The College of Engineering and Science 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 Environmental Engineering, International Engineering and Science, and one in each of the science majors (see page 106).

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 foreign language. Information is available in the Undergraduate Studies Office (107 Riggs Hall) and at www.clemson.edu/ces/students/global.

ENGINEERING PROGRAMS
The Bachelor of Science engineering degree programs in Biosystems Engineering, Ceramic and Materials Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Industrial 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. The Biosystems Engineering program is administered jointly with the College of Agriculture, Forestry and Life Sciences. The new BS degree programs in Bioengineering and Environmental Engineering are designed to meet ABET requirements and will be submitted to ABET for accreditation review when eligible.

All engineering programs have the common goal of producing engineering graduates who are able to
• 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 lifelong 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
2 - CES 102 Engineering Disciplines and Skills
4 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
1 - MTHSC 106 Calculus of One Variable I
General Education Requirement1
16
Second Semester
4 - MTHSC 108 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
2-3 - Departmental Freshman Engineering Req.2
3 - Departmental Science Requirement2
3 - General Education Requirement1
15-17

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:
2 - CES 102 Engineering Disciplines and Skills
4 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
4 - MTHSC 108 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
2-3 - Departmental Freshman Engineering Req.

In addition, the student must have the minimum grade-point ratio 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 300- or 400-level engineering courses. Engineering departments may allow General Engineering majors to enroll in selected 200-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 Curriculums
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 curriculum. 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 200, 207/209, 208/210.

Registration Requirements
A cumulative grade-point ratio of 2.0 or higher is required for registration in engineering courses numbered 300 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.
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 ratio in all engineering courses taken at Clemson. All courses with "Engineering" in the course designator (e.g., ENGR 130, M E 453, 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: Biomaterials Concentration or Bioelectrical 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 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
1 - BIO E 201 Intro. to Biomedical Engineering
2 - E C E 201 Logic and Computing Devices
3 - E C E 202 Electric Circuits I
4 - MTHSC 206 Calculus of Several Variables

Second Semester
3 - C M E 210 Introduction to Materials Science
3 - E C E 201 Statics
3 - E C E 212 Electrical Engineering Lab. II
3 - E C E 262 Electric Circuits II
4 - MTHSC 208 Intro. to Ordinary Differential Equations

Sophomore Year
First Semester
3 - BIO E 320 Biomechanics
3 - BIO E 401 Bioengineering Design Theory
4 - BIOISC 315 Functional Human Anatomy
3 - BIOSC 461 Cell Biology
2 - BIOSC 462 Cell Biology Lab.

Second Semester
1 - BIO E 400 Senior Seminar
3 - BIO E 403 Applied Biomedical Design
3 - BIO E 448 Tissue Engineering
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Senior Year
First Semester
3 - BIO E 320 Biomechanics
3 - BIO E 401 Bioengineering Design Theory
4 - BIOISC 315 Functional Human Anatomy
3 - BIOSC 461 Cell Biology
2 - BIOSC 462 Cell Biology Lab.

Second Semester
1 - BIO E 400 Senior Seminar
3 - BIO E 403 Applied Biomedical Design
3 - BIO E 448 Tissue Engineering
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Biomaterials Concentration
Freshman Year
First Semester
2 - CES 102 Engineering Disciplines and Skills
4 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
4 - MTHSC 108 Calculus of One Variable I
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Sophomore Year
First Semester
3 - BIO E 201 Intro. to Biomedical Engineering
3 - C M E 210 Introduction to Materials Science
4 - CH 201 Survey of Organic Chemistry
4 - MTHSC 106 Calculus of One Variable II
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Junior Year
First Semester
4 - CH 201 Survey of Organic Chemistry
1 - E C E 311 Electrical Engineering Lab. III
3 - E C E 320 Electronics I
3 - E C E 330 Signals, Systems, and Transforms
3 - E C E 350 Electromagnetics
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Second Semester
3 - BIO E 330 Biomaterials
3 - BIO E 337 Bioinstrumentation and Bioimaging
3 - BIOCH 305 Essential Elements of Biochem.
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Senior Year
First Semester
3 - BIO E 320 Biomechanics
3 - BIO E 401 Bioengineering Design Theory
4 - BIOISC 315 Functional Human Anatomy
3 - BIOSC 461 Cell Biology
2 - BIOSC 462 Cell Biology Lab.

Second Semester
1 - BIO E 400 Senior Seminar
3 - BIO E 403 Applied Biomedical Design
3 - BIO E 448 Tissue Engineering
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

BIMATTERIALS CONCENTRATION
Freshman Year
First Semester
2 - CES 102 Engineering Disciplines and Skills
4 - CH 101 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable I
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Second Semester
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable II
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Sophomore Year
First Semester
3 - BIO E 201 Intro. to Biomedical Engineering
3 - C M E 210 Introduction to Materials Science
4 - CH 201 Survey of Organic Chemistry
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II

Second Semester
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 106 Calculus of One Variable II
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Senior Year
First Semester
3 - BIO E 320 Biomechanics
3 - BIO E 401 Bioengineering Design Theory
4 - BIOISC 315 Functional Human Anatomy
3 - BIOSC 461 Cell Biology
2 - BIOSC 462 Cell Biology Lab.

Second Semester
1 - BIO E 400 Senior Seminar
3 - BIO E 403 Applied Biomedical Design
3 - BIO E 448 Tissue Engineering
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Biology Requirement
1 - ENGL 103 Accelerated Composition
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable I
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Second Semester
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable II
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Senior Year
First Semester
3 - BIO E 320 Biomechanics
3 - BIO E 401 Bioengineering Design Theory
4 - BIOISC 315 Functional Human Anatomy
3 - BIOSC 461 Cell Biology
2 - BIOSC 462 Cell Biology Lab.

Second Semester
1 - BIO E 400 Senior Seminar
3 - BIO E 403 Applied Biomedical Design
3 - BIO E 448 Tissue Engineering
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Biology Requirement
1 - ENGL 103 Accelerated Composition
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable I
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Second Semester
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable II
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Sophomore Year
First Semester
3 - BIO E 201 Intro. to Biomedical Engineering
3 - C M E 210 Introduction to Materials Science
4 - CH 201 Survey of Organic Chemistry
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II

Second Semester
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 106 Calculus of One Variable II
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Biology Requirement
1 - ENGL 103 Accelerated Composition
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable I
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Second Semester
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable II
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Senior Year
First Semester
3 - BIO E 320 Biomechanics
3 - BIO E 401 Bioengineering Design Theory
4 - BIOISC 315 Functional Human Anatomy
3 - BIOSC 461 Cell Biology
2 - BIOSC 462 Cell Biology Lab.

Second Semester
1 - BIO E 400 Senior Seminar
3 - BIO E 403 Applied Biomedical Design
3 - BIO E 448 Tissue Engineering
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Biology Requirement
1 - ENGL 103 Accelerated Composition
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable I
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Second Semester
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable II
3 - Arts and Humanities Requirement or
3 - Social Science Requirement

Senior Year
First Semester
3 - BIO E 320 Biomechanics
3 - BIO E 401 Bioengineering Design Theory
4 - BIOISC 315 Functional Human Anatomy
3 - BIOSC 461 Cell Biology
2 - BIOSC 462 Cell Biology Lab.

Second Semester
1 - BIO E 400 Senior Seminar
3 - BIO E 403 Applied Biomedical Design
### BIOSYSTEMS ENGINEERING

#### Bachelor of Science

Biosystems engineering is a science-based engineering discipline that integrates engineering science and design with applied biological, biochemical and environmental sciences. Biosystems engineers use engineering analysis and design to solve problems involving microorganisms, animals, humans and ecosystems. The biosystems engineering degree program is unique among engineering disciplines because it incorporates bioprocess, structural and mechanical design.

The B.S. in Biosystems Engineering is nationally accredited by ABET, the Accreditation Board for Engineering and Technology. Students who receive the Bachelor of Science degree are eligible for licensing as professional engineers after gaining acceptable experience and passing the Fundamentals of Engineering and the Principles and Practice of Engineering examinations.

Undergraduate students in Biosystems Engineering may participate in exciting research opportunities in areas of water quality, bioprocessing, non-point source pollution, instrumentation and control, and biofuels production.

Graduates in biosystems engineering are well equipped to use their expertise in engineering in many areas that affect our quality of life and environment. They have broad training in mathematics, physics, chemistry and biological sciences, as well as a sound background in the engineering sciences. Biosystems engineers are sought by industry and public service organizations primarily for their ability to apply engineering expertise to living systems and to the management of land and water resources.

For further information, visit [http://www.clemson.edu/calss/departments/biosystemseng/beng/](http://www.clemson.edu/calss/departments/biosystemseng/beng/)

#### 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 or a Master of Engineering Degree in Environmental Engineering and Science while completing the BS degree. Students in the Applied Biotechnology Concentration may apply graduate credits toward a Master of Science Degree in Bioengineering.

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.

#### Senior Year

First Semester
- **BIO E 400 Senior Seminar**
- **BIO E 403 Applied Biomedical Design**
- **BIO E 448 Tissue Engineering**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

Second Semester
- **MTHSC 402 Statistics for Science and Engr.**
- **BIO E 401 Bioengineering Design Theory**
- **BIO E 370 Bioinstrumentation and Bioimaging**
- **Bioengineering Technical Requirement**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

128 Total Semester Hours

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#### Junior Year

**First Semester**
- **BIO E 320 Biomechanics**
- **BIOSC 315 Functional Human Anatomy**
- **C M E 319 Materials Processing I**
- **C M E 326 Thermodynamics of Materials**
- **C M E 327 Transport Phenomena**

**Second Semester**
- **BIOCH 305 Essential Elements of Biochem.**
- **BIO E 321 Biofluid Mechanics**
- **MTHSC 302 Statistics for Science and Engr.**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

**Total Semester Hours**: 16

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#### Sophomore Year

**First Semester**
- **B M E 310 Intro. to Biosystems Engineering**
- **B E 428 Biochemical Engineering**
- **B E 414 Biosystems Engr. Unit Operations**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

**Second Semester**
- **MTHSC 208 Intro. to Ordinary Diff. Equations**
- **MICRO 305 General Microbiology**
- **MTHSC 208 Intro. to Ordinary Diff. Equations**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

**Total Semester Hours**: 16

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#### Freshman Year

**First Semester**
- **B E 210 Intro. to Biosystems Engineering**
- **MTHSC 206 Calculus of Several Variables**
- **PHYS 221 Physics with Calculus I**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

**Second Semester**
- **B E 212 Fundamentals of Biosystems Engr.**
- **ENG 209 Intro. to Engr./Computer Graphics**
- **M E 310 Thermodynamics and Heat Transfer**
- **CH E 220 Chem. Engr. Thermodynamics I**
- **MICRO 305 General Microbiology**
- **MTHSC 208 Intro. to Ordinary Diff. Equations**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

**Total Semester Hours**: 16

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#### APPLIED BIOTECHNOLOGY CONCENTRATION

**Freshman Year**

**First Semester**
- **B E 312 Biol. Kinetics and Reactor Modeling**
- **C E 341 Introduction to Fluid Mechanics**
- **CH E 230 Fluids/Heat Transfer**
- **E C E 302 Engineering Disciplines and Skills**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

**Second Semester**
- **CH E 412 Heat and Mass Transport in B E**
- **CH E 415 Instrumentation and Control for Biosystems Engineers**
- **B E 415 Instrumentation and Control for Biosystems Engineers**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

**Total Semester Hours**: 16

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#### Senior Year

**First Semester**
- **B E 414 Biosystems Engr. Unit Operations**
- **B E 438 Bioprocess Engineering Design**
- **B E 474 Biosystems Engr. Design/Project Mgt.**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

**Second Semester**
- **B E 414 Biosystems Engr. Unit Operations**
- **B E 438 Bioprocess Engineering Design**
- **B E 474 Biosystems Engr. Design/Project Mgt.**
- **Arts and Humanities Requirement**
- **Social Science Requirement**

**Total Semester Hours**: 17

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### Notes

1. 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.

2. Students planning to enter medical school should take CH 205 in place of CH 223/227 and take CH 224/228 as an additional course sequence. Students planning to enter medical school should also take physics laboratories as additional courses (PHYS 124 and PHYS 223).

3. Select from department-approved list.

4. Undergraduate students in Biosystems Engineering must have earned a C or better in each course in the General Engineering freshman curriculum including the Arts and Humanities/Social Science Requirements.
Second Semester
3 - B E 435 Appl. in Biotechnology Engineering
2 - B E 475 Biosystems Engr. Capstone Design
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
3 - Engineering Requirement1 or
2 - Elective
13

128 Total Semester Hours

3See 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.

4See advisor. Select from department-approved list.

5CH 223 and 227 (preferred) or CH 201

6BIOCH 101/102 or 305/306

MTHSC 413 or any approved 300–400 level course in BIOCH, BIOG, GEN, or MICRO

Notes:
1. Biosystems Engineering students are allowed to enroll in upper-level B E courses only when the following prerequisites have been completed with C or better: C E 206, 208, 341, CH E 220, 230, E M 201, 202, M E 201, 302, 310, MTHSC 206, 208, PHYS 221.

2. Students accepted to a combined BS/MS program must take 600-level instead of 400-level courses for Life Science and Engineering Requirements.

3. To complete premedicine requirements, students must take BIO 104/106 or 111, CH 224, 228, and PHYS 124, 125 as additional courses.

NATURAL RESOURCES AND ENVIRONMENT CONCENTRATION

Freshman Year
First Semester
2 - CES 102 Engineering Disciplines and Skills
4 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
16

Second Semester
4 - CH 102 General Chemistry
2 - ENGR 130 Engineering Fundamentals
4 - MTHSC 108 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
16

Sophomore Year
First Semester
2 - B E 210 Intro. to Biosystems Engineering
2 - B E 222 Geomeasurements
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II
4 - Biology Requirement1
3 - Statics Requirement1
18

Second Semester
2 - B E 212 Fundamentals of Biosystems Engr.
2 - E G 209 Intro. to Engr./Comp. Graphics
3 - M E 310 Thermodynamics and Heat Transfer
4 - MICRO 305 General Microbiology
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
2 - Dynamics Requirement1
17

Junior Year
First Semester
3 - B E 312 Biol. Kinetics and Reactor Modeling
4 - C E 321 Geotechnical Engineering or
4 - CSENV 202 Soils
4 - C E 341 Introduction to Fluid Mechanics
2 - C E 307 Basic Electrical Engineering
3 - Mechanics of Materials Requirement1
16

Second Semester
3 - B E 314 Biosystems Engr. Mechanical Design or
3 - M E 306 Fundamentals of Machine Design
3 - B E 322 Small Watershed Hydrology and Sedimentology
3 - B E 412 Heat and Mass Transport in B E
3 - B E 415 Instrumentation and Control for B E
3 - Structural Design Requirement1
16

Senior Year
First Semester
3 - B E 414 Biosystems Engr. Unit Operations
3 - B E 464 Non-Point Source Management in Engineered Ecosystems
2 - B E 474 Biosystems Engr. Design/Project Mgt.
6 - Arts and Humanities Requirement1 or
6 - Social Science Requirement1
17

Second Semester
2 - E G 209 Intro. for Soil Water Mgt.
2 - B E 475 Biosystems Engr. Capstone Design
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
3 - Engineering Requirement1 or
2 - Elective
12

128 Total Semester Hours

Notes:
1. Biosystems Engineering students are allowed to enroll in upper-level B E courses only when the following prerequisites have been completed with C or better: C E 206, 208, 341, CH E 220, 230, E M 201, 202, M E 201, 302, 310, MTHSC 206, 208, PHYS 221.

2See advisor. Select from department-approved list.

3See 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.

4See advisor. Select from department-approved list.

Notes:
1. Biosystems Engineering students are allowed to enroll in upper-level B E courses only when the following prerequisites have been completed with C or better: C E 206, 208, 341, CH E 220, 230, E M 201, 202, M E 201, 302, 310, MTHSC 206, 208, PHYS 221.

2. Students accepted to a combined BS/MS program must take 600-level instead of 400-level courses for Life Science and Engineering Requirements.

3. To complete premedicine requirements, students must take BIO 104/106 or 111, CH 224, 228, and PHYS 124, 125 as additional courses.

CERAMIC AND MATERIALS ENGINEERING

Bachelor of Science
The School of Materials Science and Engineering offers undergraduate degrees in Ceramic and Materials Engineering, and Polymer and Fiber Chemistry.

Ceramic and materials engineers design, develop, and participate in the manufacture of both standard and new materials intended for use in a wide variety of industries with diverse applications. These range from the traditional materials industries, such as structural clay, foundry, or whiteware industries to the newer industries, such as the semiconductor or aerospace 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 baccalaureate program integrates laboratory with classroom experiences to prepare students for lifelong learning. Courses covering thermodynamics, kinetics, mechanical behavior, processing, and characterization of materials prepare students for careers in industry and/or for graduate school.

In addition to the common educational objectives of all engineering programs, baccalaureate degree graduates in Ceramic and Materials Engineering will be able to
• demonstrate learning consistent with Accreditation Board for Engineering and Technology Engineering Criteria 2000 for ceramic and materials engineering programs
• function easily and well in the laboratory and plant environments and
• serve the local, national, and international ceramic and materials communities

Specifically, the Accreditation Board for Engineering and Technology Engineering Criteria 2000 requires that baccalaureate degree graduates in Ceramic and Materials Engineering be able to
• apply advanced scientific and engineering principles to materials systems
• demonstrate an integrated understanding of the scientific and engineering principles underlying structure, properties, processing, and performance relationships
• apply this understanding to the solution of ceramic and materials engineering selection and design problems and
• apply appropriate experimental, statistical, and computational methods to advantage in the solution of ceramic and materials problems

Freshman Year
First Semester
2 - CES 102 Engineering Disciplines and Skills
4 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
16
Second Semester
4 - CH 102 General Chemistry
2 - ENGR 130 Engineering Fundamentals
4 - MTHSC 108 Calculus of One Variable I
3 - PHYS 122 Physics with Calculus I
3 - Arts and Humanities Requirement1 or
  3 - Social Science Requirement2
16

Sophomore Year
First Semester
3 - C M E 210 Introduction to Materials Science
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II
6 - Arts and Humanities Requirement1 or
  6 - Social Science Requirement2
16

Second Semester
1 - C M E 241 Metrics Lab.
3 - C E 201 Statics
2 - E G 209 Intro. to Engr./Computer Graphics
3 - MS&E 324 Statistics for Materials Science
  and Engineering
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
3 - Arts and Humanities Requirement1 or
  3 - Social Science Requirement2
15

Junior Year
First Semester
3 - C M E 319 Materials Processing I
3 - C M E 326 Thermodynamics of Materials
3 - C M E 327 Transport Phenomena
3 - COMM 250 Public Speaking
3 - Technical Writing Requirement2
17

Second Semester
3 - C M E 328 Phase Diagrams for Materials
  Processing and Applications
2 - C M E 342 Structure/Property Lab.
3 - C M E 361 Process of Metals and Composites
3 - C M E 422 Mechanical Behavior of Materials
3 - I E 384 Engineering Economic Analysis
3 - PFC 303 Textile Chemistry
3 - Emphasis Area Requirement3
16

Senior Year
First Semester
3 - C M E 402 Solid State Materials
3 - C M E 413 Noncrystalline Materials
3 - C M E 432 Manufacturing Processes and Syst.
1 - C M E 441 Manufacturing Lab.
2 - PFC 415 Intro. to Polymer Science and Engr.
  3 - Research Requirement2
16

Second Semester
3 - C M E 407 Senior Capstone Design
3 - C M E 416 Electronic Properties of Materials
3 - C M E 424 Optical Materials and Applications
3 - C M E 433 Combustion Systems and
  Environmental Emissions
1 - C M E 445 Practice of Materials Engineering
13

Freshman Year
First Semester
2 - CES 102 Engineering Disciplines and Skills
3 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement1 or
  3 - Social Science Requirement2
16

Second Semester
4 - CH 102 General Chemistry
4 - CH E 130 Chemical Engineering Tools
4 - MTHSC 108 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
3 - Arts and Humanities Requirement1 or
  3 - Social Science Requirement2
17

Sophomore Year
First Semester
3 - CH 223 Organic Chemistry
4 - CH E 211 Intro. to Chemical Engineering
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II
3 - Arts and Humanities Requirement1 or
  3 - Social Science Requirement2
17

Second Semester
3 - CH 224 Organic Chemistry
1 - CH 229 Organic Chemistry Lab.
3 - CH E 220 Chemical Engr. Thermodynamics I
4 - CH E 230 Fluids/Heat Transfer
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
15

Junior Year
First Semester
1 - CH 339 Physical Chemistry Lab.
3 - CH E 307 Unit Operations Lab. I
3 - CH E 319 Engineering Materials
2 - C E 307 Basic Electrical Engineering
1 - CH E 309 Electrical Engineering Lab. I
3 - Arts and Humanities Requirement1 or
  3 - Social Science Requirement1
3 - Biochemistry Requirement2
16

Second Semester
3 - CH 342 Physical Chemistry
1 - CH 340 Physical Chemistry Lab.
3 - CH E 321 Chemical Engr. Thermodynamics II
4 - CH E 330 Mass Transfer and Separation Proc.
  3 - Arts and Humanities Requirement1 or
    3 - Social Science Requirement1
3 - Emphasis Area Requirement3
17

Senior Year
First Semester
3 - CH E 407 Unit Operations Lab. II
3 - CH E 431 Chemical Process Design I
1 - CH E 443 Chemical Engr. Senior Seminar I
3 - CH E 450 Chemical Reaction Engineering
3 - Arts and Humanities Requirement1 or
  3 - Social Science Requirement1
3 - Emphasis Area Requirement3
16

Second Semester
3 - CH E 353 Process Dynamics and Control
3 - CH E 433 Process Design II
1 - CH E 444 Chemical Engr. Senior Seminar II
3 - MICRO 413 Industrial Microbiology
3 - Emphasis Area Requirement3
13

127 Total Semester Hours

1See 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.
2See advisor. Nine credit hours devoted to completion of an
  emphasis area or approved minor are required. Emphasis areas
  are Applied Engineering, Mathematics, and Science; Biomolecu-
  lar Science and Engineering, Business Management; Environ-
  mental Engineering; Polymeric Materials; Energy Studies.
3Note: No student may exceed a maximum of two attempts,
  including a W, to complete successfully any CH E course.

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. Graduates will have careers characterized by success in chemical engineering practice, postgraduate education, or other areas such as medicine and law that make use of engineering skills; 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 their 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.

The Department of Chemical and Biomolecular Engineering also offers advanced study leading to the Master of Science and Doctor of Philosophy degrees. Additional information is available at www.ces.clemson.edu/chemeng.
### BIOMOLECULAR ENGINEERING CONCENTRATION

**Freshman Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Semester</td>
<td>2 - CES 102 Engineering Disciplines and Skills  &lt;br&gt;4 - CH 101 General Chemistry  &lt;br&gt;3 - ENGL 103 Accelerated Composition  &lt;br&gt;4 - MTHSC 106 Calculus of One Variable I  &lt;br&gt;3 - Arts and Humanities Requirement1 or  &lt;br&gt;3 - Social Science Requirement1</td>
</tr>
<tr>
<td>Second Semester</td>
<td>4 - CH 102 General Chemistry  &lt;br&gt;3 - CH E 130 Chemical Engineering Tools  &lt;br&gt;4 - MTHSC 108 Calculus of One Variable II  &lt;br&gt;3 - PHYS 122 Physics with Calculus I  &lt;br&gt;3 - Arts and Humanities Requirement1 or  &lt;br&gt;3 - Social Science Requirement1</td>
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**Sophomore Year**

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<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
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</thead>
<tbody>
<tr>
<td>First Semester</td>
<td>3 - CH 223 Organic Chemistry  &lt;br&gt;4 - CH E 211 Intro. to Chemical Engineering  &lt;br&gt;4 - MTHSC 206 Calculus of Several Variables  &lt;br&gt;3 - PHYS 221 Physics with Calculus II  &lt;br&gt;3 - Arts and Humanities Requirement1 or  &lt;br&gt;3 - Social Science Requirement1</td>
</tr>
<tr>
<td>Second Semester</td>
<td>3 - BIOC 301 Molecular Biochemistry  &lt;br&gt;2 - BIOC 302 Molecular Biochemistry Lab.  &lt;br&gt;3 - CH 224 Organic Chemistry  &lt;br&gt;1 - CH 229 Organic Chemistry Lab.  &lt;br&gt;3 - CH E 220 Chemical Eng'ng Thermodynamics I  &lt;br&gt;4 - CH E 230 Fluids/Heat Transfer</td>
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**Junior Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
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</thead>
<tbody>
<tr>
<td>First Semester</td>
<td>3 - BIOL 103 General Biology I  &lt;br&gt;1 - BIOL 105 General Biology Lab. I  &lt;br&gt;3 - CH E 307 Unit Operations Lab. I  &lt;br&gt;3 - CH E 319 Engineering Materials  &lt;br&gt;4 - MTHSC 208 Intro. to Ordinary Diff. Equations  &lt;br&gt;3 - Arts and Humanities Requirement1 or  &lt;br&gt;3 - Social Science Requirement1</td>
</tr>
<tr>
<td>Second Semester</td>
<td>3 - BIO E 302 Biomaterials  &lt;br&gt;3 - BMOLE 425 Biomolecular Engineering  &lt;br&gt;3 - CH E 321 Chemical Engr. Thermodynamics II  &lt;br&gt;4 - CH E 330 Mass Transfer and Separation Proc.  &lt;br&gt;3 - Arts and Humanities Requirement1 or  &lt;br&gt;3 - Social Science Requirement1</td>
</tr>
<tr>
<td>Senior Year</td>
<td>3 - BIOC 431 Physical Approach to Biochemistry  &lt;br&gt;3 - BMOLE 403 Bion Transport Phenomena  &lt;br&gt;3 - CH E 407 Unit Operations Lab. II  &lt;br&gt;3 - CH E 431 Chemical Process Design I  &lt;br&gt;1 - CH E 443 Chemical Engr. Senior Seminar I  &lt;br&gt;3 - CH E 450 Chemical Reaction Engineering</td>
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**Second Semester**

<table>
<thead>
<tr>
<th>Courses</th>
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<tbody>
<tr>
<td>3 - CH E 353 Process Dynamics and Control  &lt;br&gt;3 - CH E 433 Process Design II  &lt;br&gt;1 - CH E 444 Chemical Engr. Senior Seminar II  &lt;br&gt;3 - MICRO 413 Industrial Microbiology  &lt;br&gt;3 - Arts and Humanities Requirement1 or  &lt;br&gt;3 - Social Science Requirement1  &lt;br&gt;3 - Engineering Requirement</td>
</tr>
</tbody>
</table>

131 Total Semester Hours

1See 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.

2E (CH E) 428, BMOLE 423, 426, or 427

Not: No student may exceed a maximum of two attempts, including a W, to complete successfully any CH E 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 87 for the College of Engineering and Science. The complete objectives of the program can be found at www.caltech.edu.

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, lifelong 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.

The Department of Civil Engineering allows eligible students to count up to six hours of graduate credit (600- and 800-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 ratio, and must be approved by the department. Details of the suggested curriculum and program information are available from the department.

**Freshman Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
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<tbody>
<tr>
<td>First Semester</td>
<td>2 - CES 102 Engineering Disciplines and Skills  &lt;br&gt;4 - CH 101 General Chemistry  &lt;br&gt;3 - ENGL 103 Accelerated Composition  &lt;br&gt;4 - MTHSC 106 Calculus of One Variable I  &lt;br&gt;3 - Arts and Humanities Requirement1 or  &lt;br&gt;3 - Social Science Requirement1</td>
</tr>
<tr>
<td>Second Semester</td>
<td>2 - ENGR 130 Engineering Fundamentals  &lt;br&gt;3 - GEOL 101 Physical Geology  &lt;br&gt;1 - GEOL 103 Physical Geology Lab.  &lt;br&gt;4 - MTHSC 108 Calculus of One Variable II  &lt;br&gt;3 - PHYS 122 Physics with Calculus I  &lt;br&gt;1 - PHYS 124 Physics Lab. I  &lt;br&gt;3 - Arts and Humanities Requirement1 or  &lt;br&gt;3 - Social Science Requirement1</td>
</tr>
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**Sophomore Year**

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<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
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<tbody>
<tr>
<td>First Semester</td>
<td>2 - EGE 210 Intro. to Engr./Computer Graphics  &lt;br&gt;4 - MTHSC 206 Calculus of Several Variables  &lt;br&gt;3 - PHYS 221 Physics with Calculus II  &lt;br&gt;1 - PHYS 223 Physics Lab. II  &lt;br&gt;3 - Arts and Humanities Requirement1 or  &lt;br&gt;3 - Social Science Requirement1</td>
</tr>
<tr>
<td>Second Semester</td>
<td>4 - C E 206 Structural Mechanics  &lt;br&gt;2 - C E 208 Dynamics  &lt;br&gt;3 - C E 255 Geometrics  &lt;br&gt;2 - C E 352 Economic Evaluation of Projects  &lt;br&gt;4 - MTHSC 208 Intro. to Ordinary Diff. Equations</td>
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**Junior Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Semester</td>
<td>3 - C E 301 Structural Analysis  &lt;br&gt;3 - C E 331 Construction Engineering and Mgt.  &lt;br&gt;4 - C E 341 Introduction to Fluid Mechanics  &lt;br&gt;4 - C E 351 Civil Engineering Materials  &lt;br&gt;3 - EX ST 301 Introductory Statistics</td>
</tr>
<tr>
<td>Second Semester</td>
<td>3 - C E 311 Transportation Engineering Planning and Design  &lt;br&gt;4 - C E 321 Geotechnical Engineering  &lt;br&gt;3 - C E 342 Applied Hydraulics and Hydrology  &lt;br&gt;1 - C E 353 Professional Seminar  &lt;br&gt;3 - EE&amp;S 401 Environmental Engineering  &lt;br&gt;3 - Design Technical Requirement</td>
</tr>
<tr>
<td>Senior Year</td>
<td>3 - ENGL 314 Technical Writing  &lt;br&gt;3 - Design Technical Requirement1  &lt;br&gt;6 - Technical Requirement3  &lt;br&gt;3 - Technical Requirement Restricted1</td>
</tr>
</tbody>
</table>

15
SECOND SEMESTER
3 - C E 459 Capstone Design Project
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
3 - Arts and Humanities (Literature) Requirement1
3 - Technical Requirement1
3 - Elective
15

128 Total Semester Hours

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.

See advisor for approved list.

See advisor for approved list. Technical Requirements and electives may be used to complete an emphasis area in one of the following fields: Applied Fluid Mechanics, Construction, Environmental Engineering, Geotechnical/Geoenvironmental Engineering, Structural Engineering, or Transportation Engineering.

Note: Civil Engineering students may neither enroll in nor receive credit for any C E or E M course unless they have a 2.0 Engineering grade-point ratio and a passing grade in course prerequisites that have a C E or E M designation.

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 computer 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, microprocessors, 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/ces/departments/ece/.

FRESHMAN YEAR
First Semester
1 - E C E 212 Electrical Engineering Lab. II
3 - E C E 222 Systems Programming Concepts for Computer Engineering
3 - E C E 262 Electric Circuits II
3 - E C E 272 Computer Organization
1 - E C E 273 Computer Organization Laboratory
1 - MTHSC 208 Intro. to Ordinary Diff. Equations
15

Second Semester
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
6 - Arts and Humanities Requirement1 or
6 - Social Science Requirement1

Sophomore Year
First Semester
3 - CP SC 111 Elementary Computer Programming in C/C++
2 - E C E 201 Logic and Computing Devices
3 - E C E 202 Electric Circuits I
1 - E C E 209 Logic and Computing Devices Lab.
1 - E C E 211 Electrical Engineering Lab. I
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II
17

Second Semester
1 - E C E 212 Electrical Engineering Lab. II
3 - E C E 222 Systems Programming Concepts for Computer Engineering
3 - E C E 262 Electric Circuits II
3 - E C E 272 Computer Organization
1 - E C E 273 Computer Organization Laboratory
2 - MTHSC 208 Intro. to Ordinary Diff. Equations
15

Junior Year
First Semester
3 - E C E 223 Computer System Engineering
1 - E C E 317 Random Signal Analysis
3 - E C E 318 Signals, Systems, and Transforms
3 - E C E 371 Microcontroller Interfacing
1 - E C E 372 Microcontroller Interfacing Lab.
3 - MTHSC 311 Linear Algebra
17

Second Semester
3 - E C E 437, 438 Random Signal Analysis
3 - E C E (CP SC) 322 Intro. to Operating Systems
3 - E C E 327 Digital Computer Design
3 - E C E 352 Programming Systems
2 - MTHSC 419 Discrete Math. Structures I
15

Senior Year
First Semester
3 - COMM 150 Intro. to Human Comm. or
3 - COMM 250 Public Speaking
3 - E C E 409 Continuous and Discrete Sys. Design
2 - E C E 495 Integrated System Design I
3 - ENGL 314 Technical Writing
6 - Computer Engineering Technical Requirement1
17

Second Semester
2 - E C E 496 Integrated System Design II
3 - Arts and Humanities (Literature) Requirement1
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
6 - Computer Engr. Depth Tech. Requirement1
14

127 Total Semester Hours

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.

Select from department-approved list.

Select from ENGL 210, 211, 212, 213, 214, or 215.

Notes:
1. A student is allowed to enroll in E C E courses (excluding E C E 507, 508, 509) 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 ratio of 2.0 to enroll in any 400-level E C E courses.
3. No student may exceed a maximum of two attempts, excluding a W, to complete successfully any E C E course.

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/ces/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
2 - CES 102 Engineering Disciplines and Skills
4 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
16

Second Semester
4 - CH 102 General Chemistry
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable II
4 - PHYS 122 Physics with Calculus I
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
17

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.

Select from department-approved list.

Select from ENGL 220, 210, 211, 212, 213, 214, or 215.

Notes:
1. A student is allowed to enroll in E C E courses (excluding E C E 507, 508, 509) 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 ratio of 2.0 to enroll in any 400-level E C E courses.
3. No student may exceed a maximum of two attempts, excluding a W, to complete successfully any E C E course.
Sophomore Year
First Semester
3 - CP SC 111 Elementary Computer Programming in C/C++
2 - E C E 201 Logic and Computing Devices
3 - E C E 202 Electric Circuits I
1 - E C E 209 Logic and Computing Devices Lab.
1 - E C E 211 Electrical Engineering Lab. I
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II

Second Semester
1 - E C E 212 Electrical Engineering Lab. II
3 - E C E 262 Electric Circuits II
3 - E C E 272 Computer Organization
1 - E C E 273 Computer Organization Laboratory
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
3 - Arts and Humanities Requirement1 or 3 - Social Science Requirement1 or 3 - Electrical Engineering Technical Req.2,3

Junior Year
First Semester
1 - E C E 311 Electrical Engineering Lab. III
3 - E C E 320 Electronics I
3 - E C E 330 Signals, Systems, and Transforms
3 - E C E 371 Microcontroller Interfacing
1 - E C E 372 Microcontroller Interfacing Lab.
3 - E C E 380 Electromagnetics
3 - Advanced Mathematics Requirement4

Second Semester
1 - E C E 312 Electrical Engineering Lab. IV
3 - E C E 317 Random Signal Analysis
3 - E C E 321 Electronics II
3 - E C E 360 Electric Power Engineering
3 - E C E 381 Fields, Waves, and Circuits
3 - ENGL 314 Technical Writing

Senior Year
First Semester
3 - COMM 150 Intro. to Human Comm. or 3 - COMM 250 Public Speaking
3 - E C E 409 Continuous and Discrete Syst. Des.
3 - E C E 427 Communications Systems
2 - E C E 495 Integrated Systems Design I
3 - Electrical Engineering Technical Req.5

Second Semester
2 - E C E 496 Integrated System Design II
6 - Arts and Humanities Requirement1 or 6 - Social Science Requirement1
3 - Arts and Humanities Requirement1 or 3 - Social Science Requirement1 or 3 - Electrical Engineering Technical Req.6
3 - Electrical Engineering Technical Req. Depth7

126 Total Semester Hours

Students may enroll in E C E 222 for a common semester with Computer Engineering. Those not selecting this option should complete the Electrical Engineering Technical Requirement in the senior year.

Second Semester
4 - CH 102 General Chemistry
2 - ENGR 130 Engineering Fundamentals
4 - MTHSC 108 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
3 - Arts and Humanities Requirement1 or 3 - Social Science Requirement1

Sophomore Year
First Semester
3 - BIOL 103 General Biology and 1 - BIOL 105 General Biology Laboratory or 5 - BIOL 110 Principles of Biology
3 - C E 201 Statics
3 - E E&S 201 Environmental Engineering Fund. I
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II

Junior Year
First Semester
4 - CH 341 Introduction to Fluid Mechanics
3 - E E&S 430 Air Pollution Engineering
4 - MICRO 305 General Microbiology1
3 - Arts and Humanities Requirement1 or 3 - Social Science Requirement1
3 - Statistics Requirement4

Second Semester
3 - E E&S 402 Water and Wastewater Treatment
3 - E E&S 484 Municipal Solid Waste Mgt.
3 - M E 310 Thermodynamics and Heat Transfer
4 - Earth Science Requirement1
2 - Engineering Economics Requirement2
3 - Arts and Humanities Requirement1 or 3 - Social Science Requirement1

Senior Year
First Semester
1 - E E&S 450 Environ. Engr. Senior Seminar
3 - E E&S 480 Environmental Risk Assessment
3 - E E&S 486 Pollution Prevention
5 - Engineering or Science Requirement1
3 - Arts and Humanities Requirement1 or 3 - Social Science Requirement1

Second Semester
1 - B E (E E&S) 451 Newman Seminar and Lecture Series in Natural Resources Engineering
3 - E E&S 475 Capstone Design Project
3 - E E&S 485 Hazardous Waste Management
6 - Engineering or Science Requirement1

128-130 Total Semester Hours
NATURAL SYSTEMS CONCENTRATION

Freshman Year

First Semester
1. CES 102 Engineering Disciplines and Skills
2. CH 101 General Chemistry
3. ENGL 103 Accelerated Composition
4. MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement or 3 - Social Science Requirement
- 16

Second Semester
4. CH 102 General Chemistry
2. ENGR 130 Engineering Fundamentals
4. MTHSC 108 Calculus of One Variable II
3. PHYS 122 Physics with Calculus I
3 - Arts and Humanities Requirement or 3 - Social Science Requirement
- 16

Sophomore Year

First Semester
3. BIOL 103 General Biology
1. BIOL 105 General Biology Laboratory
5. BIOL 110 Principles of Biology
3. C E 201 Statics
3. EE&S 201 Environmental Engineering Fund. I
4. MTHSC 206 Calculus of Several Variables
3. PHYS 221 Physics with Calculus II
- 17-18

Second Semester
4. CH 201 Survey of Organic Chemistry or 3. CH 223 Organic Chemistry and
1. CH 227 Organic Chemistry Laboratory
2. C E 208 Dynamics
4. EE&S 202 Environmental Engineering Fund. II
4. MTHSC 208 Intro. to Ordinary Diff. Equations
- 16

Junior Year

First Semester
4. C E 341 Introduction to Fluid Mechanics
4. CSENV 202 Soils
4. MICRO 305 General Microbiology
3. Natural Systems Engineering Requirement
3 - Statistics Requirement
- 18-19

Second Semester
4. B E 415 Instrumentation and Controls
3. EE&S 402 Water and Wastewater Treatment
3. GEOL 310 Thermodynamics and Heat Transfer
3. Arts and Humanities Requirement or 3 - Social Science Requirement
- 16

Senior Year

First Semester
3. B E (CSENV) 408 Land Treatment of Wastewater and Sludges
1. EE&S 450 Environ. Engr. Senior Seminar
3. GEOL 421 GIS Applications in Geology
3. Environmental Engineering Requirement
3. Natural Systems Engineering Requirement
3. Arts and Humanities Requirement or 3 - Social Science Requirement
- 16

Second Semester
3. EE&S 475 Capstone Design Project
3. EE&S 485 Hazardous Waste Management
3. Natural Systems Engineering Requirement
3. Arts and Humanities Requirement or 3 - Social Science Requirement
- 13

1. 128-130 Total Semester Hours

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. Baccalaureate degree graduates demonstrate the ability to design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and energy. Graduates demonstrate the ability to apply the principles and techniques of industrial engineering analysis and design supported by a foundation in mathematical, physical, and social sciences, and economic, operational, and engineering analyses. Graduates possess a breadth of knowledge that allows them to practice industrial engineering with an appropriate awareness of information issues in systems improvement. In addition, graduates are able to work and communicate effectively with colleagues at every level in an 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, banks, 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 allows students to count up to 12 hours of graduate credit (approved 600- and 800-level courses) toward both the bachelor’s and master’s degrees. Students participating in this program must have a minimum grade-point ratio 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 Industrial Engineering Department.

Detailed curriculum and department information is available at www.ces.clemson.edu/ie.
Junior Year
First Semester
2 - C E 208 Dynamics4
3 - I E 360 Ind. Appl. of Probability and Statistics
1 - I E 368 Professional Practice in I E
3 - I E 440 Decision Support Systems in I E
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
3 - Mathematics or Natural Science Req.2
15
Second Semester
3 - COMM 150 Intro. to Human Comm. or
3 - COMM 250 Public Speaking
2 - E C E 307 Basic Electrical Engineering
1 - E C E 309 Electrical Engineering Lab. I
3 - I E 361 Industrial Quality Control
3 - I E 381 Methods of Operational Research II
3 - I E 386 Production Planning and Control
15
Senior Year
First Semester
3 - I E 461 Quality Engineering
3 - I E 465 Facilities Planning and Design
4 - I E 482 Systems Modeling
3 - Engineering Requirement2
3 - Technical Requirement2
16
Second Semester
3 - I E 487 Systems Design II
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
3 - Management Requirement2
3 - Technical Requirement2
12
124 Total Semester Hours
1See policy on Humanities and Social Sciences for Engineering curricula.
2Select from department-approved list. See advisor.
3 - PHYS 124 may be substituted.
4 - M E 201 may be substituted for C E 201 and 208; E E 202 may be substituted for C E 208.
5 See policy on Humanities and Social Sciences for Engineering curricula.
6 - PHYS 124 may be substituted for C E 201 and 208; E E 202 may be substituted for C E 208.

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 ratio or cumulative engineering grade-point ratio (EGPR) below 2.0 are on probation and will have restricted enrollment in classes. Students whose cumulative grade-point ratio 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.ces.clemson.edu.

Freshman Year
First Semester
2 - CES 102 Engineering Disciplines and Skills
4 - CH 101 General Chemistry
3 - ENGR 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
16
Second Semester
2 - E G 208 Engineering Graphics with Computer Applications
3 - ENGR 141 Programming and Problem Solving
4 - MTHSC 108 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
1 - PHYS 124 Physics Lab. I
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
16
Sophomore Year
First Semester
5 - M E 201 Statics and Dynamics for Mech. Engr.
2 - M E 222 Mechanical Engineering Lab. I
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II
3 - Science Requirement1
17-19
Second Semester
2 - E C E 307 Basic Electrical Engineering
1 - E C E 309 Electrical Engineering Lab. I
3 - M E 202 Foundations of Mechanical Systems
3 - M E 203 Found. of Thermal and Fluid Systems
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
3 - Numerical Analysis Requirement1
16
Junior Year
First Semester
3 - M E 302 Mechanics of Materials
3 - M E 303 Thermodynamics
3 - M E 305 Model. and Analysis of Dynamic Syst.
3 - M E 308 Fluid Mechanics
2 - M E 333 Mechanical Engineering Lab. II
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
17
Second Semester
3 - M E 304 Heat Transfer
3 - M E 306 Fundamentals of Machine Design
3 - M E 312 Manufacturing Proc. and Their Appl.
3 - Departmental Requirement1
3 - Statistics Requirement1
15
Senior Year
First Semester
3 - M E 401 Mechanical Engineering Design
3 - M E 403 Control and Integration of Multi-Domain Dynamic Systems
2 - M E 444 Mechanical Engineering Lab. Ill
3 - Technical Requirement1
14
Second Semester
1 - M E 400 Senior Seminar
3 - M E 402 Internship in Engineering Design
6 - Arts and Humanities Requirement1 or
6 - Social Science Requirement1
3 - Technical Requirement1
13
124–126 Total Semester Hours
1See 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.
2See advisor. Select from department-approved list.
Notes:
1. A student is allowed to enroll in any M E 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 M E 201, 202, or 203. Registration for a third attempt to complete one of these M E 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 M E course, registration preference will be given to students in a degree-granting engineering major whose curriculum requires the course in question.
4 - M E 201 may be substituted for C E 201 and 208; E E 202 may be substituted for C E 208.

Notes:
SCIENCE PROGRAMS

The College of Engineering and Science offers curricula leading to the Bachelor of Science in Chemistry, Computer Information Systems, Computer Science, Geology, Mathematical Sciences, Physics, and Polymer and Fiber Chemistry. The Bachelor of Arts is offered in Chemistry, Computer Science, Geology, Mathematical Sciences, and Physics.

The science departments in the College work closely with the other academic departments in the University, including such disciplines as economics and management as well as engineering. This allows students in the sciences great flexibility and responsibility in designing their own programs.

Bachelor of Science Curricula

The Bachelor of Science degree prepares graduates for professional employment or graduate study in the chosen science discipline. BS curricula are more highly structured than BA curricula but nonetheless offer opportunity for students to pursue a minor or secondary area of interest.

Bachelor of Arts Curricula

The curricula leading to the Bachelor of Arts degree are designed to meet the needs of students who desire a broad general education. They require a minor (or a second major) as well as the major concentration. A major requires a minimum of 24 credits from courses above the sophomore level, including or in addition to courses specified by the major department. In some major disciplines, certain prescribed courses at the sophomore level are counted toward the 24-credit requirement.

Students have a large degree of flexibility and responsibility in selecting a minor from those listed on page 106. Courses for these minors are to be selected in consultation with the appropriate department.

CHEMISTRY

Bachelor of Science

Chemistry, an experimental discipline based on observation guided by molecular theory, is of fundamental importance in much of modern science and technology. Its molecular concepts form the basis for ideas about complex material behavior. Due to the fundamental nature and extensive application of chemistry, an unusually large variety of challenging opportunities to contribute in the science-oriented community are open to students whose education is built around the principles of this discipline.

The Chemistry curriculum, through the career requirement options and the large number of electives, provides students the opportunity to select a coherent program of study beyond the basic courses. Career requirement options are provided for students anticipating graduate study in chemistry or related fields; employment following the BS degree in laboratory, production, technical sales, or management positions; professional studies (e.g., medicine); chemical physics; geochemistry; and employment in fields requiring extensive preparation in courses other than sciences (e.g., patent law and technical writing). Significant features of the curriculum are the student’s extensive participation in experimental work and the opportunity to take part in a research investigation during the junior and senior years.

**Freshman Year**

**First Semester**
1. CH 141 Chemistry Orientation
2. CH 101 General Chemistry
3. CH 102 General Chemistry Lab.
4. MTHSC 106 Calculus of One Variable I

**Second Semester**
1. CH 224 Organic Chemistry
2. CH 223 Organic Chemistry
3. CH 205 Introduction to Inorganic Chemistry
4. CH 228 Organic Chemistry Lab.
5. CH 227 Organic Chemistry Lab.

**Sophomore Year**

**First Semester**
1. CH 224 Organic Chemistry
2. CH 223 Organic Chemistry
3. CH 205 Introduction to Inorganic Chemistry

**Second Semester**
1. CH 228 Organic Chemistry
2. CH 223 Organic Chemistry
3. CH 205 Introduction to Inorganic Chemistry

**Junior Year**

**First Semester**
1. CH 340 Physical Chemistry Lab.
2. CH 411 Instrumental Analysis
3. Arts and Humanities (Literature) Requirement
4. Elective

**Second Semester**
1. CH 332 Physical Chemistry
2. CH 340 Physical Chemistry Lab.
3. CH 412 Instrumental Analysis Lab.
4. Arts and Humanities (Literature) Requirement
5. Elective

**Senior Year**

**First Semester**
1. CH 452 Chemistry Communication II
2. CH 403 Advanced Synthetic Techniques
3. CH 443 Research Problems
4. Arts and Humanities Requirement
5. Social Science Requirement
6. Chemistry Requirement

**Second Semester**
1. CH 444 Research Problems
2. CH 452 Chemistry Communication II
3. Arts and Humanities Requirement
4. Social Science Requirement
5. Chemistry Requirement
6. Elective

**Bachelor of Arts**

**Freshman Year**

**First Semester**
1. CH 141 Chemistry Orientation
2. CH 101 General Chemistry
3. CH 102 General Chemistry Lab.
4. MTHSC 106 Calculus of One Variable I

**Second Semester**
1. CH 224 Organic Chemistry
2. CH 223 Organic Chemistry
3. CH 205 Introduction to Inorganic Chemistry
4. CH 228 Organic Chemistry Lab.

**Sophomore Year**

**First Semester**
1. CH 224 Organic Chemistry
2. CH 223 Organic Chemistry
3. CH 205 Introduction to Inorganic Chemistry

**Second Semester**
1. CH 228 Organic Chemistry
2. CH 223 Organic Chemistry
3. CH 205 Introduction to Inorganic Chemistry
4. Elective

**Junior Year**

**First Semester**
1. CH 340 Physical Chemistry Lab.
2. CH 411 Instrumental Analysis
3. Arts and Humanities (Literature) Requirement
4. Elective

**Second Semester**
1. CH 332 Physical Chemistry
2. CH 340 Physical Chemistry Lab.
3. CH 412 Instrumental Analysis Lab.
4. Arts and Humanities (Literature) Requirement
5. Elective

**Senior Year**

**First Semester**
1. CH 452 Chemistry Communication II
2. CH 403 Advanced Synthetic Techniques
3. CH 443 Research Problems
4. Arts and Humanities Requirement
5. Social Science Requirement
6. Chemistry Requirement

**Second Semester**
1. CH 444 Research Problems
2. CH 452 Chemistry Communication II
3. Arts and Humanities Requirement
4. Social Science Requirement
5. Chemistry Requirement
6. Elective
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 ratio of 2.0 or higher.

Additional information can be found at www.cs.clemson.edu.

Second Semester
3 - MGT 312 Decision Models for Management
3 - MKT 301 Principles of Marketing
3 - Business Requirement6
3 - Computer Science Requirement6
3 - Information Systems Requirement6
15
122 Total Semester Hours

1Select either the MTHSC 102/207 or 106/108 sequence. Students who select the 106/108 sequence will have satisfied the two elective credits in the freshman year.
2Select from courses in BIOL, BIOCH, BIOSC, CH, GEOL, MICRO, PHYS; or EN SP 200. At least one course must include a laboratory and satisfy the Natural Science General Education Requirement.
3See General Education Requirements.
4MTHSC 301, 302, or 309.
5Select from School-approved list.
6Select from CP SC courses. No more than six credits of CP SC 481 may be used.
7Select from MGT 452, 454, 455, 456, or 400-level CP SC courses. CP SC 481 may not be used.
8For graduation, a candidate for the BS degree in Computer Information Systems must have earned a grade of C or better in each CP SC course applied to the degree.
9A grade of C or better must be earned in all prerequisite courses (including CP SC and MTHSC courses) before enrolling in the next CP SC course.

COMPUTER SCIENCE

Bachelor of Science

The Computer Science program is oriented toward design, implementation, and application of software systems to solve information processing problems. Emphasis areas outside computer science allow students to tailor the program to their individual needs and interests. 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 www.cs.clemson.edu.

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

Combined Bachelor’s/Master’s Plan

The School of Computing allows students to count up to nine hours of graduate credit (600- and 800-level courses) toward both the bachelor’s and master’s degrees. Students participating in this program must have a minimum grade-point ratio 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 Department.
Freshman Year
First Semester
4 - CP SC 101 Computer Science I
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
4 - Natural Science Requirement1
15
Second Semester
4 - CP SC 102 Computer Science II
4 - MTHSC 108 Calculus of One Variable II
3 - Arts and Humanities (Non-Lit.) Requirement2
4 - Natural Science Requirement1
15
Sophomore Year
First Semester
3 - CP SC 207 Discrete Structures for Computing
4 - CP SC 212 Algorithms and Data Structures
3 - Arts and Humanities (Literature) Requirement2
3 - Natural Science Requirement1
3 - Oral Communication Requirement2
16
Second Semester
3 - CP SC 215 Software Development Foundations
4 - CP SC 231 Intro. to Computer Organization
1 - CP SC 291 Seminar in Professional Issues I
3 - Natural Science Requirement1
3 - Probability and Statistics Requirement3
2 - Elective
16
Junior Year
First Semester
3 - CP SC 330 Computer Systems Organization
3 - CP SC 360 Networks and Network Program
3 - CP SC 372 Introduction to Software Engineering
3 - MTHSC 311 Linear Algebra
3 - Social Science Requirement2
15
Second Semester
3 - CP SC 322 Introduction to Operating Systems
3 - CP SC 350 Foundations of Computer Science
3 - CP SC 362 Distributed and Cluster Computing
3 - Arts and Humanities Requirement3 or 4 - Social Science Requirement4
3 - Social Science Requirement3
15
Senior Year
First Semester
3 - CP SC 352 Programming Languages
6 - Computer Science Requirement5
3 - Writing Requirement6
3 - Elective
15
Second Semester
3 - CP SC 491 Seminar in Professional Issues II
3 - Arts and Humanities Requirement5 or 4 - Social Science Requirement6
3 - Computer Science Requirement5
3 - Elective
15
122 Total Semester Hours

### Notes:
1. Two-semester sequence in the same physical or biological science, each including a laboratory, is required. Select from BIOL 101/102, 104/106; 101; CH 101, 102; GEOL 101/103 and 102 or 112/114; PHYS 122/124, 221/223. The six remaining hours may be selected from BIOL, BIOCH, BIOSC, CH, GEOL, MICRO, PHYS; or EN SP 200.
2. See General Education Requirements.
3. MTHSC 301, 302 or 309.
4. Select from courses in A A H, ANTH, ART, CHIN, COMM, DANCE, E A S, ECON, ENGL, FR, GEOG, GER, HIST, HUM, ITAL, JAPN, MUSIC, P A, P A S, PHIL, PO SC, PSYC, REL, RUSS, SOC, SPAN, THEA, W S.
5. Select from 300-level or higher CP SC courses. No more than six credits of CP SC 481 may be applied to this requirement. Up to three credits of approved 300-level or higher MTHSC or E C E courses may be substituted.
6. Select from School-approved list.

### 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 www.cs.clemson.edu.

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

### Freshman Year
First Semester
4 - CP SC 101 Computer Science I
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
4 - Foreign Language Requirement2
15
Second Semester
4 - CP SC 102 Computer Science II
3 - MTHSC 207 Multivariable Calculus1 and 1 - Elective or 4 - MTHSC 106 Calculus of One Variable I
4 - Foreign Language Requirement2
15
Senior Year
First Semester
3 - CP SC 101 Computer Science I
3 - ENGL 103 Accelerated Composition
3 - MTHSC 102 Intro. to Mathematics Analysis1 and 1 - Elective or 4 - MTHSC 106 Calculus of One Variable I
4 - Foreign Language Requirement2
15
Second Semester
4 - CP SC 102 Computer Science II
3 - MTHSC 207 Multivariable Calculus1 and 1 - Elective or 4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities (Non-Lit.) Req.3
4 - Foreign Language Requirement2
15
Sophomore Year
First Semester
3 - CP SC 207 Discrete Structures for Computing
4 - CP SC 212 Algorithms and Data Structures
3 - Arts and Humanities (Literature) Requirement2
3 - Foreign Language Requirement2
3 - Oral Communication Requirement2
16
Second Semester
3 - CP SC 215 Software Development Foundations
4 - CP SC 231 Intro. to Computer Organization
1 - CP SC 291 Seminar in Professional Issues I
3 - Foreign Language Requirement2
6 - Computer Science Requirement5
3 - Social Science Requirement3
15
Junior Year
First Semester
6 - Computer Science Requirement5
3 - Mathematical Sciences Requirement6
3 - Minor Requirement
3 - Social Science Requirement1
15
Second Semester
3 - CP SC 491 Seminar in Professional Issues II
3 - Computer Science Requirement5
3 - Fine Arts Requirement7
3 - Minor Requirement
3 - Elective
15
121 Total Semester Hours

1. For graduation, a candidate for the BS degree in Computer Science must have earned a grade of C or better in each CP SC course applied to the degree.
2. A grade of C or better must be earned in all prerequisite courses (including CP SC and MTHSC courses) before enrolling in the next CP SC course.

Notes:
1. Select either the MTHSC 102/207 or 106/108 sequence. Students who select the 106/108 sequence will have satisfied the two elective credits in the freshman year. Students interested in computer graphics should select the 106/108 sequence.
2. Four semesters (through 202) in the same modern foreign language are required.
3. See General Education Requirements.
4. Select from courses in BIOL, BIOCH, BIOSC, CH, GEOL, MICRO, PHYS; or EN SP 200. At least one course must include a laboratory and satisfy the Natural Science General Education Requirement.
5. Select from CP SC courses numbered 300 or higher. No more than six credits of CP SC 481 may be applied to this requirement. Up to three credits of approved 300-level or higher MTHSC or E C E courses may be substituted. MTHSC 301, 302, or 311, MTHSC 311 is required for all graphics courses.
6. Select from School-approved list.
7. Select from courses in A A H, ANTH, ART, CHIN, DANCE, ENGL, FR, GER, HUM, ITAL, JAPN, MUSIC, P A, PHIL, REL, RUSS, SPAN, THEA.
8. MUSIC 210 or any course in A A H, 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 CP SC course applied to the degree.
2. A grade of C or better must be earned in all prerequisite courses (including CP SC and MTHSC courses) before enrolling in the next CP SC course.

Second Semester
3 - CP SC 215 Software Development Foundations
4 - CP SC 231 Intro. to Computer Organization
1 - CP SC 291 Seminar in Professional Issues I
3 - Foreign Language Requirement2
4 - Social Science Requirement1
15
Senior Year
First Semester
6 - Computer Science Requirement5
3 - Departmental Humanities Requirement6
3 - Minor Requirement
3 - Social Science Requirement1
15
Second Semester
3 - CP SC 491 Seminar in Professional Issues II
3 - Computer Science Requirement5
3 - Fine Arts Requirement7
3 - Minor Requirement
3 - Elective
15
121 Total Semester Hours

Notes:
1. Select either the MTHSC 102/207 or 106/108 sequence. Students who select the 106/108 sequence will have satisfied the two elective credits in the freshman year. Students interested in computer graphics should select the 106/108 sequence.
2. Four semesters (through 202) in the same modern foreign language are required.
3. See General Education Requirements.
4. Select from courses in BIOL, BIOCH, BIOSC, CH, GEOL, MICRO, PHYS; or EN SP 200. At least one course must include a laboratory and satisfy the Natural Science General Education Requirement.
5. Select from CP SC courses numbered 300 or higher. No more than six credits of CP SC 481 may be applied to this requirement. Up to three credits of approved 300-level or higher MTHSC or E C E courses may be substituted. MTHSC 301, 302, or 311, MTHSC 311 is required for all graphics courses.
6. Select from School-approved list.
7. Select from courses in A A H, ANTH, ART, CHIN, DANCE, ENGL, FR, GER, HUM, ITAL, JAPN, MUSIC, P A, PHIL, REL, RUSS, SPAN, THEA.
8. MUSIC 210 or any course in A A H, ART, or THEA.
9. MTHSC 311 is required for all graphics courses.
GEOLOGY

Bachelor of Science

Geology and biogeochemical environmental science involve the physics and chemistry of materials that comprise the earth, as well as the development and influence of life on earth and the environmental systems and processes involved. The chemical, physical, and biological responses to environments on and in the earth must be thoroughly understood at a fundamental level so that the history of the earth can be deduced, future changes and natural disasters might be predicted, and sustainable approaches to natural resources developed. We depend on many geological resources; for example, water from ground and surface systems, metals from minerals, and power from coal, petroleum, and radioactive minerals. Geology integrates the science and engineering principles used for understanding and managing these geological and environmental systems. The Geology curriculum is built around three themes in geology and environmental science: appreciation for spatial and temporal scales, knowledge of earth materials and compositions of environmental systems, and understanding geological and environmental processes. The Bachelor of Science degree can be earned in traditional geology or with a concentration in Hydrogeology or Environmental Science. All majors participate in an interdisciplinary problem-oriented group research sequence and capstone course.

Employment opportunities for geologists and environmental scientists are numerous and varied. Included are such far-reaching fields as environmental and engineering consulting firms, mineral-producing industries, railroads, municipalities, natural resources conservation organizations, and water authorities. Many students go on to graduate study. It is important, therefore, that a geology or biogeochemical environmental science education develop a broad and rigorous base integrating a variety of descriptive and quantitative material.

The “traditional” curriculum provides the fundamentals of geology and excellent support in basic sciences. Graduates are prepared for employment or for graduate study in any field of geology. The Environmental Science Concentration provides an appropriate quantitative science base for students interested in environmental science and an introduction to environmental systems. It prepares students for careers in natural resources, the environmental consulting industry, government agencies or graduate school in environmental fields. The Hydrogeology Concentration may be taken by students interested in surface and groundwater systems and applying engineering principles to geologic problems. Graduates from the Hydrogeology Concentration work for consulting companies, government agencies and in the natural resources area or go on to graduate study.

Freshman Year

First Semester
4 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
3 - GEOL 101 Physical Geology
1 - GEOL 103 Physical Geology Lab.
4 - MTHSC 106 Calculus of One Variable I

Sophomore Year

First Semester
3 - BIOL 103 General Biology I
1 - BIOL 105 General Biology Lab. I
3 - GEOL 205 Mineralogy and Intro. Petrology
2 - GEOL 208 Min. and Intro. Petrography Lab.
4 - GEOL 211 Geoanalysis I
1 - GEOL 291 Introduction to Research I
1 - Elective
15

Second Semester
4 - CSENV 202 Soils
4 - GEOL 212 Geoanalysis II
1 - GEOL 292 Introduction to Research II
3 - PHYS 122 Physics with Calculus I
3 - Social Science Requirement
1
15

Junior Year

First Semester
3 - EN SP 200 Intro. to Environmental Science
4 - GEOL 302 Structural Geology
3 - GEOL 316 Igneous and Metamorphic Petrology
2 - GEOL 391 Research Methods I
3 - Arts and Humanities (Literature) Requirement
1
15

Second Semester
3 - GEOL 300 Environmental Geology
1 - GEOL 313 Sedimentology and Stratigraphy
2 - GEOL 392 Research Methods II
3 - Geology Requirement
1
15

Second Semester
2 - Elective
17

Summer
1 - Summer Geology Field Course

Senior Year

First Semester
4 - GEOL 405 Surficial Geology
3 - GEOL 408 Geohydrology
3 - GEOL 491 Research Synthesis I
2 - Elective
12

Second Semester
4 - GEOL 409 Subsurface Methods
3 - GEOL 492 Research Synthesis II
3 - Geology Requirement
2 - Elective
12

122 Total Semester Hours

ENVIRONMENTAL SCIENCE CONCENTRATION

Freshman Year

First Semester
4 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
3 - GEOL 101 Physical Geology
1 - GEOL 103 Physical Geology Lab.
4 - MTHSC 106 Calculus of One Variable I
15

Second Semester
4 - CH 102 General Chemistry
4 - GEOL 102 Earth History
4 - MTHSC 108 Calculus of One Variable II
3 - Arts and Humanities (Non-Lit.) Requirement
1
15

Sophomore Year

First Semester
3 - BIOL 103 General Biology I
1 - BIOL 105 General Biology Lab. I
3 - GEOL 205 Mineralogy and Intro. Petrology
1 - GEOL 207 Mineral and Intro. Petrography Lab.
4 - GEOL 211 Geoanalysis I
1 - GEOL 291 Introduction to Research I
3 - Arts and Humanities (Literature) Requirement
1
16

Second Semester
3 - GEOL 300 Environmental Geology
3 - GEOL 300 Environmental Geology
3 - GEOL 313 Sedimentology and Stratigraphy
2 - GEOL 392 Research Methods II
3 - Geology Requirement
1
15

Second Semester
2 - Elective
17

Junior Year

First Semester
3 - EN SP 200 Intro. to Environmental Science
2 - GEOL 391 Research Methods I
9 - Environmental Science Requirement
3 - Social Science Requirement
1
17

Second Semester
3 - GEOL 316 Igneous and Metamorphic Petrology
1 - GEOL 292 Introduction to Research II
3 - GEOL 300 Environmental Geology
3 - PHYS 122 Physics with Calculus I
15

Summer
3 - Field Experience

2011
### Senior Year

**First Semester**
- 3 - EN SP 400 Studies in Environmental Science
- 3 - GEO 408 Geohydrology
- 3 - GEO 491 Research Synthesis I
- 3 - Environmental Science Requirement

12

**Second Semester**
- 3 - CH 223 Organic Chemistry or
- 3 - CH 413 Chemistry of Aqueous Systems
- 3 - GEO 492 Research Synthesis II
- 6 - Environmental Science Requirement

12

122 Total Semester Hours

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

**HYDROGEOLOGY CONCENTRATION**

### Freshman Year

**First Semester**
- 4 - CH 101 General Chemistry
- 3 - ENGL 103 Accelerated Composition
- 3 - GEO 101 Physical Geology
- 1 - GEO 103 Physical Geology Lab.
- 4 - MTHSC 106 Calculus of One Variable I

15

**Second Semester**
- 4 - CH 102 General Chemistry
- 4 - GEO 102 Earth History
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - Arts and Humanities (Non-Lit.) Requirement

15

**Sophomore Year**

**First Semester**
- 3 - GEO 205 Mineralogy and Intro. Petrology
- 1 - GEO 207 Mineral and Intro. Petrology Lab.
- 4 - GEO 211 Geoanalysis I
- 1 - GEO 291 Introduction to Research I
- 3 - Arts and Humanities (Literature) Requirement
- 3 - Technical Requirement

15

**Second Semester**
- 4 - GEO 212 Geoanalysis II
- 1 - GEO 292 Introduction to Research II
- 3 - GEO 300 Environmental Geology
- 3 - PHYS 122 Physics with Calculus I
- 1 - PHYS 124 Physics Lab. I
- 3 - Social Science Requirement

15

### Junior Year

**First Semester**
- 4 - GEO 302 Structural Geology
- 2 - GEO 391 Research Methods I
- 3 - GEO 408 Geohydrology
- 3 - PHYS 221 Physics with Calculus II
- 3 - Geology Requirement

15

**Second Semester**
- 4 - GEO 313 Sedimentology and Stratigraphy
- 3 - GEO 318 Introduction to Geochemistry
- 2 - GEO 392 Research Methods II
- 3 - Social Science Requirement
- 3 - Technical Requirement

15

**Summer**
- 6 - GEO 475 Summer Geology Field Camp

### Senior Year

**First Semester**
- 3 - GEOL 421 GIS Applications in Geology
- 3 - GEO 491 Research Synthesis I
- 3 - Geography Requirement
- 2 - Technical Requirement

12

**Second Semester**
- 3 - EE&S 401 Environmental Engineering
- 4 - GEO 409 Subsurface Methods
- 3 - Technical Requirement

15

### Sophomore Year

**First Semester**
- 3 - BIOL 106 General Biology Lab. I
- 1 - BIOL 207 Mineral and Intro. Petrology Lab.
- 1 - GEO 291 Introduction to Research I
- 3 - Arts and Humanities (Non-Lit.) Requirement
- 4 - Foreign Language Requirement
- 3 - Minor Requirement

15

### Junior Year

**First Semester**
- 2 - GEO 391 Research Methods I
- 3 - Foreign Language Requirement
- 3 - Geology Requirement
- 3 - Minor Requirement
- 3 - Social Science Requirement
- 3 - Technical Requirement

17

**Second Semester**
- 2 - GEO 392 Research Methods II
- 3 - Foreign Language Requirement
- 3 - Geology Requirement
- 3 - Minor Requirement
- 6 - Elective

17

### Senior Year

**First Semester**
- 3 - GEOL 491 Research Synthesis I
- 3 - Arts and Humanities (Literature) Requirement
- 3 - Minor Requirement
- 3 - Elective

12

**Second Semester**
- 3 - GEOL 492 Research Synthesis II
- 3 - Technical Requirement
- 3 - Social Science Requirement
- 3 - Foreign Language Requirement
- 3 - Minor Requirement

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### College of Engineering and Science

**Bachelor of Arts**

**Freshman Year**

**First Semester**
- 4 - CH 101 General Chemistry
- 3 - ENGL 103 Accelerated Composition
- 3 - GEO 101 Physical Geology
- 1 - GEO 103 Physical Geology Lab.
- 4 - MTHSC 106 Calculus of One Variable I

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**Second Semester**
- 4 - CH 102 General Chemistry
- 4 - GEO 102 Earth History
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - Arts and Humanities (Non-Lit.) Requirement

15

**Sophomore Year**

**First Semester**
- 3 - GEO 205 Mineralogy and Intro. Petrology
- 1 - GEO 207 Mineral and Intro. Petrology Lab.
- 4 - GEO 211 Geoanalysis I
- 1 - GEO 291 Introduction to Research I
- 3 - Arts and Humanities (Literature) Requirement
- 3 - Technical Requirement

15

**Second Semester**
- 4 - GEO 212 Geoanalysis II
- 1 - GEO 292 Introduction to Research II
- 3 - GEO 300 Environmental Geology
- 3 - PHYS 122 Physics with Calculus I
- 1 - PHYS 124 Physics Lab. I
- 3 - Social Science Requirement

15

**Junior Year**

**First Semester**
- 4 - CH 101 General Chemistry
- 3 - ENGL 103 Accelerated Composition
- 3 - GEO 101 Physical Geology
- 1 - GEO 103 Physical Geology Lab.
- 3 - Mathematics Requirement

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**Second Semester**
- 4 - CH 102 General Chemistry
- 3 - GEOG 103 World Regional Geography
- 4 - GEO 102 Earth History
- 3 - Mathematics Requirement
- 2 - Elective

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MATHEMATICAL SCIENCES
Bachelor of Science
The Mathematical Sciences curriculum is designed to be versatile. Students gain a broad knowledge of mathematical concepts and methods that are applicable in sciences, engineering, business, industry, and other professions requiring a strong mathematical background. In addition to the basic courses which provide necessary mathematical skills, the curriculum allows students to select an emphasis area or concentration, providing an introduction to a specific area where mathematics is used. These areas are Abstract Mathematics, Actuarial Science/Financial Mathematics, Applied and Computational Mathematics, Biology, Computer Science, Operations Research/Management Science, and Statistics.

In addition to the overall goal of preparing students to cope with a variety of mathematical problems, the curriculum seeks to provide an adequate background for students who plan to pursue graduate study or positions in business, industry, or government. Students electing the Biology Concentration will have the necessary preparation for entering medical school. More information about the degree program can be found at www.math.clemson.edu.

All mathematical sciences majors are required to complete a capstone experience which provides an opportunity to pursue research, independent study, or an approved internship under the direction of a faculty member, or the opportunity to study mathematical models in some area of the mathematical sciences. The capstone experience requires a written report (thesis, computer code, project description, intern experience, etc.) and an oral or poster presentation by each student.

Combined Bachelor’s/Master’s Plan
Under this plan, students may reduce the time necessary to earn both degrees by applying graduate credits to both undergraduate and graduate program requirements. Students are encouraged to obtain the specific requirements for pursuing the dual degree from the Department of Mathematical Sciences (www.math.clemson.edu) as early as possible in their undergraduate program. Enrollment guidelines and procedures can be found under Academic Regulations in this catalog.

Freshman Year
First Semester
3 - ECON 211 Principles of Microeconomics
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities (Non-Lit.) Requirement
3 - Foreign Language Requirement

Second Semester
4 - MTHSC 108 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
3 - Computer Science Requirement
3 - Social Science Requirement

Sophomore Year
First Semester
4 - MTHSC 206 Calculus of Several Variables
1 - MTHSC 250 Intro. to Mathematical Sciences
3 - MTHSC 311 Linear Algebra
3 - MTHSC 360 Intermediate Math. Computing
4 - Natural Science Requirement

Second Semester
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
3 - MTHSC 302 Statistics for Science and Engr.
3 - Arts and Humanities (Literature) Requirement
4 - Natural Science Requirement
3 - Elective

Junior Year
First Semester
3 - ENGL 314 Technical Writing
3 - MTHSC 400 Theory of Probability
3 - MTHSC 440 Linear Programming
3 - MTHSC 453 Advanced Calculus I
3 - Science Requirement

Second Semester
3 - MTHSC 412 Introduction to Modern Algebra
3 - MTHSC 454 Advanced Calculus II
3 - Emphasis Area Requirement
3 - Science Requirement
3 - Elective

Senior Year
First Semester
1 - COMM 250 Public Speaking
3 - Emphasis Area Requirement
3 - Science and Tech. in Society Requirement

Second Semester
1 - MTHSC 492 Professional Development
3 - Capstone Experience
3 - Emphasis Area Requirement
3 - Mathematical Sciences Requirement
3 - Elective

122 Total Semester Hours

Notes:
1See General Education Requirements. Three of these credit hours must also satisfy the Cross-Cultural Awareness Requirement.
2Three credits in any foreign language, including American Sign Language, numbered 102 or above
3CP SC 101, 111, or 120
4A two-semester sequence selected from BIOL 103/105 and 104/106; CH 101 and 102; PHYS 221/223 and 222/224; GEOL 103/103 and 102
5ECON 314 and 405; CP SC 102 and 212; CP SC 210 and 212; or any two natural science courses from General Education Natural Science Requirements (lbs not required). Actuarial Science/Financial Mathematics and Operations Research Emphasis Areas require ECON 314 and 405. Computer Science Emphasis Area requires CP SC 102 and 212, or 210 and 212.
7May be satisfied by (1) completion of six credits of MTHSC 482 or H482; (2) completion of six credits of MTHSC 491 or an approved substitution; or (3) completion of three credits of MTHSC 450 and three credits of an additional course approved by the advisor. Students in Actuarial Science/Financial Mathematics Emphasis Area must take MTHSC 441 and FIN 455.
8Any 400-level MTHSC course approved by advisor

EMPHASIS AREAS
Abstract Mathematics
6 - Abstract Mathematics Requirement
6 - Mathematical Sciences Requirement

Actuarial Science/Financial Mathematics
3 - FIN 312 Financial Management II
3 - MTHSC 403 Intro. to Statistical Theory
3 - MTHSC 407 Regress. and Time-Ser. Analysis
3 - MTHSC 431 Theory of Interest

Applied and Computational Mathematics
3 - MTHSC 434 Advanced Engineering Math.
3 - MTHSC 460 Intro. to Numerical Analysis I
6 - Applications Area

Computer Science
3 - CP SC 215 Software Development Foundations
9 - Computer Science 300-Level Requirement

Operations Research/Management Science
3 - IE 384 Engineering Economic Analysis or IE 482 Systems Modeling
3 - MGT 402 Operations Planning and Control
3 - MTHSC 407 Regress. and Time-Ser. Analysis
3 - MTHSC 441 Intro. to Stochastic Models

Statistics
3 - MTHSC 492 Professional Development
3 - MTHSC 450 Advanced Calculus I
3 - MTHSC 466 Sampling Theory and Methods
3 - MTHSC 470 Regress. and Time-Ser. Analysis

BIOL SC 204 Principles of Biology I
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Foreign Language Requirement

BIOLOGY CONCENTRATION
Freshman Year
First Semester
5 - BIOL 110 Principles of Biology I
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Foreign Language Requirement

1See advisor.
2MTHSC 408, 410, 419, or 435
3Any 400-level MTHSC course
4Any 400-level CP SC course
Second Semester
5 - BIOL 111 Principles of Biology II
4 - MTHSC 108 Calculus of One Variable II
3 - Computer Science Requirement1
15

Sophomore Year
First Semester
4 - CH 101 General Chemistry
3 - ECON 200 Economic Concepts or
3 - ECON 211 Principles of Microeconomics
4 - MTHSC 206 Calculus of Several Variables
1 - MTHSC 250 Intro. to Mathematical Sciences
3 - PHYS 207 General Physics I
1 - PHYS 209 General Physics I Lab.
16

Second Semester
4 - CH 102 General Chemistry
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
3 - MTHSC 311 Linear Algebra
3 - PHYS 208 General Physics II
1 - PHYS 210 General Physics II Lab.
16

Junior Year
First Semester
3 - CH 223 Organic Chemistry
1 - CH 227 Organic Chemistry Lab.
3 - ENGL 314 Technical Writing
3 - MTHSC 360 Intermediate Math. Computing
3 - MTHSC 440 Linear Programming
3 - Arts and Humanities (Literature) Requirement1
16

Second Semester
3 - CH 224 Organic Chemistry
1 - CH 228 Organic Chemistry Lab.
3 - COMM 250 Public Speaking
3 - MTHSC 302 Statistics for Science and Engr.
3 - Arts and Humanities (Non-Lit.) Requirement1
3 - Math Science Requirement5
16

Senior Year
First Semester
3 - MTHSC 400 Theory of Probability
3 - MTHSC 453 Advanced Calculus I or
3 - MTHSC 463 Mathematical Analysis I
3 - Animal or Plant Diversity Requirement6
3 - Capstone Experience6
3 - Social Science Requirement5
15

Second Semester
3 - MTHSC 412 Introduction to Modern Algebra
3 - MTHSC 454 Advanced Calculus II
1 - MTHSC 492 Professional Development
3 - Biological Sciences Requirement1
3 - Capstone Experience6
13
121 Total Semester Hours

Second Semester
3 - ECON 211 Principles of Microeconomics
or
3 - ECON 200 Economic Concepts
3 - Computer Science Requirement1
3 - Second Major Requirement
4 - Natural Science Requirement3
3 - Elective
16

Senior Year
First Semester
3 - MTHSC 453 Advanced Calculus I
3 - Arts and Humanities Requirement1 or
3 - Education Requirement
3 - Capstone Experience2
3 - Minor Requirement4 or
3 - Second Major Requirement
3 - Science and Tech. in Society Requirement1
15

Second Semester
1 - MTHSC 492 Professional Development
3 - Capstone Experience2
3 - Math Science Requirement1
6 - Minor Requirement4 or
6 - Second Major Requirement
2 - Elective
15
122 Total Semester Hours

Bachelor of Science
Freshman Year
First Semester
3 - ECON 200 Economic Concepts or
3 - ECON 211 Principles of Microeconomics
3 - ENGL 103 Accelerated Composition
1 - MTHSC 492 Professional Development
1 - Elective
14
Second Semester
4 - MTHSC 108 Calculus of One Variable II
3 - Computer Science Requirement
3 - Foreign Language Requirement1
3 - Social Science Requirement5
16

Sophomore Year
First Semester
4 - MTHSC 206 Calculus of Several Variables
1 - MTHSC 250 Intro. to Mathematical Sciences
3 - MTHSC 360 Intermediate Math. Computing or
3 - EDSEC 437 Technology in Sec. Math.
3 - Arts and Humanities (Literature) Requirement1
3 - Elective
14
Second Semester
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
3 - MTHSC 302 Statistics for Science and Engr.
3 - MTHSC 311 Linear Algebra
3 - Arts and Humanities (Non-Lit.) Requirement1
3 - Minor Requirement6 or
3 - Second Major Requirement
16

Junior Year
First Semester
3 - ENGL 314 Technical Writing
3 - MTHSC 412 Introduction to Modern Algebra
3 - Math Science Requirement1
4 - Natural Science Requirement3
3 - Elective
16

Physics
Bachelor of Science
Physics, the most fundamental of the natural sciences, forms the basis of study upon which the other branches of science are founded. Physics is concerned with the fundamental behavior of matter and energy. Classical physics encompasses the fields of mechanics, heat and thermodynamics, electricity and magnetism, acoustics and optics. Modern physics is concerned with the study of atoms and molecules, atomic nuclei, elementary particles and the properties of liquids, crystalline solids, and other materials, as well as the areas of relativity, cosmology, and the large-scale structure of the universe.
The undergraduate Physics curricula provide students with a strong background in the classical areas of physics, as well as an introduction to the more important aspects of modern physics. The BS curriculum is directed toward preparing students for graduate study ultimately leading to the PhD degree or toward research and development work in industrial or governmental laboratories. It also provides a good background for graduate study or industrial work in many areas or engineering physics and applied science.

**Freshman Year**

**First Semester**
- 3 - ASTR 105 Physics of the Universe
- 4 - CH 101 General Chemistry
- 3 - ENGL 103 Accelerated Composition
- 4 - MTHSC 106 Calculus of One Variable I
- 1 - PHYS 101 Current Topics in Modern Physics

**Second Semester**
- 4 - CH 102 General Chemistry
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - PHYS 122 Physics with Calculus I
- 1 - PHYS 124 Physics Lab. I
- 3 - Arts and Humanities (Non-Lit.) Requirement

**Sophomore Year**

**First Semester**
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II
- 3 - PHYS 222 Physics Lab. II
- 4 - Foreign Language Requirement
- 3 - Oral Communication Requirement

**Second Semester**
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 3 - PHYS 223 Physics with Calculus III
- 1 - PHYS 224 Physics Lab. III
- 4 - Foreign Language Requirement
- 3 - Social Science Requirement

**Junior Year**

**First Semester**
- 3 - PHYS 311 Intro. to Meth. of Theoretical Phys.
- 3 - PHYS 321 Mechanics I
- 3 - PHYS 312 Methods of Theoretical Physics I
- 4 - MTHSC 206 Calculus with Calculus II
- 1 - PHYS 223 Physics Lab. II
- 3 - Oral Communication Requirement

**Second Semester**
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 3 - PHYS 222 Physics with Calculus III
- 1 - PHYS 224 Physics Lab. III
- 4 - Biophysics Requirement
- 3 - Social Science Requirement

**Senior Year**

**First Semester**
- 3 - PHYS 401 Senior Thesis
- 3 - PHYS 442 Electromagnetics II
- 3 - PHYS 455 Quantum Physics I
- 3 - Emphasis Area Requirement
- 3 - Science Requirement

**Second Semester**
- 3 - HIST 172 The West and the World I or
- 3 - HIST 173 The West and the World II
- 3 - PHYS 456 Quantum Physics II
- 3 - PHYS 465 Thermodynamics and Statistical Mechanics
- 3 - Arts and Humanities (Literature) Requirement
- 3 - Emphasis Area Requirement

122 Total Semester Hours

**Sophomore Year**

**First Semester**
- 3 - PHYS 356 Modern Physics Overview
- 3 - PHYS 325 Experimental Physics I
- 1 - PHYS 300 Introduction to Research
- 3 - Physics Writing Requirement
- 4 - Biophysics Requirement

**Second Semester**
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 3 - PHYS 322 Mechanics II
- 1 - PHYS 356 Modern Physics Overview
- 3 - PHYS 441 Electromagnetics I
- 4 - Biophysics Requirement
- 4 - Foreign Language Requirement

125 Total Semester Hours

**Junior Year**

**First Semester**
- 3 - PHYS 311 Intro. to Meth. of Theoretical Phys.
- 3 - PHYS 321 Mechanics I
- 3 - PHYS 325 Experimental Physics I
- 4 - Biophysics Requirement
- 3 - Physics Writing Requirement
- 3 - Science Requirement

**Second Semester**
- 3 - HIST 172 The West and the World I or
- 3 - HIST 173 The West and the World II
- 3 - PHYS 456 Quantum Physics II
- 3 - PHYS 465 Thermodynamics and Statistical Mechanics
- 3 - Arts and Humanities (Literature) Requirement
- 3 - Biophysics Requirement

122 Total Semester Hours

**Senior Year**

**First Semester**
- 3 - PHYS 441 Electromagnetics I
- 3 - PHYS 455 Quantum Physics I
- 3 - PHYS 442 Electromagnetics II
- 3 - PHYS 456 Quantum Physics II
- 3 - PHYS 465 Thermodynamics and Statistical Mechanics
- 3 - Arts and Humanities (Literature) Requirement
- 3 - Biophysics Requirement

122 Total Semester Hours

**BIOPHYSICS CONCENTRATION**

The Biophysics Concentration offers an excellent preparation for medical school or graduate work in biological sciences. It includes the flexibility of selecting courses in chemistry, biological sciences, physics, and mathematics. This concentration also provides the necessary background for employment in industry, manufacturing, and instrumentation for clinical or molecular biology applications.

**Freshman Year**

**First Semester**
- 3 - ASTR 105 Physics of the Universe
- 4 - CH 101 General Chemistry
- 3 - ENGL 103 Accelerated Composition
- 4 - MTHSC 106 Calculus of One Variable I
- 1 - PHYS 101 Current Topics in Modern Physics

**Second Semester**
- 4 - CH 102 General Chemistry
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - PHYS 122 Physics with Calculus I
- 1 - PHYS 124 Physics Lab. I
- 3 - Arts and Humanities (Non-Lit.) Requirement

**Sophomore Year**

**First Semester**
- 3 - PHYS 311 Intro. to Meth. of Theoretical Phys.
- 3 - PHYS 321 Mechanics I
- 3 - PHYS 325 Experimental Physics I
- 4 - Biophysics Requirement
- 3 - Physics Writing Requirement
- 3 - Science Requirement

**Second Semester**
- 3 - HIST 172 The West and the World I or
- 3 - HIST 173 The West and the World II
- 3 - PHYS 455 Quantum Physics II
- 3 - PHYS 456 Quantum Physics II
- 3 - PHYS 465 Thermodynamics and Statistical Mechanics
- 3 - Arts and Humanities (Literature) Requirement
- 3 - Biophysics Requirement

122 Total Semester Hours

1See General Education Requirements. Three of these credit hours must also satisfy the Science and Technology in Society Requirement.

2Two semesters (through 102) in the same modern foreign language are required.

3See advisor. Select from the following emphasis areas: Chemistry, Computer Science, Engineering, Environmental Engineering, Geology, Mathematical Sciences, Physics and Astronomy. Twelve credit hours in one of these areas, with at least six at the 300-400 level, are required. Nine credit hours for a minor in one of these areas might be satisfied with three additional credits at the 300-400 level.

4Any 200-400 level science course

5Select any ENGL course from General Education Arts and Humanities (Literature) Requirement.

6Select any ENGL course from General Education Arts and Humanities (Non-Lit.) Requirement.

7Select any ENGL course from General Education Arts and Humanities (Literature) Requirement.

8Any approved physics course may be substituted if CH 331 and 332 have been completed.

9Select any ENGL course from General Education Arts and Humanities (Literature) Requirement.
**PHYSICS**

**Bachelor of Arts**

The Bachelor of Arts in Physics program is ideal for students interested in acquiring a broad-based liberal education that includes a strong and solid understanding of either science or a broad exposure to engineering with a strong physics foundation.

**Freshman Year**

**First Semester**
- 3 - ASTR 105 Physics of the Universe
- 3 - CH 101 General Chemistry
- 3 - ENGL 103 Accelerated Composition
- 4 - MTHSC 106 Calculus of One Variable I
- 1 - PHYS 101 Current Topics in Modern Physics

**Second Semester**
- 4 - CH 102 General Chemistry
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - PHYS 122 Physics with Calculus I
- 1 - PHYS 124 Physics Lab. I
- 3 - Arts and Humanities (Non-Lit.) Requirement

**Sophomore Year**

**First Semester**
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II
- 1 - PHYS 223 Physics Lab. II
- 4 - Foreign Language Requirement
- 3 - Oral Communication Requirement

**Second Semester**
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 3 - PHYS 222 Physics with Calculus III
- 1 - PHYS 224 Physics Lab. III
- 4 - Social Science Requirement
- 3 - Technical Writing Requirement

**Junior Year**

**First Semester**
- 3 - PHYS 311 Intro. to Meth. of Theoretical Phys.
- 3 - PHYS 321 Mechanics I
- 3 - PHYS 325 Experimental Physics I
- 3 - Foreign Language Requirement
- 3 - Minor Requirement

**Second Semester**
- 1 - PHYS 300 Introduction to Research
- 3 - PHYS 312 Methods of Theoretical Physics II
- 3 - Foreign Language Requirement
- 3 - Minor Requirement

**Senior Year**

**First Semester**
- 4 - CH 101 General Chemistry
- 3 - ENGL 103 Accelerated Composition
- 4 - MTHSC 106 Calculus of One Variable I
- 3 - TEXT 175 Intro. to Textile Manufacturing

**Second Semester**
- 4 - CH 102 General Chemistry
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - PHYS 122 Physics with Calculus I
- 3 - Arts and Humanities (Non-Lit.) Requirement

**POLYMER AND FIBER CHEMISTRY**

**Bachelor of Science**

The School of Materials Science and Engineering offers undergraduate degrees in Ceramic and Materials Engineering and Polymer and Fiber Chemistry.

The Bachelor of Science degree in Polymer and Fiber Chemistry is based on a foundation in physical and mathematical sciences. From this base, students are taught, using classroom instruction, laboratory courses, and individual research, to apply their scientific knowledge to the solution of problems in polymers and fiber-based materials for diverse applications ranging from biomedical and sports to construction and communication. The degree in Polymer and Fiber Chemistry also prepares students for graduate studies in a number of science and engineering disciplines.

Graduates in Polymer and Fiber Chemistry hold jobs in corporate and personnel management, manufacturing management, design, research, development, technical service, quality control, and sales. They create new products and processes and solve problems. They create styles, patterns, textures, and colors for apparel, home, industry, and special applications. Their jobs utilize computers, automation, and product quality and are concerned with plant design, environmental control, and consumer safety.

**Freshman Year**

**First Semester**
- 4 - CH 101 General Chemistry
- 3 - ENGL 103 Accelerated Composition
- 4 - MTHSC 106 Calculus of One Variable I
- 3 - PHYS 122 Physics with Calculus I
- 1 - PHYS 124 Physics Lab. I
- 3 - Arts and Humanities (Literature) Requirement

**Second Semester**
- 4 - CH 102 General Chemistry
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - PHYS 122 Physics with Calculus I
- 1 - PHYS 124 Physics Lab. II
- 3 - Arts and Humanities (Literature) Requirement

**Sophomore Year**

**First Semester**
- 3 - CH 223 Organic Chemistry
- 1 - CH 227 Organic Chemistry Lab.
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II
- 1 - PHYS 223 Physics Lab. II
- 3 - Arts and Humanities (Literature) Requirement

**Second Semester**
- 3 - CH 224 Organic Chemistry
- 1 - CH 228 Organic Chemistry Lab.
- 3 - ECON 200 Economics Concepts
- 3 - EN SP 200 Intro. to Environmental Science
- 3 - HIST 122 History, Tech., and Science
- 1 - MS&E 251 Materials Science Portfolio I
- 4 - MTHSC 208 Intro. to Ord. Diff. Equations

**Junior Year**

**First Semester**
- 3 - PHYS 311 Intro. to Polymer Science and Engr.
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 4 - TEXT 201 Yarn Structures and Formation
- 4 - Technical Writing Requirement

**Second Semester**
- 3 - CH 332 Physical Chemistry
- 3 - COMM 250 Public Speaking
- 3 - MS&E 324 Statistics for MS&E
- 3 - PFC 416 Chemical Preparation of Textiles
- 4 - TEXT 202 Fabric Struct., Des., and Analysis

**Senior Year**

**First Semester**
- 3 - PFC 457 Dyeing and Finishing I
- 1 - PFC 459 Dyeing and Finishing I Lab.
- 3 - TEXT 421 Fiber Science
- 5 - Approved Requirement
- 3 - Departmental Requirement

**Second Semester**
- 1 - MS&E 451 MS&SE Portfolio II
- 3 - MS&E 491 Undergraduate Research
- 3 - PFC 458 Dyeing and Finishing II
- 1 - PFC 460 Dyeing and Finishing II Lab.
- 3 - TEXT 422 Properties of Textile Structures
- 3 - Departmental Requirement

120 Total Semester Hours

1 - See General Education Requirements.
2 - Select any 200-level ENGL course from General Education Arts and Humanities (Literature) Requirement.
3 - See advisor.
MINORS

Following are minors acceptable for students in the College of Engineering and Science. 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
Athletic Leadership
Biochemistry
Biological Sciences
Business Administration
Chemistry
Cluster
Communication Studies
Computer Science—not open to Computer Information Systems majors
Crop and Soil Environmental Science
East Asian Studies
Economics
Education
English
Entomology
Entrepreneurship
Environmental Engineering
Environmental Science and Policy
Equine Business
Film Studies
Financial Management
Food Science
Forest Products
Forest Resource Management
Genetics
Geography
Geology
Global Politics
Great Works
History
Horticulture
International Engineering and Science
Legal Studies
Management
Management Information Systems
Mathematical Sciences
Microbiology
Military Leadership
Modern Languages
Music
Natural Resource Economics
Nonprofit Leadership
Packaging Science
Pan African Studies
Park and Protected Area Management
Philosophy
Physics
Plant Pathology
Political Science
Psychology
Public Policy
Religion
Russian Area Studies
Science and Technology in Society
Screenwriting
Sociology
Spanish-American Area Studies
Theatre
Therapeutic Recreation
Travel and Tourism
Turfgrass
Urban Forestry
Wildlife and Fisheries Biology
Women’s Studies
Writing

See pages 36–39 for details.