COLLEGE OF ENGINEERING AND SCIENCE

The College of Engineering and Science offers a broad range of rigorous and stimulating baccalaureate programs which provide unexcelled educational opportunities. The innovative combination of engineering and science disciplines which 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.ces.clemson.edu.

Minors
Engineering and science students can complement their majors by selecting minor concentrations of study. Available minors include Bioengineering, Environmental Engineering, International Engineering and Science, one in each of the science majors, and in Textiles. (See page 99.)

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.ces.clemson.edu/afge.

ENGINEERING PROGRAMS
The professional Bachelor of Science engineering degrees 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 of the Accreditation Board for Engineering and Technology. The Biosystems Engineering program is administered jointly with the College of Agriculture, Forestry, and Life Sciences.

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

- conduct themselves professionally and ethically
- appreciate engineering's global/societal context
- understand contemporary engineering issues
- apply modern engineering methods and tools
- appreciate the need for life-long learning

Each engineering program has additional 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. To prepare students for entry into a specific engineering degree program, the second semester of the curriculum includes a Major Requirement of 6–7 credits. Additional information can be found at www.ces.clemson.edu/afge.

Freshman Curriculum
First Semester
2 - CES 102 Engineering Disciplines and Skills
4 - CH 101 General Chemistry
3 - CH 101 General Chemistry
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement or
3 - Social Science Requirement1
— 16

Second Semester
4 - MTHSC 106 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
3 - Arts and Humanities Requirement or
3 - Social Science Requirement1
6-7 - Major Requirement2
16-17

1See Policy on Humanities and Social Sciences for Engineering Curricula below.
2See advisor.

Admission into Engineering Degree Programs
To transfer into an engineering degree program, a student must have completed each course in the freshman engineering curriculum (including the Major Requirement for the desired major) with a grade of C or better with the exception of the Arts and Humanities/Social Science Requirements. The student must also have a minimum overall grade-point ratio of 2.0 or, in the case of enrollment-limited majors, must have the minimum grade-point ratio specified for that major.

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 transferring into an engineering degree program will follow the curriculum in effect at the time of transfer.

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

Engineering curricula include a minimum of 15 credits of humanities/social science courses selected so as to satisfy the University's General Education Arts and Humanities and Social Science Requirements, as well as specific program objectives. Individual engineering curricula may have more specific requirements or may require more than 15 hours of humanities/social science courses. A list of acceptable courses is available at www.ces.clemson.edu/main/students/undergrad/humanities_policy.htm.

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.

**BIOELECTRICAL CONCENTRATION**

**Freshman Year**

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

**Second Semester**
- CH 102 General Chemistry
- E C E 211 Electrical Engineering Lab. I
- E C E 262 Electric Circuits II
- E M 201 Engineering Mechanics: Statics
- MTHSC 208 Intro. to Ordinary Diff. Equations

**Junior Year**

**First Semester**
- CH 201 Survey of Organic Chemistry
- C M E 210 Introduction to Materials Science
- C M E 302 Biomedical Engineering
- Arts and Humanities Requirement or 3 - Social Science Requirement

**Second Semester**
- BIO E 370 Bioinstrumentation and Bioimaging
- BIOCH 305 Essential Elements of Biochem.
- E C E Technical Requirement

**Senior Year**

**First Semester**
- BIO E 400 Senior Seminar
- BIO E 401 Biomedical Design
- BIO E 448 Tissue Engineering
- Arts and Humanities Requirement or 3 - Social Science Requirement

**Second Semester**
- BIO E 402 Biomedical Engineering Lab.
- C M E 413 Noncrystalline Materials
- C M E 402 Solid State Materials
- Social Science Requirement

128 Total Semester Hours

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

*Students planning to enter medical school should take CH 223/227 instead of CH 201 and take CH 224/228 as an additional course sequence.

Select from department-approved list.

Notes:
1. To transfer from General Engineering into the Bioengineering degree program, students must have a minimum cumulative grade-point ratio of 3.0 in courses taken at Clemson and must have earned a C or better in each course in the General Engineering freshman curriculum including the Arts and Humanities/Social Science Requirements.
2. A student is allowed to enroll in E C E courses (excluding E C E 307, 308, 309) only when all prerequisites have been passed with a grade of C or better.
3. All Bioelectrical Concentration students must have a cumulative engineering grade-point ratio of 2.0 to enroll in any 300- or 400-level E C E courses.
4. No student may exceed a maximum of two attempts, excluding W, to complete successfully any E C E course.

**BIOMATERIALS CONCENTRATION**

**Freshman Year**

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

**Second Semester**
- CH 102 General Chemistry
- CES 102 Introduction to Materials Science
- MTHSC 108 Calculus of One Variable II
- PHYS 122 Physics with Calculus I
- Arts and Humanities Requirement or 3 - Social Science Requirement

**Sophomore Year**

**First Semester**
- BIO E 201 Intro. to Biomedical Engineering
- C M E 210 Introduction to Materials Science
- CH 201 Survey of Organic Chemistry
- MTHSC 208 Intro. to Ordinary Diff. Equations
- Arts and Humanities Requirement or 3 - Social Science Requirement

**Second Semester**
- C M E 241 Metrics Lab.
- E C E 309 Electrical Engineering Lab. I
- E M 201 Engineering Mechanics: Statics
- MTHSC 208 Intro. to Ordinary Diff. Equations
- Arts and Humanities Requirement or 3 - Social Science Requirement

**Junior Year**

**First Semester**
- BIO E 401 Intro. to Biomedical Engineering
- C M E 319 Materials Processing I
- C M E 326 Thermodynamics of Materials
- C M E 327 Transport Phenomena
- Arts and Humanities Requirement or 3 - Social Science Requirement

**Second Semester**
- BIO E 302 Biomedical Materials
- BIOC 315 Functional Human Anatomy
- MTHSC 206 Calculus of Several Variables
- PHYS 221 Physics with Calculus II

**Senior Year**

**First Semester**
- BIO E 476 Biosurface Engineering
- BIOSC 315 Functional Human Anatomy
- C M E 422 Mechanical Behavior of Materials
- MTHSC 302 Statistics for Science and Engr.
- Bioengineering Technical Requirement

82
Those interested in medical careers should consider Engineering Intern, and/or Study Abroad Programs. Education, and develop a career goal of professional concentrations, experience an interdisciplinary knowledge in both disciplines. In addition to engineering and life sciences and must be knowledgeable in both areas. Two main areas are supported: engineering for management of natural resources and biological entities. Two main areas are supported: engineering for management of natural resources and the environment and engineering for production of value-added products from bioprocessing technologies. Biosystems engineers work at the interface between engineering and life sciences and must be knowledgeable in both disciplines. In addition to the common objectives of all engineering programs listed on page 81, Biosystems Engineering students should achieve familiarity with both biosystems concentrations, experience an interdisciplinary education, and develop a career goal of professional recognition and licensure.

Students develop specialization in one of two concentrations. The Applied Biotechnology Concentration equips students to apply engineering and biological sciences to problem solving for biological systems and production of value-added bioproducts in a wide range of industries. The Natural Resources and Environment Concentration equips students to apply engineering, agricultural, and environmental sciences to assess and control the impact of human activities on the biosphere.

Students are urged to complete a minor and participate in the Cooperative Education, Biosystems Engineering Intern, and/or Study Abroad Programs. Those interested in medical careers should consider graduate study and/or medical school. Additional information is available from the departmental offices or at www.clemson.edu/engbioscience.htm.

BIOSYSTEMS ENGINEERING

Bachelor of Science

The principal objective of the Biosystems Engineering program is to educate and prepare students for a wide range of engineering endeavors involving biological entities. Two main areas are supported: engineering for management of natural resources and the environment and engineering for production of value-added products from bioprocessing technologies.

Students planning to enter medical school should take CH 223/227 instead of CH 201 and take CH 224/228 as an additional course sequence.

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.

2Students planning to enter medical school should take CH 223/227 instead of CH 201 and take CH 224/228 as an additional course sequence.

3Select from department-approved list.

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

APPLIED BIOTECHNOLOGY 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 Requirement
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
3 - Social Science Requirement
16
Sophomore Year

First Semester
2 - BE 210 Intro. to Biosystems Engineering
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II
4 - Biology Requirement
3 - Statics Requirement
6
Second Semester
2 - BE 212 Fundamentals of Biosystems Engr.
2 - E G 209 Intro. to Engr./Computer Graphics
3 - M E 310 Thermodynamics and Heat Transfer or
3 - CH E 220 Chem. Engr. Thermodynamics I
4 - MICRO 305 General Microbiology
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
2 - Dynamics Requirement
17

Combined Bachelor of Science in Biosystems Engineering/Master of Science in Bioengineering

Under this plan, students in Biosystems Engineering may reduce the time necessary to earn both degrees by applying graduate credits to both undergraduate and graduate program requirements. See Academic Regulations in this catalog for enrollment guidelines and procedures.

Students in the Applied Biotechnology Concentration may apply graduate credits toward a Master of Science Degree in Bioengineering while pursuing a Bachelor of Science Degree in Biosystems Engineering. Students are encouraged to obtain the specific requirements for the dual degree from the Department of Biosystems Engineering as early as possible in their undergraduate program.

Junior Year

First Semester
3 - BE 312 Biol. Kinetics and Reactor Modeling
4 - C E 341 Introduction to Fluid Mechanics or
4 - CH E 230 Fluids/Heat Transfer
2 - E C E 307 Basic Electrical Engineering
3 - Mechanics of Materials Requirement
4 - Organic Chemistry Requirement
16
Second Semester
3 - BE 314 Biosystems Engr. Mechanical Design or
3 - M E 306 Fundamentals of Machine Design
3 - BE 412 Heat and Mass Transport in BE
4 - BE 415 Instrumentation and Control for Biosystems Engineers
3 - BE (CH E) 428 Biochemical Engineering
4 - Biochemistry Requirement
16

Senior Year

First Semester
3 - BE 414 Biosystems Engr. Unit Operations
3 - BE 438 Bioprocess Engineering Design
2 - BE 474 Biosystems Engr. Design/Project Mgt.
6 - Arts and Humanities Requirement or
6 - Social Science Requirement
3 - Life Science Requirement
17
Second Semester
3 - BE 435 Appl. in Biotechnology Engineering
2 - BE 475 Biosystems Engr. Capstone Design
3 - Arts and Humanities Requirement or
3 - Social Science Requirement
3 - Engineering Requirement
2 - Elective
13

128 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.

3CH 223 and 227 (preferred) or CH 201

4BIOCH 301/302 or 305/306

5MICRO 413 or any approved 300-400-level course in BIOCH, BIOSC, GEN, or MICRO

Notes:
1. Biosystems Engineering students are allowed to enroll in upper-level BE courses only when the following prerequisites have been completed with a C or better: C E 206, 208, 341, CHE 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 BIOL 104/106 or 111, CH 224, 228, and PHYS 124, 223 as additional courses.
NATURAL RESOURCES AND ENVIRONMENT 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

Second Semester
4. CH 102 General Chemistry
2. ENGR 130 Engineering Fundamentals
4. MTHSC 206 Calculus of Several Variables
5. PHYS 122 Physics with Calculus I
3. Arts and Humanities Requirement or 3. Social Science Requirement

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 Requirement
3.Statics Requirement

Second Semester
1. 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 Requirement

Junior Year
First Semester
4. C E 321 Geotechnical Engineering or 4. CSENV 202 Soils
4. C E 341 Introduction to Fluid Mechanics
2. E C E 307 Basic Electrical Engineering

Second Semester
3. B E 322 Small Watershed Hydrology and Sedimentology
4. B E 415 Instrumentation and Control for B E
3. Structural Design Requirement

CERAMIC AND MATERIALS ENGINEERING

Bachelor of Science

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

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 semiconductor to the aerospace and finally to the traditional ceramics industry. The broad scope of industrial responsibilities handled by ceramic and materials engineers requires knowledge in mathematics, science, engineering, and the social sciences, skills in problem solving, engineering analysis, design, and written and oral communication.

The baccalaureate program integrates laboratory with classroom experiences to prepare students for life-long 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 ceramic and materials engineering 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 Requirement or 3. Social Science Requirement

Second Semester
4. CH 102 General Chemistry
2. ENGR 130 Engineering Fundamentals
4. MTHSC 206 Calculus of Several Variables
2. CES 102 Engineering Disciplines and Skills
3. Social Science Requirement

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 Requirement or 6. Social Science Requirement

Second Semester
2. E G 209 Intro. to Engr./Comp. Graphics
3. E M 201 Engineering Mechanics: Statics
4. MTHSC 208 Intro. to Ordinary Diff. Equations
3. Arts and Humanities Requirement or 3. Social Science Requirement

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. ENGL 314 Technical Writing
Second Semester
3 - CME 328 Phase Diagrams for Materials Processing and Applications
2 - CME 342 Structure/Property Lab.
3 - CME 361 Process. of Metals and Composites
3 - CME 422 Mechanical Behavior of Materials
3 - IIE 384 Engineering Economic Analysis
3 - PFC 303 Textile Chemistry

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

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

Sophomore Year
Second Semester
4 - CH 101 General Chemistry
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement or Social Science Requirement³ or
3 - Social Science Requirement³
17

Bachelor of Science

Chemical Engineering

The Department of Chemical and Biomolecular Engineering offers the Bachelor of Science degree in Chemical Engineering. 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 making 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.

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

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

127 Total Semester Hours

CHEMICAL ENGINEERING

Bachelor of Science

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.

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 Requirement or Social Science Requirement³ or
3 - Social Science Requirement³
16
Second Semester
4 - CH 102 General Chemistry
3 - 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 Requirement or Social Science Requirement³ or
3 - Social Science Requirement³
17

Sophomore Year
First Semester
3 - CH 223 Organic Chemistry
4 - CHE 211 Intro. to Chemical Engineering
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II
3 - Arts and Humanities Requirement or Social Science Requirement³ or
3 - Social Science Requirement³
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 - ECE 307 Basic Electrical Engineering
1 - ECE 309 Electrical Engineering Lab. I
3 - Arts and Humanities Requirement or Social Science Requirement³ or
3 - Social Science Requirement³
3 - Biochemistry Requirement²
16
Second Semester
3 - CH 332 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 Requirement or Social Science Requirement³
3 - Emphasis Area Requirement³
17

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 Civil Engineering program leads to the Bachelor of Science degree in Civil Engineering and includes the common educational goals listed on page 81 for the College of Engineering and Science. (The complete objectives of the program can be found at www.ce.clemson.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 which serve to strengthen their undergraduate background.

The Civil Engineering program prepares students to work immediately upon graduation in most areas of civil engineering or to pursue graduate degrees. Students are also exposed to issues related to professional practice, including professional registration, life-long learning, and communica-
tion 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

**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 Requirement or 3 - Social Science Requirement

**Second Semester**
- 2 - ENGR 130 Engineering Fundamentals
- 3 - GEOL 101 Physical Geology
- 1 - GEOL 103 Physical Geology Lab.
- 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 Requirement or 3 - Social Science Requirement

### Sophomore Year

**First Semester**
- 2 - E G 209 Intro. to Engr./Computer Graphics
- 3 - E M 201 Engineering Mechanics: Statics
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II
- 1 - PHYS 223 Physics Lab. II
- 3 - Arts and Humanities Requirement or 3 - Social Science Requirement

**Second Semester**
- 4 - C E 206 Structural Mechanics
- 2 - C E 208 Civil Engineering Dynamics
- 3 - C E 255 Geomatics
- 2 - C E 352 Economic Evaluation of Projects
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations

### Junior Year

**First Semester**
- 3 - C E 301 Structural Analysis
- 3 - C E 331 Construction Engineering and Mgt.
- 4 - C E 341 Introduction to Fluid Mechanics
- 4 - C E 351 Civil Engineering Materials
- 3 - EX ST 301 Introductory Statistics

**Second Semester**
- 3 - C E 311 Transportation Engineering Planning and Design
- 4 - C E 321 Geotechnical Engineering
- 3 - C E 342 Applied Hydraulics and Hydrology
- 1 - C E 353 Professional Seminar
- 3 - C E 406 Structural Steel Design
- 3 - EE&S 401 Environmental Engineering

### Second Semester

**Senior Year**

**First Semester**
- 3 - C E 401 Reinforced Concrete Design
- 6 - ENGL 314 Technical Writing
- 3 - Technical Requirement
- 3 - Technical Requirement Restricted

**Second Semester**
- 3 - C E 459 Capstone Design Project
- 3 - Arts and Humanities Requirement or 3 - Social Science Requirement
- 3 - Arts and Humanities (Literature) Requirement
- 3 - Elective

128 Total Semester Hours

1See Policy on Humanities and Social Sciences for Engineering Curriculum. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.

2CH 102, or BIOL 120 and 121, 122, 123, or 124 may be substituted.

3See advisor. 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, Transportation Engineering, or Structural Engineering.

**COMPUTER ENGINEERING**

### Bachelor of Science

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

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

Information on the program and its objectives is available at [www.ece.clemson.edu/ece/index.shtml](http://www.ece.clemson.edu/ece/index.shtml).

### Freshman Year

**First Semester**
- 3 - E C E 201 Logic and Computing Devices
- 3 - E C E 202 Electric Circuits I
- 1 - E C E 211 Electrical Engineering Lab. I
- 3 - E C E 222 Systems Programming Concepts for Computer Engineering
- 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 223 Computer Systems Engineering
- 3 - E C E 263 Electric Circuits II
- 4 - E C E 272 Computer Organization
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations

### Sophomore Year

**First Semester**
- 3 - E C E 301 Electrical Engineering Lab. III
- 3 - E C E 320 Electronics I
- 3 - E C E 329 Computer Systems Structures
- 3 - E C E 330 Signals, Systems, and Transforms
- 4 - E C E 371 Microcomputer Interfacing
- 3 - MTHSC 311 Linear Algebra

**Second Semester**
- 3 - E C E 317 Random Signal Analysis
- 3 - E C E 327 Digital Computer Design
- 3 - E C E 352 Programming Systems
- 3 - ENGL 314 Technical Writing
- 3 - MTHSC 419 Discrete Math. Structures I
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.ece.clemson.edu/ece/index.shtml.

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
1. Arts and Humanities Requirement¹ or
2. Social Science Requirement¹
3. Computer Engineering Technical Requirement²
4. Oral Communication Requirement¹

Second Semester
1. ECE 453 Software Practicum
2. Arts and Humanities Requirement¹ or
3. Social Science Requirement¹
4. Computer Engineering Depth Technical Requirement²

Sophomore Year
First Semester
1. ECE 201 Logic and Computing Devices
2. ECE 202 Electric Circuits I
3. ECE 211 Electrical Engineering Lab. I
4. MTHSC 206 Calculus of Several Variables
5. PHYS 221 Physics with Calculus II
6. Technical Requirement (ECE)³ or
7. Arts and Humanities Requirement¹ or
8. Social Science Requirement¹

Second Semester
1. ECE 212 Electrical Engineering Lab. II
2. ECE 262 Electric Circuits II
3. ECE 272 Computer Organization
4. E M 201 Engineering Mechanics: Statics
5. MTHSC 208 Intro. to Ordinary Diff. Equations

Junior Year
First Semester
1. ECE 311 Electrical Engineering Lab. III
2. ECE 320 Electronics I
3. ECE 330 Signals, Systems, and Transforms
4. ECE 371 Microcomputer Interfacing
5. ECE 380 Electromagnetics

Second Semester
1. ECE 312 Electrical Engineering Lab. IV
2. ECE 317 Random Signal Analysis
3. ECE 321 Electronics II
4. ECE 360 Electric Power Engineering
5. ECE 381 Fields, Waves, and Circuits
6. ENGL 314 Technical Writing

Senior Year
First Semester
1. ECE 409 Continuous and Discrete Syst. Des.
2. ECE 427 Communications Systems
3. ECE 495 Integrated Systems Design I
4. Oral Communication Requirement¹
5. Technical Requirement (ECE)²

Second Semester
1. ECE 496 Integrated System Design II
2. Arts and Humanities Requirement¹ or
3. Social Science Requirement¹
4. Technical Requirement (ECE)²
5. Technical Requirement Depth (ECE)²

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 will demonstrate the ability to apply 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 will 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 the organization.

The traditional areas 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 par-
Mechanical Engineering students who have a cumulative grade-point ratio of 3.4 and be admitted to the College of Engineering and Science. Mechanical Engineering students who have a cumulative grade-point ratio or cumulative engineering grade-point ratio 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 Continuing Enrollment Policy. Students on probation for EGP R 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/me.

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

Second Semester
4 - CH 102 General Chemistry II
2 - ENGR 130 Engineering Fundamentals
4 - MTHSC 108 Calculus of One Variable II
3 - PHYS 122 Physics with Calculus I
1 - PHYS 124 Physics Lab. 1
3 - Arts and Humanities Requirement 1 or
3 - Social Science Requirement 1

Sophomore Year
First Semester
2 - E C E 207 Intro. to Engr. Computer Graphics 1
4 - I E 201 System Design I
3 - CP SC 161 Intro. to Visual Basic Program. or
3 - I E 220 Design of Info. Systems in I E
4 - MTHSC 206 Calculus of Several Variables
3 - PHYS 221 Physics with Calculus II

Second Semester
3 - C M E 210 Introduction to Materials Science
3 - E M 201 Engineering Mechanics: Statics
4 - I E 210 Design and Analysis of Work Systems
3 - I E 280 Methods of Operational Research I
3 - I E 384 Engineering Economic Analysis

Junior Year
First Semester
2 - E C E 307 Basic Electrical Engineering
1 - E C E 309 Electrical Engineering Lab. I
3 - H I S T 122 History, Technology, and Society
3 - I E 360 Ind. Appl. of Probability and Statistics
4 - I E 440 Decision Support Systems in I E
3 - I E 465 Facilities Planning and Design

Second Semester
3 - COMM 150 Intro. to Human Comm. or
3 - COMM 250 Public Speaking
3 - I E 361 Industrial Quality Control
1 - I E 368 Professional Practice in I E
3 - I E 381 Methods of Operational Research II
3 - I E 386 Production Planning and Control
3 - Fundamentals of Engineering Requirement 4

Senior Year
First Semester
3 - ENGL 314 Technical Writing
3 - I E 461 Quality Engineering
4 - I E 482 Systems Modeling
3 - Fundamentals of Engineering Requirement 5
3 - Technical Requirement 6
16
Second Semester
3 - I E 467 Systems Design II
3 - MGT 201 Principles of Management
3 - PO SC 102 Intro. to International Relations
3 - Arts and Humanities Requirement 1 or
3 - Social Science Requirement 1
3 - Technical Requirement 6
15
128 Total Semester Hours

See policy on Humanities and Social Sciences for Engineering curricula.
Students may take PHYS 223 in the sophomore year in lieu of PHYS 124.
E G 208 may be substituted.
Select from department-approved list.

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.
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 - Advanced Writing Requirement
3 - Statistics Requirement

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. III
6 - Technical Requirement

Second Semester
1 - M E 400 Senior Seminar
3 - M E 402 Internship in Engineering Design
6 - Arts and Humanities Requirement or 3 - Social Science Requirement
3 - Technical Requirement

124–126 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. Select from department-approved list.

Note: 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.

SCIENCE PROGRAMS

The College offers curricula leading to the Bachelor of Science in Chemistry, Computer Information Systems, Computer Science, Geology, Mathematical Sciences, Physics, Polymer and Fiber Chemistry, and Textile Management. 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 area from those listed on page 99. 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
4 - CH 101 General Chemistry
1 - CH 141 Chemistry Orientation
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement or 3 - Social Science Requirement

Second Semester
4 - CH 102 General Chemistry
2 - CH 152 Chemistry Communication I
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

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
4 - Foreign Language Requirement

Second Semester
3 - CH 205 Introduction to Inorganic Chemistry
3 - CH 224 Organic Chemistry
1 - CH 228 Organic Chemistry Lab.
4 - MTHSC 208 Intro. to Ordinary Diff. Equations
3 - PHYS 222 Physics with Calculus III
1 - PHYS 224 Physics Lab. III

Junior Year

First Semester
3 - BIOC 301 Molecular Biochemistry or 3 - BIOC 305 Essential Elements of Bioch.
3 - CH 313 Quantitative Analysis
2 - CH 315 Quantitative Analysis Lab.
3 - CH 331 Physical Chemistry
1 - CH 339 Physical Chemistry Lab.
3 - ENGL 314 Technical Writing

Second Semester
3 - CH 332 Physical Chemistry
1 - CH 340 Physical Chemistry Lab.
3 - CH 411 Instrumental Analysis
2 - CH 412 Instrumental Analysis Lab.
3 - Arts and Humanities (Literature) Requirement or 3 - Social Science Requirement
3 - Chemistry Requirement

Senior Year

First Semester
3 - CH 402 Inorganic Chemistry
2 - CH 403 Advanced Synthetic Techniques
3 - CH 443 Research Problems
3 - Arts and Humanities Requirement or 3 - Social Science Requirement
3 - Chemistry Requirement

Second Semester
3 - CH 444 Research Problems
3 - CH 450 Chemistry Capstone
1 - CH 452 Chemistry Communication II
3 - Arts and Humanities Requirement or 3 - Social Science Requirement
3 - Chemistry Requirement
3 - Elective

122 Total Semester Hours

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

One semester (through 102) in any modern foreign language is required.

See advisor.
CHEMISTRY

Bachelor of Arts

Freshman Year

First Semester
4 - CH 101 General Chemistry
1 - CH 141 Chemistry Orientation
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
15

Second Semester
4 - CH 102 General Chemistry
2 - CH 152 Chemistry Communication I
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
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
4 - Foreign Language Requirement2
15

Second Semester
3 - CH 205 Introduction to Inorganic Chemistry
3 - CH 224 Organic Chemistry
1 - CH 228 Organic Chemistry Lab.
6 - Arts and Humanities Requirement1 or
6 - Social Science Requirement1
4 - Foreign Language Requirement2
17

Junior Year

First Semester
3 - CH 313 Quantitative Analysis
1 - CH 317 Quantitative Analysis Lab.
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
3 - Arts and Humanities (Literature) Requirement1
3 - Foreign Language Requirement2
3 - Minor Requirement
16

Second Semester
3 - CH 331 Physical Chemistry
3 - ENGL 314 Technical Writing
3 - Arts and Humanities Requirement1 or
3 - Social Science Requirement1
3 - Foreign Language Requirement2
3 - Minor Requirement
15

Senior Year

First Semester
3 - CH 332 Physical Chemistry
3 - Chemistry Requirement3
3 - Minor Requirement
6 - Elective
15

Second Semester
3 - CH 450 Chemistry Capstone
1 - CH 452 Chemistry Communication II
3 - Chemistry Requirement1
6 - Minor Requirement
13

122 Total Semester Hours

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

Four semesters (through 202) of the same modern foreign language are required.

See advisor.

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.

Freshman Year

First Semester
4 - CP SC 101 Computer Science I
3 - ENGL 103 Accelerated Composition
4 - MTHSC 106 Calculus of One Variable I
3 - Social Science Requirement1,2
14

Second Semester
4 - CP SC 102 Computer Science II
4 - MTHSC 108 Calculus of One Variable II
3 - MTHSC 119 Introduction to Discrete Methods
3 - Arts and Humanities (Non-Lit.) Requirement1,2
3 - Social Science Requirement1,2
17

Sophomore Year

First Semester
4 - CP SC 212 Algorithms and Data Structures
3 - Arts and Humanities (Literature) Requirement1
3 - Humanities or Social Science Requirement2,3
4 - Natural Science Requirement4
3 - Oral Communication Requirement1
17

Second Semester
3 - CP SC 215 Tools and Tech. for Software Dev.
4 - CP SC 231 Intro. to Computer Organization
1 - CP SC 291 Seminar in Professional Issues I
3 - MTHSC 210 Applied Matrix Algebra or
3 - MTHSC 311 Linear Algebra
4 - Natural Science Requirement4
15

Junior Year

First Semester
3 - ACCT 201 Financial Accounting Concepts
3 - CP SC 322 Introduction to Operating Systems
3 - CP SC 372 Intro. to Software Development
3 - ECON 211 Principles of Microeconomics
3 - MTHSC 301 Statistical Methods I
15

Second Semester
3 - ACCT 202 Managerial Accounting Concepts
3 - CP SC 360 Networks and Network Program.
3 - CP SC 371 Systems Analysis or
3 - MGT 452 Systems Analysis and Design
3 - MGT 201 Principles of Management
3 - Elective
15

Senior Year

First Semester
3 - CP SC 462 Database Management Systems
1 - CP SC 491 Seminar in Professional Issues II1
3 - Advanced Writing Requirement1
3 - Business Requirement6
3 - Computer Science Requirement2
3 - Information Systems Requirement2
16

Second Semester
3 - MGT 312 Decision Models for Management
3 - MKT 301 Principles of Marketing
3 - Business Requirement6
3 - Computer Science Requirement2
1 - Elective
13

122 Total Semester Hours

See General Education Requirements.

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

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, PSYCH, REL, RUSS, SOC, SPAN, THEA, W S.

Select from one of the following sequences: BIOL 103/105, 104/106; 110, 111; CH 101, 102, 105, 106; PHYS 122/124, 221/223, 327/329, 208/210.

CP SC H195 may be substituted.

FIN 306, MGT 390, or 400

Select from 300-400 level CP SC courses.

MGT 452, 454, 455, 456, or 400-level CP SC course

Notes:
1. For graduation, a candidate for the BS degree in Computer Information Systems must have earned a grade of C or better in each 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.

 Shutdown has started.

90
# 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 of the Accreditation Board for Engineering and Technology (ABET). 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
- 3 - Social Science Requirement*1

### Second Semester
- 4 - CP SC 102 Computer Science II
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - MTHSC 119 Introduction to Discrete Methods
- 3 - Arts and Humanities (Non-Lit.) Requirement*1
- 3 - Social Science Requirement*1

## Sophomore Year

### First Semester
- 4 - CP SC 212 Algorithms and Data Structures
- 3 - PHYS 122 Physics with Calculus I
- 3 - Arts and Humanities Requirement*2 or Social Science Requirement*2
- 3 - Arts and Humanities (Literature) Requirement*1
- 3 - Oral Communication Requirement*1

### Second Semester
- 3 - CP SC 215 Tools and Tech. for Software Dev.
- 4 - CP SC 231 Intro. to Computer Organization
- 1 - CP SC 291 Seminar in Professional Issues I
- 3 - MTHSC 301 Statistical Methods I or 2 - MTHSC 302 Stats. for Science and Engr.
- 3 - PHYS 221 Physics with Calculus II

## Junior Year

### First Semester
- 3 - CP SC 330 Computer Systems Organization
- 3 - CP SC 360 Networks and Network Program.
- 3 - CP SC 372 Intro. to Software Development
- 3 - MTHSC 311 Linear Algebra
- 4 - Natural Science Requirement*1

### 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 - Emphasis Area Requirement*4
- 4 - Natural Science Requirement*1

## Senior Year

### First Semester
- 3 - CP SC 428 Design and Implementation of Programming Languages
- 3 - Advanced Writing Requirement*1
- 3 - Computer Science Requirement*5
- 3 - Emphasis Area Requirement*4
- 3 - Elective

### Second Semester
- 1 - CP SC 491 Seminar in Professional Issues II*6
- 3 - Arts and Humanities Requirement*2 or Social Science Requirement*1
- 3 - Computer Science Requirement*5
- 3 - Emphasis Area Requirement*4
- 4 - Elective

### 122 Total Semester Hours

*See General Education Requirements. Three credit hours satisfying the Arts and Humanities Requirement must also satisfy the Cross-Cultural Awareness Requirement. Three hours satisfying the Arts and Humanities or Social Science Requirement must also satisfy the Science and Technology Society Requirement.

*Select from courses in A A H, ANTH, ART, CHIN, COMM, DANCE, F A S, ECON, ENGL, FR, GEOG, GED, HIST, HUM, ITAL, JAPN, MUSCIP, P A, P A S, PHIL, PO SC, PSYCH, REL, RUSS, SOC, SPAN, THEA, W S.

*Two-semester sequence in the same physical or biological science, each including a laboratory is required. Select from BIOL 101/103, 104/106, 110, 111; CH 101, 102; GEOL 101/103 and 102, 112, 114; Alternately, if PHYS 124 and 223 are completed, six hours may be selected from courses in BIOL, BIOCH, BIOCIS, CH, GEOL, MICRO, PHYS, or EN SP 203.

*Select nine hours from any single University approved minor. At least three hours must be at the 300 level or above.

*Select from 400-level CP SC courses. At least three hours must be selected from CP SC 405, 411, 462, 472.

*CP SC H595 may be substituted.

### Notes:
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.

### Combined Bachelor's/Master's Plan

The program is oriented toward design, implementation, and application of 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
- 3 - Social Science Requirement*2

### Second Semester
- 4 - CP SC 102 Computer Science II
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - MTHSC 119 Introduction to Discrete Methods
- 4 - Foreign Language Requirement*1

## Sophomore Year

### First Semester
- 4 - CP SC 212 Algorithms and Data Structures
- 3 - PHYS 122 Physics with Calculus I
- 3 - Arts and Humanities (Literature) Requirement*2
- 3 - Foreign Language Requirement*1
- 4 - Natural Science Requirement*1
- 3 - Oral Communication Requirement*1

### Second Semester
- 4 - CP SC 215 Tools and Tech. for Software Dev.
- 4 - CP SC 231 Intro. to Computer Organization
- 1 - CP SC 291 Seminar in Professional Issues I
- 3 - Foreign Language Requirement*1
- 4 - Natural Science Requirement*1

## Junior Year

### First Semester
- 6 - Computer Science Requirement*4
- 3 - Mathematical Sciences Requirement*1
- 3 - Minor Requirement
- 3 - Social Science Requirement*1,6

### Second Semester
- 3 - Advanced Writing Requirement*1
- 3 - Arts and Humanities (Non-Lit.) Requirement*2,6
- 3 - Computer Science Requirement*4
- 6 - Minor Requirement
College of Engineering and Science

Senior Year
First Semester
6 - Computer Science Requirement
3 - Departmental Humanities Requirement
3 - Minor Requirement
3 - Social Science Requirement
15

Second Semester
1 - CP SC 491 Seminar in Professional Issues II
3 - Computer Science Requirement
3 - Fine Arts Requirement
3 - Minor Requirement
5 - Elective
15

122 Total Semester Hours

GEOLOGY

Bachelor of Science

Geology and biogeochemical environmental science involve the physics and chemistry of materials which 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
15

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

Sophomore Year
First Semester
3 - BIOL 103 General Biology I
1 - BIOL 105 General Biology Lab. I
4 - GEOL 206 Mineralogy and Intro. Petrology
4 - GEOL 211 Geosynthesis I
1 - GEOL 291 Introduction to Research I
3 - Social Science Requirement
16

Second Semester
4 - CSENV 202 Soils
4 - GEOL 212 Geosynthesis II
2 - GEOL 216 Petrography
1 - GEOL 292 Introduction to Research II
3 - PHYS 122 Physics with Calculus I
14

Junior Year
First Semester
3 - EN SP 200 Intro. to Environmental Science
4 - GEOL 302 Structural Geology
3 - GEOL 316 Igneous and Metamorphic Petrology
1 - GEOL 391 Research Methods I
3 - Arts and Humanities (Literature) Requirement
14

Second Semester
3 - GEOL 300 Environmental Geology
4 - GEOL 313 Sedimentology and Stratigraphy
1 - GEOL 392 Research Methods II
3 - Geology Requirement
3 - Social Science Requirement
2 - Elective
16

Summer
6 - Summer Geology Field Course

Senior Year
First Semester
4 - GEOL 405 Surficial Geology
3 - GEOL 408 Geohydrology
4 - GEOL 491 Research Synthesis I
2 - Elective
13

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

121 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 - GEOL 102 Earth History
3 - MTHSC 108 Calculus of One Variable II
3 - Arts and Humanities (Non-Lit.) Requirement
15

Sophomore Year
First Semester
3 - BIOL 103 General Biology I
1 - BIOL 105 General Biology Lab. I
4 - GEOL 206 Mineralogy and Intro. Petrology
4 - GEOL 211 Geosynthesis I
1 - GEOL 291 Introduction to Research I
3 - Social Science Requirement
16

Second Semester
4 - CSENV 202 Soils
4 - GEOL 212 Geosynthesis II
2 - GEOL 216 Petrography
1 - GEOL 292 Introduction to Research II
3 - PHYS 122 Physics with Calculus I
14

Junior Year
First Semester
3 - EN SP 200 Intro. to Environmental Science
4 - GEOL 302 Structural Geology
3 - GEOL 316 Igneous and Metamorphic Petrology
1 - GEOL 391 Research Methods I
3 - Arts and Humanities (Literature) Requirement
14

Second Semester
3 - GEOL 300 Environmental Geology
4 - GEOL 313 Sedimentology and Stratigraphy
1 - GEOL 392 Research Methods II
3 - Geology Requirement
3 - Social Science Requirement
2 - Elective
16

Summer
6 - Summer Geology Field Course
### Bachelor of Arts

#### First Semester
- BIOL 105 General Biology Lab. I
- CHEM 102 General Chemistry

#### Second Semester
- BIOL 106 General Biology Lab. II
- BIOL 103 General Biology
- MTHSC 301 Calculus of One Variable I

#### Junior Year

**First Semester**
- GEOL 206 Mineralogy and Intro. Petrology
- GEOL 211 Geosynthesis I
- GEOL 291 Introduction to Research I
- Arts and Humanities (Literature) Requirement

**Second Semester**
- GEOL 300 Environmental Geology
- PHYS 122 Physics with Calculus I
- Field Experience

#### Senior Year

**First Semester**
- EN SP 200 Intro. to Environmental Science
- GEOL 381 Research Methods I

**Second Semester**
- GEOL 382 Research Methods II
- GEOL 398 Geohydrology

**Summer**
- Field Experience

**HYDROGEOLOGY CONCENTRATION**

#### Freshman Year

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

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

#### Sophomore Year

**First Semester**
- GEOL 206 Mineralogy and Intro. Petrology
- GEOL 211 Geosynthesis I
- GEOL 291 Introduction to Research I
- Arts and Humanities (Literature) Requirement
- Technical Requirement

**Second Semester**
- GEOL 212 Geosynthesis II
- GEOL 292 Introduction to Research II
- GEOL 300 Environmental Geology
- PHYS 122 Physics with Calculus I
- Social Science Requirement

**Junior Year**

**First Semester**
- GEOL 302 Structural Geology
- GEOL 391 Research Methods I
- GEOL 308 Geohydrology
- PHYS 221 Physics with Calculus II
- Geology Requirement

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

**Summer**
- GEOL 475 Summer Geology Field Camp

**Senior Year**

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

**Second Semester**
- EE&S 401 Environmental Engineering
- GEOL 409 Subsurface Methods
- GEOL 492 Research Synthesis II
- Technical Requirement

121 Total Semester Hours

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

*MTHSC 206 and 208 or 301 or EX ST 301 substitute.*

*Select from department-approved list.*

*Any 300- or 400-level geology course*
Second Semester
1. GEOL 392 Research Methods II
2. Foreign Language Requirement
3. Geology Requirement
4. Minor Requirement
6. Elective
13

Senior Year
First Semester
4. GEOL 491 Research Synthesis I
3. Arts and Humanities (Literature) Requirement
3. Minor Requirement
3. Elective
13
Second Semester
4. GEOL 492 Research Synthesis II
3. Minor Requirement
3. Technical Requirement
6. Elective
16

122 Total Semester Hours

1MTHSC 106 and 108 are recommended; however, MTHSC 101 and 102 or MTHSC 102 and 203 may be substituted.
2See General Education Requirements.
3Spanish is recommended. Two years (through 202) in the same foreign language are required.
4See advisor.
5Any 100- or 400-level geology course
6Select from department-approved list.

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 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, internship 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
16
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
16

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
15
Second Semester
4. MTHSC 208 Intro. to Ordinary Diff. Equations
3. MTHSC 302 Statistics for Science and Engineering
3. Arts and Humanities (Literature) Requirement
4. Natural Science Requirement
3. Elective
17

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
Science Requirement
15
Second Semester
3. MTHSC 412 Introduction to Modern Algebra
3. MTHSC 454 Advanced Calculus II
3. Emphasis Area Requirement
3. Science Requirement
3. Elective
15

Senior Year
First Semester
3. COMM 250 Public Speaking
3. Capstone Experience
6. Emphasis Area Requirement
3. Science and Tech. in Society Requirement
15
Second Semester
1. MTHSC 492 Professional Development
3. Capstone Experience
3. Emphasis Area Requirement
3. Mathematical Sciences Requirement
3. Elective
13

122 Total Semester Hours

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
3CPS 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 101/103 and 102
5ECON 314 and 405; CP SC 102 and 212; CP SC 102 and 210; or any two natural science courses from General Education Natural Science Requirements (labs 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 405.
8Any 400-level MTHSC course approved by advisor

Notes:
1. For graduation, a candidate for the BS degree in Mathematical Sciences will be required to have a 2.0 or higher cumulative grade-point ratio in all required MTHSC courses.
2. A grade of C or better must be earned in all prerequisite courses before enrolling in the next MTHSC course.

EMPHASIS AREAS
Abstract Mathematics
6. Abstract Mathematics Requirement
6. Mathematical Sciences Requirement
12
Actuarial Science/Financial Mathematics
3. FIN 312 Financial Management
3. MTHSC 403 Intro. to Statistical Theory
3. MTHSC 407 Regression and Time-Series Analysis
3. MTHSC 431 Theory of Interest
12
Applied and Computational Mathematics
3. MTHSC 460 Intro. to Numerical Analysis I
6. Applications Area
12

94
BIOLOGY CONCENTRATION

Freshman Year

First Semester
5 - BIOL 110 Principles of Biology I
3 - ENGL 103 Accelerated Composition
3 - MTHSC 106 Calculus of One Variable I
3 - Foreign Language Requirement
12

Second Semester
5 - BIOL 111 Principles of Biology II
4 - MTHSC 108 Calculus of One Variable II
3 - Computer Science Requirement
15

Sophomore Year

First Semester
4 - CH 101 General Chemistry
3 - ECON 200 Economic Concepts or
3 - ECON 211 Principles of Microeconomics
3 - ENGL 103 Accelerated Composition
4 - MTHSC 206 Calculus of Several Variables
3 - Arts and Humanities (Literature) Requirement
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.
15
### Senior Year

**First Semester**
- 3 - MTHSC 453 Advanced Calculus I
- 3 - Arts and Humanities Requirement ¹ or
- 3 - Education Requirement ⁶
- 3 - Capstone Experience ²
- 3 - Minor Requirement ³ or
- 3 - Second Major Requirement
- 3 - Science and Tech. in Society Requirement ¹

**Second Semester**
- 1 - MTHSC 492 Professional Development
- 3 - Capstone Experience ²
- 3 - Math Science Requirement ⁵
- 6 - Minor Requirement ³ or
- 6 - Second Major Requirement
- 2 - Elective

122 Total Semester Hours

¹Six credits in any foreign language, including American Sign Language, numbered 200 or above
²CP SC 101, 111, or 120
³See General Education Requirements. Three of these credit hours must also satisfy the Cross-Cultural Awareness Requirement.
⁴See page 99 for approved minors.
⁵MTHSC 308, 400, or 454
⁶See advisor.

### 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 ¹

15

### 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 ²
- 3 - Oral Communication Requirement ³

15

**Second Semester**
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 3 - PHYS 222 Physics with Calculus III
- 1 - PHYS 224 Physics Lab. III
- 4 - Foreign Language Requirement ²
- 3 - Social Science Requirement ¹

15

### 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 - Advanced Writing Requirement ¹
- 3 - Emphasis Area Requirement ¹

15

**Second Semester**
- 1 - PHYS 300 Introduction to Research
- 3 - PHYS 312 Methods of Theoretical Physics II
- 3 - PHYS 322 Mechanics II
- 3 - PHYS 326 Experimental Physics II
- 1 - PHYS 356 Modern Physics Overview
- 3 - PHYS 441 Electromagnetics I
- 3 - Emphasis Area Requirement ¹

17

### Senior Year

**First Semester**
- 3 - PHYS 401 Senior Thesis
- 3 - PHYS 442 Electromagnetics II
- 3 - PHYS 455 Quantum Physics I
- 3 - Emphasis Area Requirement ¹
- 3 - Science Requirement ⁴

15

**Second Semester**
- 3 - HIST 172 or 173 Western Civilization
- 3 - PHYS 456 Quantum Physics II
- 3 - Arts and Humanities (Literature) Requirement ³
- 3 - Emphasis Area Requirement ⁴

15

122 Total Semester Hours

¹See General Education Requirements. Six of these credit hours must also satisfy the Cross-Cultural Awareness and Science and Technology in Society Requirements.
²Two semesters (through 102) in the same modern foreign language are required.
³Select from department-approved list of courses in astronomy, chemistry, computer science, engineering, environmental engineering, geology, mathematical sciences, and physics. Twelve credit hours in one of these areas, with at least six at the 300–400 level, are required. Note: Requirements 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.

### 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

15

**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 ¹

15

### Sophomore Year

**First Semester**
- 5 - BIOL 110 Principles of Biology
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II
- 1 - PHYS 224 Physics Lab. II
- 3 - Oral Communication Requirement ³

16

**Second Semester**
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 3 - PHYS 222 Physics with Calculus III
- 1 - PHYS 224 Physics Lab. III
- 4 - Foreign Language Requirement ²
- 3 - Social Science Requirement ¹

15

### 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 - Advanced Writing Requirement ¹
- 3 - Emphasis Area Requirement ¹

15

**Second Semester**
- 1 - PHYS 300 Introduction to Research
- 3 - PHYS 312 Methods of Theoretical Physics II
- 3 - PHYS 322 Mechanics II
- 3 - PHYS 326 Experimental Physics II
- 1 - PHYS 356 Modern Physics Overview
- 3 - PHYS 441 Electromagnetics I
- 3 - Emphasis Area Requirement ¹

17

### Senior Year

**First Semester**
- 3 - PHYS 401 Senior Thesis
- 3 - PHYS 442 Electromagnetics II
- 3 - PHYS 455 Quantum Physics I
- 3 - Emphasis Area Requirement ¹
- 3 - Science Requirement ⁴

15

**Second Semester**
- 3 - HIST 172 or 173 Western Civilization
- 3 - PHYS 456 Quantum Physics II
- 3 - Arts and Humanities (Literature) Requirement ³
- 3 - Emphasis Area Requirement ⁴

15

122 Total Semester Hours

¹See General Education Requirements. Six of these credit hours must also satisfy the Cross-Cultural Awareness and Science and Technology in Society Requirements.
²Two semesters (through 102) in the same modern foreign language are required.
³Select from department-approved list of courses in astronomy, chemistry, computer science, engineering, environmental engineering, geology, mathematical sciences, and physics. Twelve credit hours in one of these areas, with at least six at the 300–400 level, are required. Note: Requirements 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.
Second Semester
1 - PHYS 300 Introduction to Research
3 - PHYS 312 Methods of Theoretical Physics II
3 - PHYS 322 Mechanics II
1 - PHYS 356 Modern Physics Overview
3 - MTHSC 441 Electromagnetics I
1 - Biophysics Requirement
3 - Foreign Language Requirement
1 - PHYS 356 Modern Physics Overview
9

Senior Year
First Semester
3 - PHYS 442 Electromagnetics II
3 - PHYS 455 Quantum Physics I
3 - Advanced Writing Requirement
3 - Biophysics Requirement
3 - Physics Requirement
9

Second Semester
3 - HIST 172 or 173 Western Civilization
3 - PHYS 456 Quantum Physics II
3 - PHYS 465 Thermodynamics and Statistical Mechanics
3 - Arts and Humanities (Literature) Requirement
3 - Biophysics Requirement
9

125 Total Semester Hours

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
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
15

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
15

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
9
Second Semester
4 - MTHSC 205 Intro to Ordinary Diff. Equations
3 - PHYS 222 Physics with Calculus III
1 - PHYS 224 Physics Lab. III
4 - Foreign Language Requirement
3 - Social Science Requirement
15

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
15

Second Semester
1 - PHYS 300 Introduction to Research
3 - PHYS 312 Methods of Theoretical Physics II
3 - PHYS 322 Mechanics II
1 - PHYS 356 Modern Physics Overview
3 - MTHSC 441 Electromagnetics I
3 - Foreign Language Requirement
3 - Minor Requirement
17

Senior Year
First Semester
3 - PHYS 455 Quantum Physics I
3 - Advanced Writing Requirement
3 - Minor Requirement
3 - Physics Requirement
9

Second Semester
3 - HIST 172 or 173 Western Civilization
3 - Arts and Humanities (Literature) Requirement
3 - Minor Requirement
3 - Physics Requirement
3 - Elective
15

122 Total Semester Hours

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
14

POLYMER AND FIBER CHEMISTRY
Bachelor of Science
Freshman 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
3 - History Requirement
17

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
14

POLYMER AND FIBER CHEMISTRY AND TEXTILE MANAGEMENT
The School of Materials Science and Engineering offers undergraduate degrees in Ceramic and Materials Engineering, Polymer and Fiber Chemistry, and Textile Management.

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 polymeric 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.

Students majoring in Textile Management study the production, structure, and properties of natural and man-made fibers; the processes for converting these fibers into textile structures; the science of coloring agents and finishes to improve the desirability and serviceability of the product; and the methods for evaluating the performance of textile materials.

Graduates in Polymer and Fiber Chemistry and Textile Management 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.
<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>First Semester</td>
<td>3 - CH 223</td>
<td>Organic Chemistry</td>
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<td>1 - CH 227</td>
<td>Organic Chemistry Lab.</td>
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<td>4 - MTHSC 206</td>
<td>Calculus of Several Variables</td>
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<td>3 - PHYS 221</td>
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<td>1 - PHYS 223</td>
<td>Physics Lab. II</td>
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<td>3 - Arts and Humanities (Literature) Requirement*</td>
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<td><strong>Second Semester</strong></td>
<td>3 - CH 224</td>
<td>Organic Chemistry</td>
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<td>1 - CH 228</td>
<td>Organic Chemistry Lab.</td>
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<td>3 - ECON 200</td>
<td>Economics Concepts</td>
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<td>3 - EN SP 200</td>
<td>Intro. to Env. Science or</td>
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<td>3 - HIST 122</td>
<td>History, Tech., and Science or</td>
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<td>3 - HIST 124</td>
<td>Environmental History Survey</td>
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<td>1 - MUS&amp;E 251</td>
<td>Materials Science Portfolio I</td>
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<td>4 - MTHSC 208</td>
<td>Intro. to Ordinary Diff. Equations</td>
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<td><strong>Junior Year</strong></td>
<td>3 - CH 331</td>
<td>Physical Chemistry</td>
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<td>3 - ENGL 314</td>
<td>Technical Writing</td>
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<tr>
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<td>3 - FFC 415</td>
<td>Intro. to Polymer Science and Engr.</td>
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<td>1 - FFC 417</td>
<td>Polymer and Fiber Lab.</td>
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<tr>
<td></td>
<td>4 - TEXT 201</td>
<td>Yarn Structures and Formation</td>
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<td><strong>Senior Year</strong></td>
<td>3 - PFC 457</td>
<td>Dyeing and Finishing I</td>
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<td>1 - PFC 459</td>
<td>Dyeing and Finishing I Lab.</td>
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<td>3 - TEXT 421</td>
<td>Fiber Science</td>
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<td>3 - ACCT 202</td>
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<td>3 - FFC 301</td>
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<td><strong>Senior Year</strong></td>
<td>3 - TEXT 470</td>
<td>Textile Costing and Inventory</td>
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*See General Education Requirements. Three of these credit hours must also satisfy the Cross-Cultural Awareness Requirement. For students not selecting the CH 105/106 sequence, three of these credits must also satisfy the Science and Technology in Society Requirement. (Note: Three additional credit hours in social sciences or arts and humanities are required beyond the basic General Education Requirements.)

*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
Athletic Leadership
Biochemistry
Bioengineering
Biological Sciences
Business Administration
Chemistry
Cluster
Communication Studies
Community Recreation Management
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
Health Science
History
Horticulture
Human Resource Management
International Engineering and Science
Legal Studies
Management
Mathematical Sciences
Microbiology
Military Leadership
Modern Languages
Music
Natural Resource Economics
Nonprofit Leadership
Operations Management
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
Sport Management
Textiles — not open to Polymer and Fiber Chemistry or Textile Management majors
Theatre
Therapeutic Recreation
Travel and Tourism
Turfgrass
Urban Forestry
Wildlife and Fisheries Biology
Women’s Studies
Writing

See pages 35–38 for details.