEERING EMPHASIS AREA

Senior Year

First Semester
2 - BE 4210 Engineering Systems for Soil Water Management
2 - BE 4740 Biosystems Engr. Design/Project Mgt.
2 - BE 4750 Biosystems Engr. Capstone Design
4 - CE 2060 Structural Mechanics
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
3 - Ecological Requirement[6]
16

Second Semester
3 - BE 4240 Ecological Engineering
6 - Arts and Humanities Requirement[2] *or*
6 - Social Science Requirement[2]
3 - Engineering Requirement[7]
3 - Global Sustainability Requirement[8]
15

126 Total Semester Hours

[6]Ecological Requirement: Choose from 3000-level or higher courses in BIOL, FOR, HORT, MICR, PES, or WFB

[7]Select from BE 3140, 4080, 4140, 4170, 4220, 4400, 4640, 4730, 4840, CE 3210, 3520, 4020, 4060, 4820, EES 4010, 4020, 4100, 4300, 4800, 4840, 4850, 4860, GEOL 4210, IE 3840, or any 3000–4000-level ENGR course.

[8]Select any course from Sustainability Minor course list.

Notes for Bioprocess and Ecological Engineering emphasis areas:

1. The following must be completed with C or better: CE 2010, 2080, 3410; MATH 2060, 2080; ME 3100; PHYS 2210.
2. Biosystems Engineering students are encouraged to complete a Minor, Coop Ed program, internship (BE 3700) and/or a Study Abroad Program.
3. Departmental Honors Thesis (BE 3000/3010/4000) is available for qualifying Junior/Senior students.

CHEMICAL ENGINEERING

Bachelor of Science

The Department of Chemical and Biomolecular Engineering offers the Bachelor of Science degree in Chemical Engineering. Chemical Engineering students select one of several emphasis areas (such as energy studies or environmental engineering), a concentration in Biomolecular Engineering (to prepare them for medical school or a career in biotechnology), or any approved minor.

Chemical engineering is based on chemistry, biology, physics, and mathematics. The curriculum at Clemson includes classroom and laboratory instruction and emphasizes broadly applicable fundamental principles and current technology to prepare graduates for professional practice and professional growth. The Educational Objective of the BS degree program is for graduates to have careers characterized by:

- success in chemical engineering practice, post-graduate education, or other areas making use of engineering skills, as defined by accomplishments and/or job satisfaction;
- demonstrated success in the design of chemical processes and/or identification, formulation, and solution of chemical engineering problems;
- ethical behavior in all endeavors;
- demonstrated effectiveness in teamwork, communication, and service to society through professional contributions;
- demonstrated technical and/or managerial leadership; and
- demonstrated commitment to lifelong learning.

Chemical engineers are involved in the research, manufacture, sales, and use of commodity and specialty chemicals, fuels, pharmaceuticals, electronic components, synthetic fibers and textiles, food and consumer goods, and many other products. They work on environmental pollution prevention and remediation and apply engineering science to solve medical and health-related problems.

Combined Bachelor of Science/ Master of Science

Qualified students can reduce the time to earn a Master's Degree by applying graduate credits to both the Bachelor's and Master's program requirements. Undergraduate Chemical and Biomolecular Engineering students who have earned a grade-point average of 3.4 or above and completed 90 credit hours can begin work toward a Master of Science in Chemical Engineering or a Master of Science in Environmental Engineering and Science by selecting approved graduate courses for their emphasis area. Details are available in the ChBE Undergraduate Handbook, which can be found at *www.clemson.edu/ces/chbe.*

Freshman Year

First Semester
4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester
4 - CH 1020 General Chemistry
3 - CHE 1300 Intro to Chemical Engineering
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Sophomore Year

First Semester
3 - CH 2230 Organic Chemistry
4 - CHE 2110 Mass and Energy Balances
4 - MATH 2060 Calculus of Several Variables
3 - PHYS 2210 Physics with Calculus II
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Second Semester
3 - CH 2240 Organic Chemistry
1 - CH 2290 Organic Chemistry Lab.
3 - CHE 2200 Chemical Engr. Thermodynamics I
4 - CHE 2300 Fluids/Heat Transfer
4 - MATH 2080 Intro. to Ordinary Diff. Equations
15

Junior Year

First Semester
1 - CH 3390 Physical Chemistry Lab.
3 - CHE 3210 Chemical Engr. Thermodynamics II
4 - CHE 3300 Mass Transfer and Separation Proc.
2 - ECE 2070 Basic Electrical Engineering
1 - ECE 2080 Basic Electrical Engineering Lab.
3 - STAT 4110 Statistical Methods for Process Development and Control
3 - Emphasis Area Requirement[3]
17

Second Semester
3 - BMOL 4250 Biomolecular Engineering
3 - CH 3320 Physical Chemistry
1 - CH 3400 Physical Chemistry Lab.
3 - CHE 3070 Unit Operations Lab. I
3 - CHE 3190 Engineering Materials
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Senior Year

First Semester
3 - CHE 4070 Unit Operations Lab. II
3 - CHE 4310 Chemical Process Design I
2 - CHE 4430 Safety, Environ & Prof Practice I
3 - CHE 4500 Chemical Reaction Engineering
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
3 - Emphasis Area Requirement[3]
17

Second Semester
3 - BMOL 4290 Bioprocess Engineering
3 - CHE 3530 Process Dynamics and Control
3 - CHE 4330 Process Design II
1 - CHE 4440 Safety, Environ. and Prof. Practice II
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
3 - Emphasis Area Requirement[3]
16

131 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on Humanities and Social Sciences for Engineering Curricula. Six of these credit hours must also satisfy the Cross-Cultural Awareness and Science and Technology in Society Requirements.

[3]See advisor for details. Nine credit hours devoted to completion of an emphasis area or approved minor are required. Emphasis Area courses may not be used to satisfy other degree requirements Emphasis areas are:

Applied Engineering, Mathematics and Science Emphasis Area—Select from the following lists. At least one course must be selected from the Engineering courses list.

Engineering Courses—CHE 4010, 4140, CE 2010, IE 3600, 3610, 4620, ME 2040

Mathematics Courses—MATH 4340 or 4500

Science Courses—CH 3130, 4020, 4110, 4130, 4210, 4270, 4350, PHYS 2220, 4200, 4320, 4410, 4450

Biomolecular Science and Engineering Emphasis Area—Select from the following lists. At least one course must be selected from the Engineering courses list and the Science courses list.

Engineering Courses—BE 4280, BIOE 3020, 4010, 4020, 4400, 4480, 4490, BMOL 4260, 4270

Science Courses—BCHM 3050, 4310, 4330, 4060, 4360, BIOL 4340, CH 3600, 4040, 4140, 4250, GEN 3120,4400, MICR 3050, 4070, 4130, PHYS 4170

Business Management Emphasis Area—MGT 2010 is required. Select two additional courses from ACCT 2010, ECON 3060, 3100, 3210, ELE 3010, 4000, 4010, MGT 3150, 3900, 4110, 4230, MKT 3140

Energy Studies Emphasis Area—Select from AGRB 4570, BE 4400, CE 4370, 4400, 4430, 4910, CHE 4140, 4150, ECE 4200, 4570, 4610, 4710, ECON 4570, EES 3100, 4100, 4120, GEOL 4090, ME 4200, 4220, 4260, 4570

Environmental Engineering and Science Emphasis Area—Select two engineering courses and one science or policy course from the following lists:

Engineering Courses—BE 4240, 4400, BMOL 4030, CHE 4010, 4140, 4150, EES 4010, 4020, 4100, 4110, 4300, 4800, 4850, 4860, ETOX 4210, 4460

Science/Policy Courses—CH 4110, 4130, ENR 3120, ENSP 4000, PHYS 2450, 4200

Polymeric Materials Emphasis Area—Select from BIOE 3020, CH 4510, CHE 4120, 4130, 4450, MSE 4150, 4610, PKSC 4160. Students may not use both CHE 4120 and MSE 4150 to satisfy this requirement.

Note: No student may exceed a maximum of two attempts, including a *W*, to complete successfully any CHE course.

BIOMOLECULAR ENGINEERING CONCENTRATION

Freshman Year

First Semester
4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester
4 - CH 1020 General Chemistry
3 - CHE 1300 Intro to Chemical Engineering
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Sophomore Year

First Semester
5 - BIOL 1100 Principles of Biology I
3 - CH 2230 Organic Chemistry
4 - CHE 2110 Mass and Energy Balances
4 - MATH 2060 Calculus of Several Variables
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
19

Second Semester
3 - CH 2240 Organic Chemistry
1 - CH 2290 Organic Chemistry Lab.
3 - CHE 2200 Chemical Engr. Thermodynamics I
4 - CHE 2300 Fluids/Heat Transfer
4 - MATH 2080 Intro. to Ordinary Diff Equations
15

Junior Year

First Semester
3 - CHE 3210 Chemical Engr. Thermodynamics II
4 - CHE 3300 Mass Transfer and Separation Proc.
3 - PHYS 2210 Physics with Calculus II
3 - STAT 4110 Stat Methods for Process Dev & Con
3 - Biochemistry Requirement[3]
16

Second Semester
3 - BIOE 3020 Biomaterials
2 - BIOL 4340 Biological Chem Lab Techniques
3 - BMOL 4250 Biomolecular Engineering
3 - CHE 3070 Unit Operations Lab. I
3 - CHE 3190 Engineering Materials
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Senior Year

First Semester
3 - BCHM 4310 Physical Approach to Biochem
3 - CHE 4070 Unit Operations Lab. II
3 - CHE 4310 Chemical Process Design I
2 - CHE 4430 Safety, Environ & Prof Prac I
3 - CHE 4500 Chemical Reaction Engineering
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Second Semester
3 - BMOL 4290 Bioprocess Engineering
3 - CHE 3530 Process Dynamics and Control
3 - CHE 4330 Process Design II
1 - CHE 4440 Safety, Environ & Prof Prac II
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
3 - Engineering Requirement[4]
16

133 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on Humanities and Social Sciences for Engineering Curricula. Six of these credit hours must also satisfy the Cross-Cultural Awareness and Science and Technology in Society Requirements.

[3]Select from BCHM 3010, 3050, 4230, or CH 3600.

[4]Select from BE 4280, 4350, BIOE 4400, 4490, 4760, BMOL 4030, 4270, CHE 4010, or MICR 4130.

Note: No student may exceed two attempts, including a *W*, to complete successfully any CHE course.

CIVIL ENGINEERING

Bachelor of Science

Civil Engineering involves the planning, design, construction management, operation, and maintenance of facilities and systems in the built environment, including bridges, buildings, airports, water supply systems, ports, dams, and highways.

The Bachelor of Science degree program in Civil Engineering includes the common educational goals listed on page 110 for the College of Engineering, Computing and Applied Sciences. The complete objectives of the program can be found at *www.clemson.edu/ce*.

The first two years provide students with building blocks necessary to be successful civil engineers, including proficiency in calculus, engineering mechanics, physics, and chemistry. During the junior year, students receive a broad introduction to the fundamental areas of civil engineering (structures, hydraulics, geotechnical, transportation, environmental, construction materials, and construction engineering and management). Design experiences are integrated throughout the curriculum, culminating in the senior year with a major capstone design project. In addition, during the senior year, students can select from available emphasis areas that serve to strengthen their undergraduate background.

The Civil Engineering program prepares students to work immediately upon graduation in most areas of civil engineering or to pursue graduate degrees. Students are also exposed to issues related to professional practice, including professional registration, life-long learning, and communication and team skills. Because a concerned society demands a realistic consideration of the impacts of engineering projects, civil engineering students are also educated in the broad areas of the humanities and social sciences.

To be eligible for admission into the Bachelor of Science degree program in Civil Engineering, students must have completed the courses outlined in the freshman core curriculum and have a cumulative grade-point average of 2.6 or higher.

The Department of Civil Engineering allows eligible students to count up to six hours of graduate credit (6000- and 8000-level courses) toward both the bachelor's and master's degrees. Students participating in this program must have completed the junior year, must have earned a minimum 3.4 grade-point average, and must be approved by the department. Details of the suggested curriculum and program information are available from the department.

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester

3 - ENGR 1410 Programming and Problem Solving[3]
2 - ENGR 2100 Computer-Aided Design and Engineering Applications
3 - GEOL 1010 Physical Geology
1 - GEOL 1030 Physical Geology Lab.
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I
1 - PHYS 1240 Physics Lab. I
17

Sophomore Year

First Semester

3 - CE 2010 Statics
3 - CE 2550 Geomatics
4 - MATH 2060 Calculus of Several Variables
3 - PHYS 2210 Physics with Calculus II
1 - PHYS 2230 Physics Lab. II
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Second Semester

4 - CE 2060 Structural Mechanics
2 - CE 2080 Dynamics
2 - CE 3520 Economic Evaluation of Projects
3 - COMM 2500 Public Speaking
4 - MATH 2080 Intro. to Ordinary Diff. Equations
15

Junior Year

First Semester

3 - CE 3010 Structural Analysis
3 - CE 3310 Construction Engineering and Mgt.
4 - CE 3410 Introduction to Fluid Mechanics
4 - CE 3510 Civil Engineering Materials
3 - MATH 3020 Statistics for Engineering and Science
17

Second Semester

3 - CE 3110 Transportation Engineering Planning and Design
4 - CE 3210 Geotechnical Engineering
3 - CE 3420 Applied Hydraulics and Hydrology
1 - CE 3530 Professional Seminar
3 - EES 4010 Environmental Engineering
3 - Design Technical Requirement[4]
17

Senior Year

First Semester

3 - ENGL 3140 Technical Writing
3 - Design Technical Requirement[4]
6 - Technical Requirement[5]
3 - Technical Requirement Restricted[6]
15

Second Semester

3 - CE 4590 Capstone Design Project
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
3 - Arts and Humanities (Literature) Requirement[2]
3 - Technical Requirement[5]
3 - Elective
15

129 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on Humanities and Social Sciences for Engineering Curricula. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.

[3]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[4]Six credits selected from the following: CE 4210 or 4240; CE 4020, 4040, 4060, 4070 or 4080; CE 4110 or 4560; CE 4470; EES 4020

[5]Select from BE 4840, CE 4010, 4020, 4040, 4060, 4070, 4080, 4100, 4110, 4120, 4210, 4240, 4330, 4340, 4360, 4380, 4390, 4430, 4460, 4470,4560, 4570, 4620, 4820, 4910, CRP 4120, CSM 3040, 3050, ECE 3090, EES 4020, 4100, 4300, 4840, 4850, 4860, GEOL 4080, LAW 3220, 3330, ME 3100, MSE 2100. Technical Requirements and electives may be used to complete an emphasis area in one or more of the following fields:

Applied Fluid Mechanics Emphasis Area—Two credits selected from CE 4430, 4460, 4470, 4620; and two credits selected from CE 4430, 4460, 4470, 4620, 4900, EES 4020

Construction Emphasis Area—Nine credits selected from CE 4330, 4340, 4360, 4380, 4390, 4560, 4570, 4910; and three credits selected from CE 4020, 4040, 4060, 4070, 4110, 4210, 4240, 4560, 4570, CSM 3040, 3050, 3510, 4530

Environmental Engineering Emphasis Area—Six credits selected from CE 4470, 4820, EES 4020, 4100, 4110, 4300, 4500, 4510, 4750, 4800; and six credits selected from CE 4900, any ENSP course or HIST 3920

Geotechnical/Geoenvironmental Engineering Emphasis Area—Three credits selected from CE 4210, 4240, 4910; and nine credits selected from CE 4020, 4210, 4240, 4570, 4820, 4900, 4910, EES 4800, 4840, GEOL 3000, 4210

Structural Engineering Emphasis Area—CE 4010, 4020 and 4060; and three additional credits selected from CE 4040, 4070, 4210, 4240, 4900

Transportation Engineering Emphasis Area—Six credits selected from CE 4100, 4110, 4120; and six credits selected from CE 4100, 4110, 4120, 4330, 4340, 4470, 4900, GEOG 3030, MGT 3050

[6]Select from BE 4840, CE 4100, 4110, 4120, 4210, 4240, 4560, 4820, CRP 4120, EES 4020, 4100, 4300, 4840, 4850, 4860

Notes:

1. Civil Engineering students may neither enroll in nor receive credit for any CE or EM course unless they have a 2.0 Engineering grade-point average.
2. Civil Engineering students enrolling in any CE course (except CE 4590) must have a grade of C or better in the prerequisites for that course.

COMPUTER ENGINEERING

Bachelor of Science

Computer engineers have excellent career opportunities in the design and application of hardware and software components for a variety of computer applications. These include mainframe, desktop, and embedded microprocessor platforms, as well as the networking of various types of computers and peripherals.

Based on a strong foundation in mathematics, computer science, and the physical sciences, the Computer Engineering program includes engineering science and design in circuits, electronics, computer organizations and design, peripheral interfacing, and software engineering. Emphasis is placed on hands-on experience with networked computer systems, micro-, mini-, and mainframe computers, and the solution of a wide range of practical problems using engineering principles. In addition to these technical skills, students learn to communicate effectively and to develop interpersonal, teamwork, and management skills, all of which contribute to success in a professional engineering career. The program is also an excellent preparation for graduate study.

Information on the program and its objectives is available at *www.clemson.edu/cecas/departments/ece/*.

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I[2]
3 - Arts and Humanities Requirement[3] *or*
3 - Social Science Requirement[3]
16

Second Semester

3 - ENGR 1410 Programming and Problem Solving[4]
4 - MATH 1080 Calculus of One Variable II[2]
3 - PHYS 1220 Physics with Calculus I[2]
6 - Arts and Humanities Requirement[3] *or*
6 - Social Science Requirement[3]
16

Sophomore Year

First Semester

3 - CPSC 1110 Introduction to Programming in C[2]
2 - ECE 2010 Logic and Computing Devices[2]
3 - ECE 2020 Electric Circuits I[2]
1 - ECE 2090 Logic and Computing Devices Lab.
1 - ECE 2110 Electrical Engineering Lab. I[2]
4 - MATH 2060 Calculus of Several Variables[2]
3 - PHYS 2210 Physics with Calculus II[2]
17

Second Semester

1 - ECE 2120 Electrical Engineering Lab. II[2]
3 - ECE 2220 Systems Programming Concepts for Computer Engineering[2]
3 - ECE 2620 Electric Circuits II[2]
3 - ECE 2720 Computer Organization[2]
1 - ECE 2730 Computer Organization Laboratory
4 - MATH 2080 Intro. to Ordinary Diff. Equations[2]
15

Junior Year

First Semester

3 - ECE 2230 Computer Systems Engineering[2]
1 - ECE 3110 Electrical Engineering Lab. III[2]
3 - ECE 3200 Electronics I[2]
3 - ECE 3300 Signals, Systems, and Transforms[2]
3 - ECE 3710 Microcontroller Interfacing[2]
1 - ECE 3720 Microcontroller Interfacing Lab.
3 - MATH 3110 Linear Algebra[2]
17

Second Semester

3 - ECE 3170 Random Signal Analysis[2]
3 - ECE (CPSC) 3220 Intro. to Operating Systems[2]
3 - ECE 3270 Digital Computer Design
3 - ECE 3520 Programming Systems[2]
3 - MATH 4190 Discrete Math. Structures I
15

Senior Year

First Semester

3 - COMM 1500 Intro. to Human Comm. *or*
3 - COMM 2500 Public Speaking
3 - ECE 4090 Intro. to Linear Control Systems[2]
2 - ECE 4950 Integrated System Design I[2]
3 - ENGL 3140 Technical Writing
6 - Computer Engineering Technical Requirement[5]
17

Second Semester

2 - ECE 4960 Integrated System Design II
3 - Arts and Humanities Requirement[3] *or*
3 - Social Science Requirement[3]
6 - Computer Engineering Technical Requirement[5]
3 - Special Requirement[6]
14

127 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]This course must be passed with a grade of C or better either to transfer into Computer Engineering from General Engineering or to satisfy later course prerequisites.

[3]See General Education section of the *Undergraduate Announcements*. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.

[4]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[5]Twelve credit hours selected from BIOE 3700*, 4310*, 4350*, 4710*, ECE 3210*, 4050+, 4270, 4300, 4380, 4400, 4420, 4490, 4550, 4600, 4670, 4680, 4730, 4910+, 4920+, 4930+, 4990+. Three credits of this requirement must include ECE 4270, 4300 or 4400. A maximum of six credits of courses marked with an asterisk and a maximum of three credits of courses marked with a plus may be used to satisfy this requirement.

[6]Three additional credits of university or college approved Arts and Humanities or Social Science courses; or ELE 3010 or 4010; or any additional three-credit, 4000-level course from footnote 5 above; or any course selected from the following: ECE 2220, 4040, 4060, 4180, 4190, 4200, 4220, 4320, 4360, 4370, 4460, 4570, 4610, or ME 3100; or one additional course selected from MATH 4120, 4340, 4350, 4400, 4410, or 4530.

Notes:

1. A student is allowed to enroll in ECE courses (excluding ECE 2070, 2080, 3080) only when all prerequisites have been passed with a grade of C or better.
2. All Computer Engineering students must have a cumulative engineering grade-point average of 2.0 to enroll in any 3000- or 4000-level ECE courses.
3. No student may exceed a maximum of two attempts, excluding a *W*, to complete successfully any ECE course.

COMPUTER INFORMATION SYSTEMS

Bachelor of Science

The Computer Information Systems degree program is oriented toward computer applications in management-related problems. The program emphasizes functional areas of management, including accounting, production, marketing, and finance and the applications of computers in these areas. The curriculum is designed to prepare students for careers in areas such as systems design and analysis, applications programming, database administration, and information retrieval, as well as for continued study toward an advanced degree.

Students who change majors into Computer Information Systems must have a cumulative grade-point average of 2.0 or higher.

Additional information can be found at *http://www.clemson.edu.computing.*

Freshman Year

First Semester

3 - ENGL 1030 Composition and Rhetoric
3 - MATH 1020 Business Calculus I[1] *or*
4 - MATH 1060 Calculus of One Variable I[1]
4 - Introduction to Computing Requirement[2]
4 - Natural Science Requirement[3]
1 - Elective[1]
15

Second Semester

3 - MATH 2070 Business Calculus II[1] *or*
4 - MATH 1080 Calculus of One Variable II[1]
3 - Arts and Humanities (Non-Lit.) Requirement[4]
4 - Introduction to Computing Requirement[2]
3 - Natural Science Requirement[3]
3 - Social Science Requirement[4]
1 - Elective[1]
17

Sophomore Year

First Semester

3 - CPSC 2070 Discrete Structures for Computing[5]
4 - CPSC 2120 Algorithms and Data Structures
3 - Arts and Humanities (Literature) Requirement[4]
3 - Oral Communication Requirement[6]
3 - Social Science Requirement[4]
16

Second Semester

3 - CPSC 2150 Software Development Foundations
4 - CPSC 2310 Intro. to Computer Organization
1 - CPSC 2910 Seminar in Professional Issues I
3 - MGT 2010 Principles of Management
3 - STAT 3090 Introductory Business Statistics[7]
14

Junior Year

First Semester

3 - ACCT 2010 Financial Accounting Concepts
3 - CPSC 2200 Microcomputer Applications
3 - CPSC 3220 Introduction to Operating Systems
3 - CPSC 3720 Intro. to Software Engineering
3 - Writing Requirement[8]
15

Second Semester

3 - ACCT 2020 Managerial Accounting Concepts
3 - CPSC 3600 Networks and Network Program.
3 - CPSC 3710 Systems Analysis *or*
3 - MGT 4520 Systems Analysis and Design
3 - Computer Science Requirement[9]
3 - Economics Requirement[10]
15

Senior Year

First Semester

3 - CPSC 4200 Computer Security Principles *or*
3 - CPSC 4240 System Admin. and Security
3 - CPSC 4620 Database Management Systems
3 - CPSC 4910 Seminar in Professional Issues II
3 - Business Requirement[11]
3 - Computer Science Requirement[9]
15

Second Semester

3 - MGT 3120 Decision Models for Management
3 - MKT 3010 Principles of Marketing
3 - Business Requirement[11]
3 - Computer Science Requirement[9]
3 - Information Systems Requirement[12]
15

122 Total Semester Hours

[1]Select either the MATH 1020/2070, 1060/2070 or 1060/1080 sequence. Students who select the 1060/1080 sequence will have satisfied the two elective credits in the freshman year.

[2]Select either the CPSC 1010 and 1020 sequence; or the CPSC 1060 and 1070 sequence. The sequence of CPSC 1110 and 1020 is also acceptable with one elective credit taken in the first semester.

[3]Select from courses in BIOL, BCHM, CH, GEOL, MICR, PHYS; or ENSP 2000. At least one course must include a laboratory and satisfy the Natural Science General Education Requirement.

[4]See General Education Requirements.

[5]MATH 1190 may be substituted.

[6]Select from: COMM 1500, 2500, HON 2230; or the cluster of courses AS 3090, 3100, 4090, 4100; or ML 1010, 1020.

[7]MATH 3020 or STAT 3300 may be substituted.

[8]Select from: ENGL 3040, 3120, 3140, 3150, 3330; AS 3090, 3100, 4090, 4100; ML 3010, 3020, 4010, 4020.

[9]Select from 3000-level or higher CPSC courses or DPA 3070. No more than three credits of CPSC 3990 or 4810 may be applied to this requirement, and no more than six credits of CPSC 4820 may be applied. Up to three credits of ECE 3000-level or higher courses; or MATH 3650; or MATH 4000-level courses may be substituted.

[10]Select from ECON 2000, 2110, or 2120.

[11]Select from FIN 3060 and MGT 3900, 4000.

[12]Select from MGT 4520, 4540, 4550, 4560, or any 4000-level CPSC course. CPSC 4810 may not substitute.

Notes:

1. For graduation, a candidate for the BS degree in Computer Information Systems must have earned a grade of C or better in each CPSC course applied to the non-elective requirements of the degree.
2. A grade of C or better must be earned in all prerequisite courses (including CPSC and MATH courses) before enrolling in the next CPSC course.
3. General Education Cross-Cultural Awareness and Science and Technology in Society requirements must be satisfied.

COMPUTER SCIENCE

Bachelor of Arts

The Bachelor of Arts in Computer Science is ideal for students interested in acquiring a broad-based liberal arts education that includes a strong and solid understanding of computer science. The curriculum is oriented toward design, implementation, and application of computer software systems to solve information processing problems. The program prepares students for employment in the computer software field or for continued study toward an advanced degree in computer science. Additional information can be found at *http://www.clemson.edu.computing.*

Students who change majors into Computer Science must have a cumulative grade-point average of 2.0 or higher.

Freshman Year

First Semester

3 - ENGL 1030 Composition and Rhetoric
3 - MATH 1020 Business Calculus I[1] *or*
4 - MATH 1060 Calculus of One Variable I[1]
4 - Modern Language Requirement[2]
4 - Introduction to Computing Requirement[3]
1 - Elective[1]
15

Second Semester
3 - MATH 2070 Business Calculus II[1] *or*
4 - MATH 1080 Calculus of One Variable II[1]
3 - Arts and Humanities (Non-Lit.) Req.[4]
4 - Modern Language Requirement[2]
4 - Introduction to Computing Requirement[3]
1 - Elective[1]
15

Sophomore Year

First Semester
3 - CPSC 2070 Discrete Structures for Computing[5]
4 - CPSC 2120 Algorithms and Data Structures
3 - Arts and Humanities (Literature) Requirement[4]
3 - Modern Language Requirement[2]
3 - Oral Communication Requirement[6]
16

Second Semester
3 - CPSC 2150 Software Development Foundations
4 - CPSC 2310 Intro. to Computer Organization
1 - CPSC 2910 Seminar in Professional Issues I
3 - Modern Language Requirement[2]
4 - Natural Science Requirement[7]
15

Junior Year

First Semester
3 - STAT 3090 Introductory Business Statistics[8]
6 - Computer Science Requirement[9]
3 - Minor Requirement
3 - Natural Science Requirement[7]
15

Second Semester
3 - Computer Science Requirement[9]
6 - Minor Requirement
3 - Social Science Requirement[4]
3 - Writing Requirement[10]
15

Senior Year

First Semester
6 - Computer Science Requirement[9]
3 - Departmental Humanities Requirement[11]
3 - Minor Requirement
3 - Social Science Requirement[4]
15

Second Semester
6 - Computer Science Requirement[9]
3 - Fine Arts Requirement[12]
3 - Minor Requirement
3 - Elective
15

121 Total Semester Hours

[1]Select either the MATH 1020/2070, 1060/2070, or 1060/1080 sequence. Students who select the MATH 1060/1080 sequence will have satisfied the elective credits in the freshman year. Students interested in computer graphics should select the MATH 1060/1080 sequence.

[2]Students must complete through 2020 in a modern language. See Modern Languages Requirement at Clemson University statement on page 27.

[3]Select either the CPSC 1010 and 1020 sequence; or the CPSC 1060 and 1070 sequence. The sequence of CPSC 1110 and 1020 is also acceptable with one elective credit taken in the first semester.

[4]See General Education Requirements.

[5]MATH 1190 may be substituted.

[6]Select from: COMM 1500, 2500, HONS 2230; or the cluster of courses AS 3090, 3100, 4090, 4100; or ML 1010, 1020.

[7]Select from courses in BIOL, BCHM, CH, GEOL, MICR, PHYS; or ENSP 2000. At least one course must include a laboratory and satisfy the Natural Science General Education Requirement.

[8]MATH 3020 or MATH 3110 or STAT 3300 may be substituted. MATH 3110 is required for computer graphics courses.

[9]Select from 3000-level or higher CPSC courses or DPA 3070. No more than three credits of CPSC 3990 or 4810 may be applied to this requirement, and no more than six credits of CPSC 4820 may be applied. Up to three credits of ECE 3000-level or higher courses; or MATH 3650; or MATH 4000-level courses may be substituted.

[10]Select from: ENGL 3040, 3120, 3140, 3150, 3330; AS 3090, 3100, 4090, 4100; ML 3010, 3020, 4010, 4020.

[11]Select from courses in AAH, ANTH, ART, CHIN, DANC, ENGL, FR, GER, HUM, ITAL, JAPN, MUSC, PA, PHIL, REL, RUSS, SPAN, THEA.

[12]MUSC 2100 or any course in AAH, ART, or THEA.

Notes:

1. For graduation, a candidate for the BA degree in Computer Science must have earned a grade of C or better in each CPSC course applied to the non-elective requirements for the degree.
2. A grade of C or better must be earned in all prerequisite courses (including CPSC and MATH courses) before enrolling in the next CPSC course.
3. General Education Cross-Cultural Awareness and Science and Technology in Society requirements must be satisfied.

COMPUTER SCIENCE

Bachelor of Science

The Computer Science program is oriented toward design, implementation, and application of software systems to solve information processing problems. This program is more technically oriented than the Computer Information Systems curriculum. It prepares students for employment in the computer software field or for continued study toward an advanced degree in computer science. This program is accredited by the Computing Accreditation Commission (CAC) of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone: (410) 347-7700. Additional information can be found at *http://www.clemson.edu.computing.*

Students who change majors into Computer Science must have a cumulative grade-point average of 2.0 or higher.

Combined Bachelor's/Master's Plan

The School of Computing allows students to apply up to nine hours of graduate credit (6000- and 8000-level courses) toward both the bachelor's and master's degrees. Students participating in this program must have a minimum grade-point average of 3.4 and be admitted to the Graduate School prior to registering for graduate courses. Details of the suggested curriculum and program information are available from the School.

Freshman Year

First Semester
3 - ENGL 1030 Composition and Rhetoric
4 - MATH 1060 Calculus of One Variable I
4 - Introduction to Computing Requirement[1]
4 - Natural Science Requirement[2]
15

Second Semester
4 - MATH 1080 Calculus of One Variable II
3 - Arts and Humanities (Non-Lit.) Requirement[3]
4 - Introduction to Computing Requirement[1]
4 - Natural Science Requirement[2]
15

Sophomore Year

First Semester
3 - CPSC 2070 Discrete Structures for Computing[4]
4 - CPSC 2120 Algorithms and Data Structures
3 - Arts and Humanities (Literature) Requirement[3]
3 - Natural Science Requirement[2]
3 - Oral Communication Requirement[5]
16

Second Semester
3 - CPSC 2150 Software Development Foundations
4 - CPSC 2310 Intro. to Computer Organization
1 - CPSC 2910 Seminar in Professional Issues I
3 - STAT 3090 Introductory Business Statistics[6]
3 - Natural Science Requirement[2]
2 - Elective
16

Junior Year

First Semester
3 - CPSC 3300 Computer Systems Organization
3 - CPSC 3600 Networks and Network Program.
3 - CPSC 3720 Intro. to Software Engineering
3 - MATH 3110 Linear Algebra
3 - Social Science Requirement[3]
15

Second Semester
3 - CPSC 3220 Introduction to Operating Systems
3 - Arts and Humanities Requirement[7] *or*
3 - Social Science Requirement[7]
3 - Computer Science Requirement[8]
3 - Social Science Requirement[3]
3 - Theory Requirement[9]
15

Senior Year

First Semester
3 - CPSC 3520 Programming Languages
6 - Computer Science Requirement[8]
3 - Writing Requirement[10]
3 - Elective
15

Second Semester
3 - CPSC 4910 Seminar in Professional Issues II
3 - Arts and Humanities Requirement[7] *or*
3 - Social Science Requirement[7]
6 - Computer Science Requirement[8]
3 - Elective
15

122 Total Semester Hours

[1]Select either the CPSC 1010 and 1020 sequence; or the CPSC 1060 and 1070 sequence. The sequence of CPSC 1110 and 1020 is also acceptable with one elective credit taken in the first semester.

[2]Two-semester sequence in the same physical or biological science, each including a laboratory, is required. Select from BIOL 1030/1050, 1040/1060; 1100, 1110; CH 1010, 1020; GEOL 1010/1030 and 2020 or 1120/1140; PHYS 1220/1240, 2210/2230. The six remaining hours may be selected from BIOL, BCHM, CH, GEOL, MICR, PHYS; or ENSP 2000. Excess credits in the lab sciences may apply to the remaining science requirements.

[3]See General Education Requirements.

[4]MATH 1190 may be substituted.

[5]Select from: COMM 1500, 2500, HONS 2230; or the cluster of courses AS 3090, 3100, 4090, 4100; or ML 1010, 1020.

[6]MATH 3020 or STAT 3300 may be substituted.

[7]Select from courses in AAH, ANTH, ART, CHIN, COMM, DANC, EAS, ECON, ENGL, FR, GEOG, GER, HIST, HUM, ITAL, JAPN, MUSC, PA, PAS, PHIL, POSC, PSYC, REL, RUSS, SOC, SPAN, THEA, WS.

[8]Select from 3000-level or higher CPSC courses or DPA 3070. No more than three credits of CPSC 3990 or 4810 may be applied to this requirement, and no more than six credits of CPSC 4820 may be applied. Up to three credits of ECE 3000-level or higher courses; or MATH 3650; or MATH 4000-level courses may be substituted.

[9]Select CPSC 3120 or 3500

[10]Select from: ENGL 3040, 3120, 3140 3150, 3330; AS 3090, 3100, 4090, 4100; ML 3010, 3020, 4010, 4020.

Notes:

1. For graduation, a candidate for the BS degree in Computer Science must have earned a grade of C or better in each CPSC course applied to the non-elective requirements of the degree.
2. A grade of C or better must be earned in all prerequisite courses (including CPSC and MATH courses) before enrolling in the next CPSC course.
3. General Education Cross-Cultural Awareness and Science and Technology in Society requirements must be satisfied.

ELECTRICAL ENGINEERING

Bachelor of Science

Electrical engineers are in high demand for a wide range of influential positions. Professional duties range from analytical problem solving to the design of components and systems. The scope of employment requires a unique breadth and depth of knowledge and technical skills, which are reflected in the Electrical Engineering program. This program also offers an excellent preparation for graduate education. Detailed information can be found at *www.clemson.edu/cecas/departments/ece/*.

Building on a foundation of mathematical and physical sciences, students progress into the application of these in the engineering science areas of circuits, electronics, communications, controls, power, and electromagnetics. In these subjects, students also begin to apply the concepts and techniques learned to the design of circuits and systems. Senior technical design courses offer the opportunity to further develop expertise in a selected area.

In addition to these technical skills, students learn to communicate effectively, both orally and with the written word. Because engineers work for the benefit of society, the curriculum includes a strong component of humanities and social science courses. Also, many project design assignments enable the development of interpersonal, teamwork, and management skills, which are necessary for success in a professional engineering career.

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I[2]
3 - Arts and Humanities Requirement[3] *or*
3 - Social Science Requirement[3]
16

Second Semester

4 - CH 1020 General Chemistry
3 - ENGR 1410 Programming and Problem Solving[4]
4 - MATH 1080 Calculus of One Variable II[2]
3 - PHYS 1220 Physics with Calculus I[2]
3 - Arts and Humanities Requirement[3] *or*
3 - Social Science Requirement[3]
17

Sophomore Year

First Semester

3 - CPSC 1110 Introduction to Programming in C[2]
2 - ECE 2010 Logic and Computing Devices[2]
3 - ECE 2020 Electric Circuits I[2]
1 - ECE 2090 Logic and Computing Devices Lab.
1 - ECE 2110 Electrical Engineering Lab. I[2]
4 - MATH 2060 Calculus of Several Variables[2]
3 - PHYS 2210 Physics with Calculus II[2]
17

Second Semester

1 - ECE 2120 Electrical Engineering Lab. II[2]
3 - ECE 2620 Electric Circuits II[2]
3 - ECE 2720 Computer Organization[2]
1 - ECE 2730 Computer Organization Laboratory
4 - MATH 2080 Intro. to Ordinary Diff. Equations[2]
3 - Arts and Humanities Requirement[3] *or*
3 - Social Science Requirement[3]
15

Junior Year

First Semester

1 - ECE 3110 Electrical Engineering Lab. III[2]
3 - ECE 3200 Electronics I[2]
3 - ECE 3300 Signals, Systems, and Transforms[2]
3 - ECE 3600 Electric Power Engineering[2]
3 - ECE 3800 Electromagnetics[2]
3 - Advanced Mathematics Requirement[5]
16

Second Semester

1 - ECE 3120 Electrical Engineering Lab. IV
3 - ECE 3170 Random Signal Analysis[2]
3 - ECE 3210 Electronics II[2]
3 - ECE 3710 Microcontroller Interfacing[2]
1 - ECE 3720 Microcontroller Interfacing Lab.
3 - ECE 3810 Fields, Waves, and Circuits[2]
3 - ENGL 3140 Technical Writing
17

Senior Year

First Semester

3 - COMM 1500 Intro. to Human Comm. *or*
3 - COMM 2500 Public Speaking
3 - ECE 4090 Intro. to Linear Control Systems[2]
3 - ECE 4270 Communications Systems
2 - ECE 4950 Integrated Systems Design I[2]
3 - Electrical Engineering Technical Requirement[6]
14

Second Semester

2 - ECE 4960 Integrated System Design II
3 - Arts and Humanities Requirement *or*
3 - Social Science Requirement
6 - Electrical Engineering Technical Requirement[6]
3 - Special Requirement[7]
14

126 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]This course must be passed with a grade of C or better either to transfer into Electrical Engineering from General Engineering or to satisfy later course prerequisites.

[3]See General Education section of the *Undergraduate Announcements*. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.

[4]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[5]MATH 4190, 4340, 4350, 4530, or 4540

[6]Nine credits selected from BIOE 3700, 4310, 4350, 4710, ECE 2220, 4040, 4050*, 4060, 4180, 4190, 4200, 4220, 4300, 4320, 4360, 4370, 4380, 4400, 4420, 4460, 4550, 4570, 4600, 4610, 4670, 4680, 4730, 4910*, 4920*, 4930*, 4990*, or ME 3100. A maximum of three credits of courses marked with an asterisk may be used to satisfy this requirement..

[7]Three additional credits of university or college approved Arts and Humanities or Social Science courses; or ELE 3010 or 4010; or any additional three-credit, 4000-level course selected from footnote 6 above; or a course selected from the following list: ECE 3210, 4270, 4490; or one additional course selected from MATH 3110, 4120, 4190, 4340, 4350, 4400, 4410, 4530, or 4540.

Notes:

1. A student is allowed to enroll in ECE courses (excluding ECE 2070, 2080, 3080) only when all prerequisites have been passed with a grade of C or better.
2. All Electrical Engineering students must have a cumulative engineering grade-point average of 2.0 to enroll in any 3000- or 4000-level ECE courses.
3. No student may exceed a maximum of two attempts, excluding a *W*, to complete successfully any ECE course.

ENVIRONMENTAL ENGINEERING

Bachelor of Science

Our complex world faces many challenges, including contaminated water supplies, hazardous wastes, an increasing population and limited resources. Environmental engineers help to solve many of the environmental problems faced by society using the principles of biology, chemistry, physics, mathematics and earth sciences. An undergraduate degree in Environmental Engineering opens the door to a variety of rewarding career options. Environmental engineers protect water quality by designing water and wastewater treatment systems; ensure public safety by managing solid, hazardous and radioactive wastes; improve air quality by controlling emissions from mobile and stationary sources; reduce human health risks by tracking contaminants as they move through the environment; clean up toxic waste spills and restore historically contaminated sites; and design a more sustainable future by understanding our use of resources.

The curriculum for the Bachelor of Science degree in Environmental Engineering consists of 127 credit hours. All students participate in one professional seminar course and complete a capstone design project.

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester

4 - CH 1020 General Chemistry
3 - ENGR 1410 Programming and Problem Solving[3]
3 - HIST 1240 Environmental History Survey[4]
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I
17

Sophomore Year

First Semester

3 - BIOL 1030 General Biology[5]
1 - BIOL 1050 General Biology Lab[5]
3 - CE 2010 Statics
3 - EES 2010 Environmental Engineering Fund. I
4 - MATH 2060 Calculus of Several Variables
3 - PHYS 2210 Physics with Calculus II
17

Second Semester

2 - CE 2080 Dynamics
3 - CH 2010 Survey of Organic Chemistry [6]
4 - EES 2020 Environmental Engineering Fund. II
2 - ENGR 2100 Computer-Aided Design and Engineering Applications[7]
4 - MATH 2080 Intro. to Ordinary Diff. Equations
15

Junior Year

First Semester

2 - EES 3030 Water Treatment
2 - EES 3040 Wastewater Treatment
1 - EES 3050 Water and Wastewater Treatment Lab
3 - MATH 3020 Statistics for Science and Engineering
4 - MICR 3050 General Microbiology
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
15

Second Semester

4 - CE 3410 Introduction to Fluid Mechanics
3 - EES 4840 Municipal Solid Waste Mgt.
3 - EES 4850 Hazardous Waste Management
3 - GEOL 1010 Physical Geology[8]
1 - GEOL 1030 Physical Geology Lab[8]
3 - ME 3100 Thermodynamics and Heat Transfer
17

Senior Year

First Semester

3 - EES 4300 Air Pollution Engineering
1 - EES 4500 Environ. Engr. Senior Seminar
3 - EES 4800 Environmental Risk Assessment
3 - EES 4860 Environmental Sustainability
2 - Engineering Economics Requirement[9]
3 - Engineering or Science Requirement[10]
15

Second Semester

3 - EES 4750 Capstone Design Project
6 - Engineering or Science Requirement[10]
6 - Arts and Humanities Requirement[2] *or*
6 - Social Science Requirement[2]
15

127 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on Humanities and Social Sciences for Engineering Curricula. Three of these credit hours must also satisfy the Cross-Cultural Awareness General Education requirement. Students are encouraged (but not required) to take PHIL 3450 (Environmental Ethics) to fulfill the non-literature humanities requirement.

[3]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[4]HIST 1240 satisfies three credit hours of the social science requirement and the Science and Technology in Society General Education requirement. If a student is unable to enroll in the second semester of the freshman year, this course may be taken at another time.

[5]May substitute BIOL 1100 for BIOL 1030 and BIOL 1050; BIOL 1100 is five hours.

[6]CH 2230 may be substituted.

[7]ENGR 2080 may be substituted.

[8]May substitute PES 2020 for GEOL 1010 and GEOL 1030.

[9]Select CE 3520 or IE 3840.

[10]Select from BCHM 3050, 3060, BE 3220, 4150, 4220, 4240, 4400, 4640, BIOL 2110, 4100, 4430, 4440, CE 2060, 2550, 3210, 3310, 3420, 4430, 4470, 4820, CH 3300, 3310, 4130, ECE 2070, 2080, EES 3000, 3010, 4000, 4100, 4110, 4120, 4370, 4910, 4950, ENSP 4000, GEOL 2700, 3000, 3180, 4210, 4820, ME 4260, MICR 3050, 4100, MATH 3110, 3650, 4340, PES 4850, PHYS 2400, 2450, 4200

Notes:

1. The following courses must be completed with a C or better: CE 2010, CE 2080, CE 3410, MATH 2060, MATH 2080, PHYS 2210.

GEOLOGY

Bachelor of Science

Geology is the study of the Earth. It is an applied science that integrates principles from physics, chemistry, biology, engineering, and other disciplines to better understand the natural processes and human influences that shape our planet. Geology helps people deduce Earth's natural history, locate natural resources needed to support society, develop sustainable approaches to energy and resource management, and predict, assess, and manage global change and natural disasters.

Employment opportunities for geologists are numerous and varied. Examples include environmental and engineering consulting firms, energy exploration and production firms, mineral and metal industries, municipal, state, and federal governments, natural resource conservation organizations, and water authorities. Many students go on to graduate school in the geosciences, environmental sciences, or related fields. Geology is a professional degree and state certification as a Registered Professional Geologist is obtainable. Given the various career options that are possible, students are provided the opportunity to develop a broad range of skills and knowledge within the Geology program.

The Geology curriculum provides students with a well-rounded background in geology and related fields and is built around three critical themes: (1) appreciation for spatial and temporal scales, (2) knowledge of earth materials and compositions of environmental systems, and (3) understanding of geological and environmental processes. While providing solid fundamentals within science and engineering, the Geology program is also flexible, allowing students to choose among many electives to tailor their education to specific interests and career goals. The program has been carefully designed to help students develop quantitative and other critical skills, while familiarizing them with the topics, technologies, and resources needed for a variety of career paths in the geosciences. As students progress through the program they have multiple opportunities to enhance their skills of observation, computation, synthesis, communication and problem solving. Because Geology is inherently a field-based discipline, all students are required to take one or more courses that provide them with field experience. All Geology majors also participate in a multi-semester research program that provides them with hands-on experiences conducting geologic research and solving real-world problems in their chosen area of interest. It is also possible for Geology majors to pursue the Engineering Cluster Minor; students interested in this pathway should consult with their advisor early in their program of study.

Within the Geology curriculum, students who are particularly interested in environmental or water resources issues may choose to specialize in the Environmental Science Concentration or the Hydrogeology Concentration. These two concentrations provide more structured course pathways through the curriculum and help prepare students for careers in these specific areas. The Environmental Science Concentration in Geology focuses on environmental aspects of geoscience and is well suited for students interested in topics such as environmental policy, natural hazard assessment and remediation, evaluation of land use impacts, understanding geochemical cycles, and environmental systems analysis. This concentration provides a rigorous background in the sciences so that students can scientifically address environmental issues and integrate material from several fields to solve complex environmental problems. The Hydrogeology Concentration in Geology is designed for students who want to specialize in areas such as surface- and ground-water systems, treatment of water and cleanup of contaminated sites, contaminant flow and fluid transport, and water resource sustainability.

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
3 - GEOL 1010 Physical Geology
1 - GEOL 1030 Physical Geology Lab.
4 - MATH 1060 Calculus of One Variable I
15

Second Semester

4 - CH 1020 General Chemistry
3 - GEOL 1120 Earth Resources
4 - MATH 1080 Calculus of One Variable II
3 - Arts and Humanities (Non-Lit.) Requirement[1]
3 - Social Science Requirement[1]
17

Sophomore Year

First Semester

3 - GEOL 2050 Mineralogy and Intro. Petrology
1 - GEOL 2070 Mineralogy and Intro. Petrology Lab.
1 - GEOL 2910 Introduction to Research I
3 - PHYS 1220 Physics with Calculus I
3 - Arts and Humanities (Literature) Requirement[1]
3 - Social Science Requirement[1]
3 - STEM Requirement[2]
17

Second Semester

4 - GEOL 2020 Earth History
1 - GEOL 2920 Introduction to Research II
3 - Quantitative Science Requirement[3]
7 - STEM Requirement[2]
15

Junior Year

First Semester

4 - GEOL 3020 Structural Geology
2 - GEOL 3910 Research Methods I
3 - Quantitative Science Requirement[3]
3 - STEM Requirement[2]
12

Second Semester
2 - GEOL 3920 Research Methods II
7 - Geology Requirement[4]
3 - STEM Requirement[2]
12

Summer
6 - Field Experience[5]

Senior Year
First Semester
3 - GEOL 4910 Research Synthesis I
4 - Geology Requirement[4]
6 - STEM Requirement[2]
13

Second Semester
3 - GEOL 4920 Research Synthesis II
4 - Geology Requirement[4]
6 - STEM Requirement[2]
13

120 Total Semester Hours

[1]See General Education Requirements. Three of these credit hours must also satisfy the Cross-Cultural Awareness Requirement.

[2]Total of 28 credit hours, with no more than 14 credits below the 3000-level and no more than eight credits below the 2000-level, selected from courses in ASTR, BCHM (except 4910, 4920, 4930), BE (except 1990, 2990, 3000, 3010, 3700, 3990, 4000, 4510, 4730, 4990), BIOE (except 4000, 4510, 4600, 4610, 4690, 4900, 4910), BIOL (except 3940, 4910, 4920, 4930, 4940, 4950), CE (except 1990, 2990, 3530, 3870, 3880, 3890, 3990, 4870, 4880, 4890, 4900, 4990), CH (except 1990, 2990, 3990, 4430, 4440, 4500, 4990), CHE (except 3000, 3950, 3990, 4430, 4440, 4950, 4970, 4990), ECE (except 1990, 2990, 3000, 3990, 4910, 4920, 4990), EES (except 3000, 3010, 4000, 4500, 4510, 4900, 4950), ETOX, GEOL, IE (except 2680, 3000, 4000, 4040, 4690), MATH (except 2990, 3820, 3990, 4810, 4820, 4910, 4920, 4990), ME (except 2990, 3000, 3900, 4000, 4020, 4150, 4900), MICR (except 3940, 4910, 4920, 4930, 4940, 4950), MSE (except 3000, 3950, 4070, 4450, 4500, 4510, 4910, 4950, 4970), or PHYS (except 1990, 2990, 3000, 3990, 4010, 4990); or a maximum of one course from CPSC 1110, 1150 or 1610; or EM 2020, ENGR 1020, 1410, ENSP 2000, PES 2020. Credit for GEOL 4110 is limited to a maximum of three credits. Courses may not be used to satisfy any other requirement.

[3]Select six credits from Group I courses; *or* select three credits from Group I courses and three credits from Group II courses. Courses may not be used to satisfy any other requirement. Group I Courses—GEOL 4150, MATH 2060, 2080, 3110 Group II Courses—CPSC 1610, 1150, 1110, ENGR 1410, MATH 3020, 3600, STAT 2300

[4]Fifteen credit hours. Select from GEOL 3130, 3180, 4050, 4090, 4150, 4210, or (CE) 4820. Only excess hours may be used to satisfy STEM requirement hours.

[5]GEOL 4750, or other six-credit summer geology field camp, or a combination of GEOL 2750 plus a three-credit field course in geology (select GEOL 3700, 3750 or 3800) or other approved discipline. Students desiring to become registered professional geologists should take a six-credit summer field camp in geology/hydrogeology.

ENVIRONMENTAL SCIENCE CONCENTRATION

Freshman Year
First Semester
4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
3 - GEOL 1010 Physical Geology
1 - GEOL 1030 Physical Geology Lab.
4 - MATH 1060 Calculus of One Variable I
15

Second Semester
4 - CH 1020 General Chemistry
3 - GEOL 1120 Earth Resources
4 - MATH 1080 Calculus of One Variable II
3 - Arts and Humanities (Non-Lit.) Requirement[1]
3 - Social Science Requirement[1]
17

Sophomore Year
First Semester
3 - BIOL 1030 General Biology I
1 - BIOL 1050 General Biology Lab. I
3 - ENSP 2000 Intro. to Environmental Science
3 - GEOL 2050 Mineralogy and Intro. Petrology
1 - GEOL 2070 Mineral. and Intro. Petrology Lab.
1 - GEOL 2910 Introduction to Research I
3 - Arts and Humanities (Literature) Requirement[1]
15

Second Semester
3 - BIOL 1040 General Biology II
1 - BIOL 1060 General Biology Lab. II
3 - CH 2010 Survey of Organic Chemistry *or*
3 - CH 2230 Organic Chemistry
4 - GEOL 2020 Earth History
1 - GEOL 2920 Introduction to Research II
3 - PHYS 1220 Physics with Calculus I
15

Junior Year
First Semester
3 - GEOL 3000 Environmental Geology
4 - GEOL 3020 Structural Geology
2 - GEOL 3910 Research Methods I
4 - GEOL 4150 Analysis of Geological Processes[2]
13

Second Semester
3 - GEOL 3180 Introduction to Geochemistry
2 - GEOL 3920 Research Methods II
3 - GEOL 4210 GIS Applications in Geology
3 - MATH 3020 Statistics for Science and Engr. *or*
3 - STAT 2300 Statistical Methods I
4 - Environmental Science Requirement[3]
15

Summer
6 - Field Experience[4]

Senior Year
First Semester
3 - ENSP 4000 Studies in Environmental Science
3 - GEOL (CE) 4820 Groundwater and Contaminant Transport
3 - GEOL 4910 Research Synthesis I
3 - Social Science Requirement[1]
12

Second Semester
3 - GEOL 4920 Research Synthesis II
10 - Environmental Science Requirement[3]
13

121 Total Semester Hours

[1]See General Education Requirements. Three of these credit hours must also satisfy the Cross-Cultural Awareness Requirement.

[2]MATH 2060 may be substituted.

[3]Total of 14 credit hours selected from AGRB 2570, 3570, 4570, BE 3220, 4080, 4220, BIOL 3130, 4100, 4130, 4410, 4430, CH 4130, EES 4010, 4100, 4800, 4840, 4850, ENR 4130, ENSP 3150, FNR 2040, GEOL 2700, 2750, 3130, 3700, 3750, 3800, 4050, 4090, 4590, 4750, 4850, MATH 2060, 2080, 3110, 3600, MICR 3050, 4010, 4020, 4100, PES 2020, 4080, 4850, PHYS 2210, 2400, 2450, WFB 3130. No more than eight hours below the 3000-level. Courses cannot be used to satisfy any other requirement.

[4]GEOL 4750 or a combination of GEOL 2750 plus a three credit hour field course in geology (select from GEOL 3700, 3750 or 3800), ecology or other approved discipline. Students desiring to become registered professional geologists should take a six-credit hour summer field camp in geology/hydrogeology.

HYDROGEOLOGY CONCENTRATION

Freshman Year
First Semester
4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
3 - GEOL 1010 Physical Geology
1 - GEOL 1030 Physical Geology Lab.
4 - MATH 1060 Calculus of One Variable I
15

Second Semester
4 - CH 1020 General Chemistry
3 - GEOL 1120 Earth Resources
4 - MATH 1080 Calculus of One Variable II
3 - Arts and Humanities (Non-Lit.) Requirement[1]
3 - Social Science Requirement[1]
17

Sophomore Year
First Semester
3 - GEOL 2050 Mineralogy and Intro. Petrology
1 - GEOL 2070 Mineral. and Intro. Petrology Lab.
1 - GEOL 2910 Introduction to Research I
3 - PHYS 1220 Physics with Calculus I
1 - PHYS 1240 Physics Lab I
3 - Arts and Humanities (Literature) Requirement[1]
3 - Hydrogeology Requirement[2]
15

Second Semester
4 - GEOL 2020 Earth History
1 - GEOL 2920 Introduction to Research II
3 - MATH 3020 Statistics for Science and Engr. *or*
3 - STAT 2300 Statistical Methods I
3 - PHYS 2210 Physics with Calculus II
3 - Social Science Requirement[1]
3 - Hydrogeology Requirement[2]
17

Junior Year
First Semester
3 - GEOL 3000 Environmental Geology
4 - GEOL 3020 Structural Geology
2 - GEOL 3910 Research Methods I
4 - GEOL 4150 Analysis of Geological Processes[3]
13

Second Semester
4 - GEOL 3130 Sedimentology and Stratigraphy
3 - GEOL 3180 Introduction to Geochemistry
2 - GEOL 3920 Research Methods II
3 - GEOL 4210 GIS Applications in Geology
12

Summer
6 - GEOL 4750 Summer Geology Field Camp

Senior Year

First Semester

3 - GEOL (CE) 4820 Groundwater and Contaminant Transport
3 - GEOL 4910 Research Synthesis I
6 - Hydrogeology Requirement[2]
12

Second Semester

3 - EES 4010 Environmental Engineering
4 - GEOL 4050 Surficial Geology
4 - GEOL 4090 Environmental and Exploration Geophysics
3 - GEOL 4920 Research Synthesis II
14

121 Total Semester Hours

[1]See General Education Requirements. Three of these credit hours must also satisfy the Cross-Cultural Awareness Requirement.

[2]Total of 12 credits selected from CE 2010, 2080, CH 2010, 2230, EM 2020, ENGR 1020, 1410, ENSP 2000, GEOL 2700, 2750, MATH 2060, 2080, PES 2020; one course from CPSC 1110, 1150 or 1610; or any 3000–4000-level course in ASTR, BCHM (except 4910, 4920, 4930), BE (except 3000, 3010, 3700, 3990, 4000, 4510, 4730, 4990), BIOE (except 4000, 4510, 4600, 4610, 4690, 4900, 4910), BIOL (except 3940, 4910, 4920, 4930, 4940, 4950), CE (except 3530, 3870, 3880, 3890, 3990, 4870, 4880, 4890, 4900, 4990), CH (except 3990, 4430, 4440, 4500, 4990), CHE (except 3000, 3950, 3990, 4430, 4440, 4950, 4970, 4990), ECE (except 3000, 3990, 4910, 4920, 4990), EES (except 3000, 3010, 4000, 4500, 4510, 4900, 4950), ETOX, GEOL, IE (except 3000, 4000, 4040, 4690), MATH (except 3820, 3990, 4810, 4820, 4910, 4920, 4990), ME (except 3000, 3900, 4000, 4020, 4150, 4900), MICR (except 3940, 4910, 4920, 4930, 4940, 4950), MSE (except 3000, 3950, 4070, 4450, 4500, 4510, 4910, 4950, 4970), or PHYS (except 3000, 3990, 4010, 4990). Credit for GEOL 4110 is limited to a maximum of three credits. Courses may not be used to satisfy any other requirement.

[3]MATH 2060 may be substituted.

INDUSTRIAL ENGINEERING

Bachelor of Science

Industrial engineers design, install, and improve the complex systems that provide goods and services vital to our society and economy. These systems place unique demands for breadth of preparation on industrial engineers. The Industrial Engineering baccalaureate program prepares graduates to: (1) design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and energy using appropriate analytical, computational and experimental practices; (2) apply information technologies to the practice of industrial engineering; (3) conduct themselves in a professional and ethical manner; and (4) work and communicate effectively with colleagues at every level in the organization.

The traditional arenas for the practice of industrial engineering are the manufacturing facilities of industry; however, many practicing industrial engineers are employed in non-manufacturing institutions such as hospitals, financial institutions, consulting firms and government agencies. In addition to numerous employment opportunities in professional practice, industrial engineering graduates may further their formal education. The Department of Industrial Engineering offers programs leading to the Master of Science and Doctor of Philosophy degrees.

The Department of Industrial Engineering also offers a combined Bachelor's/Master's plan in which accepted students may count up to 12 hours of graduate credit (approved 6000- and 8000-level courses) toward both a bachelor's and a master's degree, with the stipulation that a minimum of 150 credit hours must be earned. To be eligible, the student must have senior standing and a minimum overall grade-point average of 3.4. Most students completing the joint BS/MS program in IE can only double count nine units. Details of the suggested curriculum and program information are available from the Industrial Engineering Department.

Freshman Year

First Semester

4 - CH 1010 General Chemistry[1]
3 - ENGL 1030 Composition and Rhetoric[1]
2 - ENGR 1020 Engineering Disciplines and Skills[2]
4 - MATH 1060 Calculus of One Variable I[1]
3 - Arts and Humanities Requirement[3] *or*
3 - Social Science Requirement[3]
16

Second Semester

3 - ENGR 1410 Programming and Problem Solving[4]
4 - MATH 1080 Calculus of One Variable II[1]
3 - PHYS 1220 Physics with Calculus I[1]
3 - Arts and Humanities Requirement *or*[3]
3 - Social Science Requirement[3]
4 - Lab Science Requirement[5]
17

Sophomore Year

First Semester

3 - CE 2010 Statics[6]
2 - ENGR 2080 Engineering Graphics and Machine Design *or*
2 - ENGR 2090 Intro to Engineering/ Computer Graphics *or*
2 - ENGR 2100 Computer-Aided Design and Engineering Graphics
4 - MATH 2060 Calculus of Several Variables
3 - MATH 3110 Linear Algebra
3 - PHYS 2210 Physics with Calculus II
1 - PHYS 2230 Physics Lab. II[7]
16

Second Semester

3 - IE 2100 Design and Analysis of Work Systems
4 - IE 3010 Systems Design I
1 - IE 3140 Seminar in Industrial Engineering
3 - IE 3600 Industrial Apps of Prob/Stat I
3 - IE 3800 Deterministic Operations Research
3 - MSE 2100 Introduction to Materials Science
17

Junior Year

First Semester

3 - IE 3610 Industrial Apps of Prob/Stat II
3 - IE 3810 Probabilistic Operations Research
3 - IE 3840 Engineering Economic Analysis
3 - IE 4400 Decision Support Systems in IE
3 - Arts and Humanities Requirement[3] *or*
3 - Social Science Requirement[3]
15

Second Semester

3 - IE 3860 Production Planning and Control
3 - IE 4610 Quality Engineering
3 - IE 4650 Facilities Planning and Design
4 - IE 4820 Systems Modeling
3 - Oral Communication Requirement[8]
16

Senior Year

First Semester

3 - IE 4880 Human Factors Engineering
3 - Electrical Engineering Requirement[9]
3 - Ethics and Professional Practice Requirement[10]
6 - Technical Requirement[11]
15

Second Semester

4 - IE 4670 Systems Design II
3 - Management Requirement[12]
3 - Arts and Humanities Requirement[3] *or*
3 - Social Science Requirement[3]
3 - Technical Requirement[11]
13

125 Total Semester Hours

[1]This course must be passed with a C or better either to transfer into IE from General Engineering or to satisfy later course prerequisites.

[2]ENGR 1050 and 1060 may be substituted for ENGR 1020

[3]See General Education Requirements. Six of these credit hours must also satisfy the Cross-Cultural Awareness and Science and Technology in Society Requirements.

[4]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[5]Select from BIOL 1030/1050, 1040/1060, 1100, 1220/1200, 1230/1200, CH 1020, GEOL 1010/1030

[6]ME 2010 may be substituted.

[7]PHYS 1240 may be substituted.

[8]See General Education Requirements. COMM 1500 is recommended.

[9]Select either ECE 2020 and 2110; or ECE 2070 and 2080.

[10]Select from PHIL 1030, 3440, 3450, 3460, LAW 3220

[11]Select from IE 4000, 4020, 4030, 4040, 4300, 4460, 4520, 4560, 4570, 4600, 4620, 4630, 4810, 4850, 4860, 4870, 4890, 4910

[12]Select from ACCT 2010, 2020, AS 3090, ELE 4000, MGT 2010, 3070, 4110, MKT 4210, ML 3010

Notes:

1. No student may exceed three attempts, including a *W* and academic forgiveness (with the exception of a withdrawal from the University), to successfully complete any IE course (with a grade of *D* or better). Moreover, a third attempt is only granted by a written request to the department chair before the deadline to add a course in a subsequent term.

2. Industrial Engineering students who have a cumulative grade-point average or cumulative engineering grade-point average (EGPA) below 2.0 are on probation and will have restricted enrollment in classes. Students whose cumulative grade-point average is below 2.0 are subject to the regulations stipulated under the University's Academic Eligibility Policy. Students on probation for an EGPA below 2.0 who fail to recover (i.e. raise their EGPA above 2.0) in the first regular semester (fall or spring) will not be allowed to register for industrial engineering classes. After one year, such students may petition the Industrial Engineering Department for continued enrollment. An advising policy for students on probation is available from the Industrial Engineering Department.

MATERIALS SCIENCE AND ENGINEERING

Bachelor of Science

Materials scientists and engineers design, develop, and produce traditional and new advanced materials with diverse applications intended for use in a wide variety of industries. These include traditional materials-intensive industries such as structural clay, foundry, whiteware, polymers, plastics, fibers, textiles, composite materials, and automotive industries. Also included are high performance technology industries such as semiconductor, defense, biomaterials, aerospace, and communication industries. The broad career responsibilities of this discipline require competence in science, engineering, mathematics, and the social sciences. The curriculum develops skills in problem solving, engineering analysis, and design, as well as oral and written communication.

The Department of Materials Science and Engineering offers two areas of concentration within the Bachelor of Science degree in Materials Science and Engineering. The Inorganic Materials Concentration provides for more in-depth study of the engineering and science of materials such as ceramics, glasses, metals, optical and electronic materials; while the Polymeric Materials Concentration provides more emphasis on plastics, elastomers, fibers and fibrous materials, films, coatings and adhesives. Students select either the Inorganic Materials Concentration or the Polymeric Materials Concentration at the beginning of their sophomore year. Both concentrations in Materials Science and Engineering integrate laboratory with classroom experiences to prepare students for life-long learning and exciting career opportunities. Courses covering thermodynamics, kinetics, mechanical behavior, processing, fabrication and characterization of materials prepare students for careers in industry and for graduate school.

INORGANIC MATERIALS CONCENTRATION

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester

4 - CH 1020 General Chemistry
3 - ENGR 1410 Programming and Problem Solving[3]
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Sophomore Year

First Semester

3 - CH 2230 Organic Chemistry
1 - CH 2270 Organic Chemistry Lab.
3 - MSE 2100 Introduction to Materials Science
4 - MATH 2060 Calculus of Several Variables
3 - PHYS 2210 Physics with Calculus II
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Second Semester

3 - CE 2010 Statics
3 - CH 2240 Organic Chemistry
1 - CH 2280 Organic Chemistry Lab
2 - ENGR 2080 Engineering Graphics and Machine Design
4 - MATH 2080 Intro. to Ordinary Diff. Equations
3 - MSE 3610 Process of Metals & Their Composites
16

Junior Year

First Semester

3 - COMM 2500 Public Speaking
3 - MSE 3190 Materials Processing I
3 - MSE 3260 Thermodynamics of Materials
3 - MSE 3270 Transport Phenomena
3 - MSE 4150 Intro. to Polymer Sci. and Engr.
15

Second Semester

3 - IE 3840 Engineering Economic Analysis
3 - MATH 3020 Statistics for Science and Engr. *or*
3 - STAT 2300 Statistical Methods I
3 - MSE 3280 Phase Diagrams for Materials Processing and Applications
2 - MSE 3420 Structure/Property Laboratory
3 - MSE 4220 Mechanical Behavior of Materials
3 - Arts and Humanities Requirement[2]
17

Senior Year

First Semester

3 - MSE 4020 Solid State Materials
3 - MSE 4130 Noncrystalline Materials
3 - MSE 4320 Manufacturing Processes and Sys.
1 - MSE 4410 Manufacturing Laboratory
3 - MSE 4910 Undergraduate Research
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester

3 - MSE 4070 Senior Capstone Design
3 - MSE 4160 Electrical Properties of Materials
3 - MSE 4240 Optical Materials and Applications
3 - MSE 4330 Combustion System and Environmental Emissions
1 - MSE 4450 Practice of Materials Engineering
13

127 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on Humanities and Social Sciences for Engineering Curricula. Six of these credits must also satisfy the Cross-Cultural Awareness and the Science and Technology in Society General Education requirements.

[3]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

POLYMERIC MATERIALS CONCENTRATION

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester

4 - CH 1020 General Chemistry
3 - ENGR 1410 Programming and Problem Solving[3]
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Sophomore Year

First Semester

3 - CH 2230 Organic Chemistry
1 - CH 2270 Organic Chemistry Laboratory
3 - MSE 2100 Introduction to Materials Science
4 - MATH 2060 Calculus of Several Variables
3 - PHYS 2210 Physics with Calculus II
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
17

Second Semester

3 - CE 2010 Statics
3 - CH 2240 Organic Chemistry
1 - CH 2280 Organic Chemistry Laboratory
2 - ENGR 2080 Engineering Graphics and Machine Design
4 - MATH 2080 Intro. to Ordinary Diff. Equations
3 - MSE 3610 Proc. of Metals & Their Composites
16

Junior Year

First Semester

3 - CH 3310 Physical Chemistry
3 - COMM 2500 Public Speaking
3 - MSE 3270 Transport Phenomena
3 - MSE 4150 Intro. to Polymer Sci. and Engineering
1 - MSE 4550 Polymer and Fiber Lab.
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester

3 - CH 3320 Physical Chemistry
3 - IE 3840 Engineering Economic Analysis
3 - MATH 3020 Stat. for Science and Engr. *or*
3 - STAT 2300 Statistical Methods I
3 - MSE 4220 Mechanical Behavior or Materials
3 - MSE 4560 Polymer and Fiber Science II
15

Senior Year

First Semester

3 - MSE 4580 Surface Phenomena in Materials Science and Engineering
1 - MSE 4600 Surface Phenomena in Materials Science and Engineering Laboratory
3 - MSE 4610 Polymer and Fiber Science III
3 - MSE 4910 Undergraduate Research
3 - Technical Requirement[4]
13

Second Semester

3 - MSE 4070 Senior Capstone Design
1 - MSE 4450 Practice of Materials Engineering
3 - MSE 4570 Color Science
1 - MSE 4590 Color Science Laboratory
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
3 - Technical Requirement[4]
14

124 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on Humanities and Social Sciences for Engineering Curricula. Six of these credits must also satisfy the Cross-Cultural Awareness and the Science and Technology in Society General Education requirements.

[3]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[4]Select from 3000–4000-level courses in BCHM, BE, BIOE, BIOL, BMOL, CE, CH, CHE, ECE, EES, FIN, GEOL, IE, LAW, MATH, ME, MGT, MICR, MKT, MSE, PHYS, PKSC. *Note: At least three credits must be selected from BE, BIOE, BMOL, CE, CHE, ECE, EES, IE, ME or MSE courses.*

MECHANICAL ENGINEERING

Bachelor of Science

Breadth, individuality, and flexibility are inherent characteristics of the mechanical engineering profession. Mechanical engineers, in a broad sense, make major contributions to the creation of products and systems that benefit mankind. They work in a variety of areas, including bioengineering, energy systems, environmental and life-support systems, propulsion and transportation systems, food production, materials processing, automated manufacturing, and construction. A wide spectrum of career opportunities is open to them. The practice of mechanical engineering includes one or more of the following activities: manufacturing, testing, research, development, design, technical management, technical sales and marketing, construction, and teaching.

Preparation for a 40–45-year professional career requires development of the whole person through a balanced program encompassing the humanities, social sciences, communication and computer skills, physical and engineering sciences, design, and laboratory experience. Students start with the physical sciences and communication skills and progress through the engineering sciences, ultimately applying the principles learned in such areas as energy conversion and transfer, mechanical design, and systems analysis. Throughout the curriculum, the fundamental nature of engineering as a problem-solving discipline is emphasized.

Most graduates take positions in industry, government, or business. Many, however, continue their formal education in a graduate program. The Department of Mechanical Engineering offers study leading to the Master of Science and Doctor of Philosophy degrees.

Mechanical Engineering students who have a cumulative grade-point average or cumulative engineering grade-point average (EGPA) below 2.0 are on probation and will have restricted enrollment in classes. Students whose cumulative grade-point average is below 2.0 are subject to the regulations stipulated under *Academic Eligibility Policy.* Students on probation for EGPR below 2.0 who fail to recover in the first regular semester (fall or spring) will not be allowed to register for mechanical engineering classes. After one year, such students may petition the Mechanical Engineering Department for continued enrollment. An advising policy for students on probation is available from the Mechanical Engineering Department.

Additional information can be found at *www.clemson.ces.edu/me.*

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Composition and Rhetoric
2 - ENGR 1020 Engineering Disciplines and Skills[1]
4 - MATH 1060 Calculus of One Variable I
3 - Arts and Humanities (Non-Lit.) Requirement[2] *or*
3 - Social Science Requirement[2]
16

Second Semester

3 - ENGR 1410 Programming and Problem Solving[3]
2 - ENGR 2080 Engineering Graphics and Machine Design
4 - MATH 1080 Calculus of One Variable II
3 - PHYS 1220 Physics with Calculus I
1 - PHYS 1240 Physics Lab. I
3 - Arts and Humanities (Lit.) Requirement[2] *or*
3 - Social Science Requirement[2]
16

Sophomore Year

First Semester

1 - ME 2000 Sophomore Seminar
5 - ME 2010 Statics and Dynamics for Mech. Engr.
2 - ME 2220 Mechanical Engineering Lab. I[4] *or*
3 - MSE 2100 Intro. to Materials Science[4]
4 - MATH 2060 Calculus of Several Variables
3 - PHYS 2210 Physics with Calculus II
15-16

Second Semester

2 - ECE 2070 Basic Electrical Engineering
1 - ECE 2080 Basic Electrical Engineering Lab.
3 - ME 2030 Found. of Thermal and Fluid Systems
3 - ME 2040 Mechanics of Materials
2 - ME 2220 Mechanical Engineering Lab. I[4] *or*
3 - MSE 2100 Intro. to Materials Science[4]
4 - MATH 2080 Intro. to Ordinary Diff. Equations
15-16

Junior Year

First Semester

3 - ENGL 3140 Technical Writing[5]
3 - ME 3030 Thermodynamics
3 - ME 3070 Foundations of Mechanical Systems
3 - ME 3080 Fluid Mechanics
2 - ME 3330 Mechanical Engineering Lab. II[4] *or*
3 - Statistics Requirement[4,6]
3 - MATH 3650 Numerical Methods for Engineers
17-18

Second Semester

3 - ME 3040 Heat Transfer
3 - ME 3050 Model. and Analysis of Dynamic Syst.
3 - ME 3060 Fundamentals of Machine Design
3 - ME 3120 Manufacturing Processes and Their App
2 - ME 3330 Mechanical Engineering Lab. II[4] *or*
3 - Statistics Requirement[4,6]
14-15

Senior Year

First Semester

3 - ME 4010 Mechanical Engineering Design
3 - ME 4030 Control and Integration of Multi-Domain Dynamic Systems
2 - ME 4440 Mechanical Engineering Lab. III[4] *or*
3 - Technical Requirement[4,7]
3 - Mechanical Engineering Professional Req.[8]
3 - Mechanical Engineering Technical Requirement[9]
14-15

Second Semester

1 - ME 4000 Senior Seminar
3 - ME 4020 Internship in Engineering Design
2 - ME 4440 Mechanical Engineering Lab. III[4] *or*
3 - Technical Requirement[4,7]
6 - Arts and Humanities Requirement[2] *or*
6 - Social Science Requirement[2]
3 - Mechanical Engineering Technical Requirement[9]
15-16

125 Total Semester Hours

[1]ENGR 1050 and 1060 may be substituted for ENGR 1020

[2]See Policy on Humanities and Social Sciences for Engineering Curricula. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements. These requirements may be filled in any order.

[3]ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410

[4]Both are required but may be taken in either semester.

[5]ROTC students only may substitute the AS or ML series of courses.

[6]Select from MATH 3020 or STAT 4110

[7]Select from BE 4240, 4400, BIOE 4350, CH 3310, 3600, 4040, 4250, ECE 4700, 4710, EES 4010, 4100, 4300, IE 4400, 4570, 4620, 4880, MATH 4000, 4100, 4120, 4190, 4340, 4350, 4400, 4530, 4600, 4630, PHYS 3110, 3210, 3550, 4170, 4200, 4320, 4410, 4520

[8]Select any course that meets the technical requirement (any course listed in footnote 7 or 9); or any 3000- or 4000-level modern language course; or a minor requirement.

[9]Select from ME 4150*, 4170, 4180, 4200, 4210, 4220, 4230, 4250, 4260, 4280, 4290, 4300, 4310, 4320, 4400, 4530, 4540, 4550, 4570, 4710, 4930. *ME 4150 may only be taken once for technical elective credit.

Notes:

1. Enrollment Policy (see website for Complete Statement of Department Policy): A student is allowed to enroll in any ME course only when all prerequisites, as defined by current official listings for that course, have been passed with a grade of C or higher.

2. No student may exceed three attempts to complete successfully ME 2010, 2030, or 2040. Registration for a third attempt to complete one of these ME courses requires the approval of the undergraduate coordinator in the Department of Mechanical Engineering. A grade of *W* counts as an unsuccessful attempt at completing the course.

3. For students repeating an ME course, registration preference will be given to students in a degree-granting engineering major whose curriculum requires the course in question.

4. To change majors into the Mechanical Engineering degree program, students must have a minimum cumulative grade-point average of 2.60 or higher at Clemson and earned a C or better in each course in the General Engineering freshman curriculum, EXCLUDING the Arts and Humanities/Social Science requirements.

5. In addition to other institutional requirements for graduation, candidates for a BS degree in Mechanical Engineering are required to have a 2.00 or higher cumulative GPA in all engineering courses taken at Clemson University.

MINORS

Following are minors acceptable for students in the College of Engineering, Computing and Applied Sciences. Students cannot major and minor in the same field or acquire a minor that is not allowed by the degree program.

Accounting
Adult/Extension Education
Aerospace Studies
Agricultural Business Management
Agricultural Mechanization and Business
American Sign Language Studies
Animal and Veterinary Sciences
Anthropology
Architecture
Art
Athletic Leadership
Biochemistry
Biological Sciences
Brand Communications
British and Irish Studies
Business Administration
Chemistry
Chinese Studies
Cluster
Communication Studies
Computer Science–*not open to Computer Information Systems majors*
Creative Writing
Crop and Soil Environmental Science
Digital Production Arts
East Asian Studies
Economics
English
Entomology
Entrepreneurship
Environmental Science and Policy
Equine Industry
Film Studies
Financial Management
Food Science
Forest Products
Forest Resource Management
French Studies
Gender, Sexuality and Women's Studies
Genetics
Geography
Geology
German Studies
Global Politics
Great Works
History
Horticulture
Human Resource Management
International Engineering and Science
Italian Studies
Japanese Studies
Legal Studies
Management
Management Information Systems
Mathematical Sciences
Microbiology
Middle Eastern Studies
Military Leadership
Music
Natural Resource Economics
Nonprofit Leadership
Nuclear Engineering and Radiological Sciences
Packaging Science
Pan African Studies
Park and Protected Area Management
Philosophy
Physics
Plant Pathology
Political and Legal Theory
Political Science
Precision Agriculture
Psychology
Public Policy
Race, Ethnicity and Migration
Religious Studies
Russian Area Studies
Science and Technology in Society
Screenwriting
Sociology
Spanish Studies
Spanish-American Area Studies
Sustainability
Theatre
Travel and Tourism
Turfgrass
Urban Forestry
Wildlife and Fisheries Biology
Women's Leadership
Writing
Youth Development Studies

See Minors section for details.