

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 102.)

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/global.

ENGINEERING PROGRAMS

The 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 (ABET). The Biosystems Engineering program is administered jointly with the College of Agriculture, Forestry, and Life Sciences. The new BS in Bioengineering is designed to meet ABET requirements and will be submitted to ABET for accreditation review when eligible.

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

- apply knowledge of math, science, and engineering
- identify, formulate, and solve engineering problems
- design and conduct experiments and analyze data

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

Each engineering program has 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.clemson.edu/gef.

Freshman Curriculum

First Semester

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

Second Semester

- 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
 - 6-7 - Major Requirement²
-

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 curricula. 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, ME 453, etc.) are used in this calculation.

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

BIOENGINEERING

Bachelor of Science

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

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

Combined Bachelor's/Master's Plan

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

BIOELECTRICAL CONCENTRATION

Freshman Year

First Semester

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

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Second Semester

- 4 - CH 102 General Chemistry
- 3 - ENGR 141 Programming and Problem Solving
- 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

1 - Biology Requirement²

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Sophomore Year

First Semester

- 3 - BIO E 201 Intro. to Biomedical Engineering
- 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
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II

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Second Semester

- 3 - C M E 210 Introduction to Materials Science
- 1 - E C E 212 Electrical Engineering Lab. II
- 3 - E C E 262 Electric Circuits II
- 3 - E M 201 Engineering Mechanics: Statics
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations

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Junior Year

First Semester

- 4 - CH 201 Survey of Organic Chemistry³
- 1 - E C E 311 Electrical Engineering Lab. III
- 3 - E C E 320 Electronics I
- 3 - E C E 330 Signals, Systems, and Transforms
- 3 - E C E 380 Electromagnetics
- 3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹

17

Second Semester

- 3 - BIO E 302 Biomaterials
- 3 - BIO E 370 Bioinstrumentation and Bioimaging
- 3 - BIOCH 305 Essential Elements of Biochem.
- 6 - E C E Technical Requirement²

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Senior Year

First Semester

- 3 - BIO E 320 Biomechanics
- 4 - BIOSC 315 Functional Human Anatomy
- 3 - BIOSC 461 Cell Biology
- 2 - BIOSC 462 Cell Biology Lab.
- 3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹

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Second Semester

- 1 - BIO E 400 Senior Seminar
- 3 - BIO E 401 Biomedical Design
- 3 - BIO E 448 Tissue Engineering
- 3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹
- 6 - Bioengineering Technical Requirement²

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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.

²Select from department-approved list.

³Students planning to enter medical school should take CH 223/227 instead of CH 201 and take CH 224/228 as an additional course sequence.

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 a W, to complete successfully any E C E course.

BIOMATERIALS CONCENTRATION

Freshman Year

First Semester

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

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Second Semester

- 1 - BIO E 101 Biology for Bioengineers
- 4 - CH 102 General Chemistry
- 2 - ENGR 130 Engineering Fundamentals
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - PHYS 122 Physics with Calculus I
- 3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹

17

Sophomore Year

First Semester

- 3 - BIO E 201 Intro. to Biomedical Engineering
- 3 - C M E 210 Introduction to Materials Science
- 4 - CH 201 Survey of Organic Chemistry²
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II

17

Second Semester

- 3 - BIO E 302 Biomaterials
- 1 - C M E 241 Metrics Lab.
- 2 - E C E 307 Basic Electrical Engineering
- 1 - E C E 309 Electrical Engineering Lab. I
- 3 - E M 201 Engineering Mechanics: Statics
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹

17

Junior Year

First Semester

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

16

Second Semester

- 3 - BIOCH 305 Essential Elements of Biochem.
- 3 - C M E 422 Mechanical Behavior of Materials
- 3 - MTHSC 302 Statistics for Science and Engr.
- 3 - Bioengineering Technical Requirement³
- 3 - Arts and Humanities Requirement¹ or
- 3 - Social Science Requirement¹

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Senior Year**First Semester**

- 3 - BIO E 370 Bioinstrumentation and Bioimaging
- 3 - BIOSC 461 Cell Biology
- 2 - BIOSC 462 Cell Biology Lab.
- 3 - C M E 402 Solid State Materials
- 3 - C M E 413 Noncrystalline Materials
- 3 - PFC 415 Intro. to Polymer Science and Engr.

17

Second Semester

- 1 - BIO E 400 Senior Seminar
- 3 - BIO E 401 Biomedical Design
- 3 - BIO E 448 Tissue Engineering
- 3 - Arts and Humanities Requirement¹ or
- 3 - Social Science Requirement¹
- 3 - Bioengineering Technical Requirement³

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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.

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.

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.

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 84, 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/agbio-eng/bio/home.htm.

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 or Bioengineering as early as possible in their undergraduate program.

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 Requirement¹ or
- 3 - Social Science Requirement¹

16

Second Semester

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

16

Sophomore Year**First Semester**

- 2 - B E 210 Intro. to Biosystems Engineering
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II
- 4 - Biology Requirement²
- 3 - Statics Requirement²

16

Second Semester

- 2 - B E 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 Requirement²

17

Junior Year**First Semester**

- 3 - B E 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 Requirement²
- 4 - Organic Chemistry Requirement³

16

Second Semester

- 3 - B E 314 Biosystems Engr. Mechanical Design or
- 3 - M E 306 Fundamentals of Machine Design
- 3 - B E 412 Heat and Mass Transport in B E
- 4 - B E 415 Instrumentation and Control for Biosystems Engineers
- 3 - B E (CH E) 428 Biochemical Engineering
- 4 - Biochemistry Requirement⁴

17

Senior Year**First Semester**

- 3 - B E 414 Biosystems Engr. Unit Operations
- 3 - B E 438 Bioprocess Engineering Design
- 2 - B E 474 Biosystems Engr. Design/Project Mgt.
- 6 - Arts and Humanities Requirement¹ or
- 6 - Social Science Requirement¹
- 3 - Life Science Requirement⁵

17

Second Semester

- 3 - B E 435 Appl. in Biotechnology Engineering
- 2 - B E 475 Biosystems Engr. Capstone Design
- 3 - Arts and Humanities Requirement¹ or
- 3 - Social Science Requirement¹
- 3 - Engineering Requirement²
- 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 B E courses only when the following prerequisites have been completed with C or better: C E 206, 208, 341, CH E 220, 230, E M 201, 202, M E 201, 302, 310, MTHSC 206, 208, PHYS 221.

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

3. To complete premedicine requirements, students must take BIOL 104/106 or 111, CH 224, 228, and PHYS 124, 223 as additional courses.

NATURAL RESOURCES AND ENVIRONMENT CONCENTRATION

Freshman Year

First Semester

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

Second Semester

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

Sophomore Year

First Semester

- 2 - B E 210 Intro. to Biosystems Engineering
- 2 - B E 222 Geomeasurements
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II
- 4 - Biology Requirement²
- 3 - Statics Requirement²
- 18

Second Semester

- 2 - B E 212 Fundamentals of Biosystems Engr.
- 2 - E G 209 Intro. to Engr./Comp. Graphics
- 3 - M E 310 Thermodynamics and Heat Transfer
- 4 - MICRO 305 General Microbiology
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 2 - Dynamics Requirement²
- 17

Junior Year

First Semester

- 3 - B E 312 Biol. Kinetics and Reactor Modeling
- 4 - C E 321 Geotechnical Engineering *or*
- 4 - CSENV 202 Soils
- 4 - C E 341 Introduction to Fluid Mechanics
- 2 - E C E 307 Basic Electrical Engineering
- 3 - Mechanics of Materials Requirement²
- 16

Second Semester

- 3 - B E 314 Biosystems Engr. Mechanical Design *or*
- 3 - M E 306 Fundamentals of Machine Design
- 3 - B E 322 Small Watershed Hydrology and Sedimentology
- 3 - B E 412 Heat and Mass Transport in B E
- 4 - B E 415 Instrumentation and Control for B E
- 3 - Structural Design Requirement²
- 16

Senior Year

First Semester

- 3 - B E 414 Biosystems Engr. Unit Operations
- 3 - B E 464 Non-Point Source Management in Engineered Ecosystems
- 2 - B E 474 Biosystems Engr. Design/Project Mgt.
- 6 - Arts and Humanities Requirement¹ *or*
- 6 - Social Science Requirement¹
- 3 - Engineering Requirement²
- 17

Second Semester

- 2 - B E 421 Engineering Syst. for Soil Water Mgt.
- 2 - B E 475 Biosystems Engr. Capstone Design
- 3 - Arts and Humanities Requirement¹ *or*
- 3 - Social Science Requirement¹
- 3 - Engineering Requirement²
- 2 - Elective
- 12

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.

Notes:

1. Biosystems Engineering students are allowed to enroll in upper-level B E courses only when the following prerequisites have been completed with C or better: C E 206, 208, 341, CH E 220, 230, E M 201, 202, M E 201, 302, 310, MTHSC 206, 208, PHYS 221.
2. Students accepted to a combined BS/MS program must take 600-level instead of 400-level courses for Engineering Requirements.

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 traditional materials industries such as structural clay, foundry, or whiteware industries to the newer industries such as the semiconductor or aerospace industries. The broad career responsibilities of this discipline require competence in science, engineering, mathematics, and the social sciences. The curriculum develops skills in problem solving, engineering analysis, and design as well as oral and written communication.

The baccalaureate program integrates laboratory with classroom experiences to prepare students for 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 materials systems
- demonstrate an integrated understanding of the scientific and engineering principles underlying structure, properties, processing, and performance relationships
- apply this understanding to the solution of ceramic and materials engineering selection and design problems and
- apply appropriate experimental, statistical, and computational methods to advantage in the solution of ceramic and materials problems

Freshman Year

First Semester

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

Second Semester

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

Sophomore Year

First Semester

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

Second Semester

- 1 - C M E 241 Metrics Lab.
- 2 - E G 209 Intro. to Engr./Computer Graphics
- 3 - E M 201 Engineering Mechanics: Statics
- 3 - MS&E 324 Statistics for Materials Science and Engineering
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 3 - Arts and Humanities Requirement¹ *or*
- 3 - Social Science Requirement¹
- 16

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
-
- 15

Second Semester

- 3 - C M E 328 Phase Diagrams for Materials Processing and Applications
 - 2 - C M E 342 Structure/Property Lab.
 - 3 - C M E 361 Process. of Metals and Composites
 - 3 - C M E 422 Mechanical Behavior of Materials
 - 3 - I E 384 Engineering Economic Analysis
 - 3 - PFC 303 Textile Chemistry
-
- 17

Senior Year**First Semester**

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

Second Semester

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

125 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.

CHEMICAL ENGINEERING**Bachelor of Science**

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

Chemical engineering is based on chemistry, biology, physics, and mathematics. The curriculum at Clemson includes classroom and laboratory instruction and emphasizes broadly applicable fundamental principles and current technology to prepare graduates for professional practice and professional growth. Graduates will have careers characterized by success in chemical engineering practice, post-graduate education, or other areas such as medicine and law that make use of engineering skills; demonstrated success in the design of chemical processes and/or identification, formulation, and solution of

chemical engineering problems; ethical behavior in all endeavors; demonstrated effectiveness in teamwork, communication, and service to society through their professional contributions; demonstrated technical and/or managerial leadership; and demonstrated commitment to lifelong learning.

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

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

Freshman Year**First Semester**

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

Second Semester

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

Sophomore Year**First Semester**

- 3 - CH 223 Organic Chemistry
 - 4 - CH E 211 Intro. to Chemical Engineering
 - 4 - MTHSC 206 Calculus of Several Variables
 - 3 - PHYS 221 Physics with Calculus II
 - 3 - Arts and Humanities Requirement¹ or
 - 3 - Social Science Requirement¹
-
- 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 - E C E 307 Basic Electrical Engineering
 - 1 - E C E 309 Electrical Engineering Lab. I
 - 3 - Arts and Humanities Requirement¹ or
 - 3 - Social Science Requirement¹
 - 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 Requirement¹ or
 - 3 - Social Science Requirement¹
 - 3 - Emphasis Area Requirement³
-
- 17

Senior Year**First Semester**

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

Second Semester

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

127 Total Semester Hours

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

²BIOCH 301, 305, or 423

³See advisor for details. Nine credit hours devoted to completion of an emphasis area or approved minor are required. Emphasis areas are Applied Engineering, Mathematics, and Science; Biomolecular Science and Engineering; Business Management; Environmental Engineering; Polymeric Materials.

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

BIOMOLECULAR ENGINEERING CONCENTRATION**Freshman Year****First Semester**

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

Second Semester

- 4 - CH 102 General Chemistry
 - 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 Requirement¹ or
 - 3 - Social Science Requirement¹
-
- 17

Sophomore Year**First Semester**

- 3 - CH 223 Organic Chemistry
 - 4 - CH E 211 Intro. to Chemical Engineering
 - 4 - MTHSC 206 Calculus of Several Variables
 - 3 - PHYS 221 Physics with Calculus II
 - 3 - Arts and Humanities (Literature) Requirement²
-

Second Semester

- 3 - BIOCH 301 Molecular Biochemistry
 - 1 - BIOCH 302 Molecular Biochemistry Lab.
 - 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
-

Junior Year**First Semester**

- 3 - BIOL 103 General Biology I
 - 1 - BIOL 105 General Biology Lab. I
 - 3 - CH E 307 Unit Operations Lab. I
 - 3 - CH E 319 Engineering Materials
 - 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
 - 3 - Arts and Humanities Requirement¹ *or*
 - 3 - Social Science Requirement¹
-

17

Second Semester

- 3 - BIOCH 431 Physical Approach to Biochem.
 - 3 - CH E 321 Chemical Engr. Thermodynamics II
 - 4 - CH E 330 Mass Transfer and Separation Proc.
 - 3 - Arts and Humanities Requirement¹ *or*
 - 3 - Social Science Requirement¹
 - 3 - Engineering Requirement³
-

16

Senior Year**First Semester**

- 3 - BIO E 302 Biomaterials
 - 3 - BMOLE 403 Biotransport Phenomena
 - 3 - CH E 407 Unit Operations Lab. II
 - 3 - CH E 431 Chemical Process Design I
 - 1 - CH E 443 Chemical Engr. Senior Seminar I
 - 3 - CH E 450 Chemical Reaction Engineering
-

16

Second Semester

- 3 - CH E 353 Process Dynamics and Control
 - 3 - CH E 433 Process Design II
 - 1 - CH E 444 Chemical Engr. Senior Seminar II
 - 3 - MICRO 413 Industrial Microbiology
 - 3 - Arts and Humanities Requirement¹ *or*
 - 3 - Social Science Requirement¹
 - 3 - Engineering Requirement³
-

16

130 Total Semester Hours

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

²See General Education Requirements.

³B E (CH E) 428, BMOLE 423, 425, or 426

CIVIL ENGINEERING**Bachelor of Science**

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

The Bachelor of Science degree program in Civil Engineering includes the common educational goals listed on page 84 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 communication and team skills. Because a concerned society demands a realistic consideration of the impacts of engineering projects, civil engineering students are also educated in the broad areas of the humanities and social sciences.

The Department of Civil Engineering allows eligible students to count up to six hours of graduate credit (600- and 800-level courses) toward both the bachelor's and master's degrees. Students participating in this program must have completed the junior year, must have earned a minimum 3.4 grade-point ratio, and must be approved by the department. Details of the suggested curriculum and program information are available from the department.

Freshman Year**First Semester**

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

16

Second Semester

- 2 - ENGR 130 Engineering Fundamentals
 - 3 - GEOL 101 Physical Geology²
 - 1 - GEOL 103 Physical Geology Lab.²
 - 4 - MTHSC 108 Calculus of One Variable II
 - 3 - PHYS 122 Physics with Calculus I
 - 1 - PHYS 124 Physics Lab. I
 - 3 - Arts and Humanities Requirement¹ *or*
 - 3 - Social Science Requirement¹
-

17

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 Requirement¹ *or*
 - 3 - Social Science Requirement¹
-

16

Second Semester

- 4 - C E 206 Structural Mechanics
 - 2 - C E 208 Civil Engineering Dynamics
 - 3 - C E 255 Geomatics
 - 2 - C E 256 Economic Evaluation of Projects
 - 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
-

15

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
-

17

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
-

17

Senior Year**First Semester**

- 3 - C E 402 Reinforced Concrete Design
 - 3 - ENGL 314 Technical Writing
 - 6 - Technical Requirement³
 - 3 - Technical Requirement Restricted³
-

15

Second Semester

- 3 - C E 459 Capstone Design Project
 - 3 - Arts and Humanities Requirement¹ *or*
 - 3 - Social Science Requirement¹
 - 3 - Arts and Humanities (Literature) Requirement¹
 - 3 - Technical Requirement³
 - 3 - Elective
-

15

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.

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

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.

Note: Civil Engineering students may neither enroll in nor receive credit for any C E courses unless they have a 2.0 engineering grade-point ratio and a grade of C or better in course prerequisites that have a C E or E M designation. Exceptions: 1) Students may always re-enroll in C E courses which they have previously completed with a grade of C or lower. 2) Students need not have a C or better in 300-level C E courses to enroll in C E 459 (see course prerequisites).

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.

Freshman Year

First Semester

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

16

Second Semester

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

16

Sophomore Year

First Semester

- 3 - CP SC 111 Elementary Computer Programming in C/C++
- 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
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II

17

Second Semester

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

15

Junior Year

First Semester

- 3 - E C E 223 Computer Systems Engineering
- 1 - E C E 311 Electrical Engineering Lab. III
- 3 - E C E 320 Electronics I
- 3 - E C E 330 Signals, Systems, and Transforms
- 4 - E C E 371 Microcomputer Interfacing
- 3 - MTHSC 311 Linear Algebra

17

Second Semester

- 3 - E C E 317 Random Signal Analysis
- 3 - E C E 327 Digital Computer Design
- 3 - E C E 329 Computer Systems Structures
- 3 - E C E 352 Programming Systems
- 3 - MTHSC 419 Discrete Math. Structures I

15

Senior Year

First Semester

- 3 - COMM 150 Intro. to Human Comm. or
3 - COMM 250 Public Speaking
- 3 - ENGL 314 Technical Writing
- 9 - Computer Engineering Technical Requirement²

15

Second Semester

- 3 - E C E 453 Software Practicum
- 3 - Arts and Humanities (Literature) Requirement³
- 3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹
- 6 - Computer Engr. Depth Tech. Requirement²

15

126 Total Semester Hours

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

²Select from department-approved list.

³See General Education Requirements.

Notes:

1. 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.

2. All Computer Engineering students must have a cumulative engineering grade-point ratio of 2.0 to enroll in any 300- or 400-level E C E courses.

3. No student may exceed a maximum of two attempts, excluding a W, to complete successfully any E C E course.

ELECTRICAL ENGINEERING

Bachelor of Science

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

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

16

Second Semester

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

17

Sophomore Year

First Semester

- 3 - CP SC 111 Elementary Computer Programming in C/C++
- 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
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II

17

Second Semester

- 1 - E C E 212 Electrical Engineering Lab. II
 - 3 - E C E 262 Electric Circuits II
 - 4 - E C E 272 Computer Organization
 - 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
 - 3 - Arts and Humanities Requirement¹ or
 - 3 - Social Science Requirement¹ or
 - 3 - Technical Requirement^{2,3}
-

Junior Year**First Semester**

- 1 - E C E 311 Electrical Engineering Lab. III
 - 3 - E C E 320 Electronics I
 - 3 - E C E 330 Signals, Systems, and Transforms
 - 4 - E C E 371 Microcomputer Interfacing
 - 3 - E C E 380 Electromagnetics
 - 3 - Technical Requirement (Adv. Mathematics)⁴
-

Second Semester

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

Senior Year**First Semester**

- 3 - COMM 150 Intro. to Human Comm. or
 - 3 - COMM 250 Public Speaking
 - 3 - E C E 409 Continuous and Discrete Syst. Des.
 - 3 - E C E 427 Communications Systems
 - 2 - E C E 495 Integrated Systems Design I
 - 3 - Technical Requirement (E C E)³
-

Second Semester

- 2 - E C E 496 Integrated System Design II
 - 6 - Arts and Humanities Requirement¹ or
 - 6 - Social Science Requirement¹
 - 3 - Arts and Humanities Requirement¹ or
 - 3 - Social Science Requirement¹ or
 - 3 - Technical Requirement (E C E)³
 - 3 - Technical Requirement Depth (E C E)³
-

126 Total Semester Hours

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

²Students may enroll in E C E 222 for a common semester with Computer Engineering. Those not selecting this option should complete the Technical Requirement (E C E) in the senior year.

³Select from department-approved list.

⁴MTHSC 434, 435, 453, or 454

Notes:

1. 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.
2. All Electrical Engineering students must have a cumulative engineering grade-point ratio of 2.0 to enroll in any 300- or 400-level E C E courses.
3. No student may exceed a maximum of two attempts, excluding a W, to complete successfully any E C E course.

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 the principles and techniques of industrial engineering analysis and design supported by a foundation in mathematical, physical, and social sciences, and economic, operational, and engineering analyses. Graduates 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 arenas for the practice of industrial engineering are the manufacturing facilities of industry; however, many practicing industrial engineers are employed in non-manufacturing institutions such as hospitals, banks, and government agencies. In addition to numerous employment opportunities in professional practice, industrial engineering graduates may further their formal education. The Department of Industrial Engineering offers programs leading to the Master of Science and Doctor of Philosophy degrees.

The Department of Industrial Engineering allows students to count up to 12 hours of graduate credit (approved 600- and 800-level courses) toward both the bachelor's and master's degrees. Students participating in this program must have a minimum grade-point ratio of 3.4 and be admitted to the Graduate School prior to registering for graduate courses. Details of the suggested curriculum and program information are available from the Industrial Engineering Department.

Detailed curriculum and department information is available at www.ces.clemson.edu/ie.

Freshman Year**First Semester**

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

Second Semester

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

16

Sophomore Year**First Semester**

- 3 - CP SC 161 Intro. to Visual Basic Program. or
 - 3 - I E 220 Design of Info. Systems in I E
 - 2 - E G 208 Engineering Graphics with Computer Applications or
 - 2 - E G 209 Intro. to Engr./Comp. Graphics
 - 4 - I E 201 System Design I
 - 4 - MTHSC 206 Calculus of Several Variables
 - 3 - PHYS 221 Physics with Calculus II
 - 1 - PHYS 223 Physics Lab. II²
-

Second Semester

- 3 - C M E 210 Introduction to Materials Science
 - 3 - E M 201 Engineering Mechanics: Statics
 - 3 - I E 210 Design and Analysis of Work Systems
 - 1 - I E 268 Creative Inquiry Seminar in I E
 - 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 - I E 360 Ind. Appl. of Probability and Statistics
 - 3 - I E 440 Decision Support Systems in I E
 - 3 - I E 465 Facilities Planning and Design
 - 3 - Arts and Humanities Requirement¹ or
 - 3 - Social Science Requirement¹
-

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 Requirement³
-

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 Requirement³
 - 3 - Technical Requirement³
-

Second Semester

- 3 - I E 467 Systems Design II
 - 1 - I E 469 Creative Inquiry Symposium in Industrial Engineering
 - 3 - MGT 201 Principles of Management
 - 6 - Arts and Humanities Requirement¹ or
 - 6 - Social Science Requirement¹
 - 3 - Technical Requirement³
-

128 Total Semester Hours

¹See policy on Humanities and Social Sciences for Engineering curricula. HIST 122 and PO SC 102 must be included.

²PHYS 124 may be substituted

³Select 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.

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

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

Freshman Year

First Semester

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

16

Second Semester

- 2 - E G 208 Engineering Graphics with Computer Applications
- 3 - ENGR 141 Programming and Problem Solving
- 4 - MTHSC 108 Calculus of One Variable II
- 3 - PHYS 122 Physics with Calculus I
- 1 - PHYS 124 Physics Lab. I
- 3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹

16

Sophomore Year

First Semester

- 5 - M E 201 Statics and Dynamics for Mech. Engr.
 - 2 - M E 222 Mechanical Engineering Lab. I
 - 4 - MTHSC 206 Calculus of Several Variables
 - 3 - PHYS 221 Physics with Calculus II
 - 3-5 - Science Requirement²
- 17-19

Second Semester

- 2 - E C E 307 Basic Electrical Engineering
 - 1 - E C E 309 Electrical Engineering Lab. I
 - 3 - M E 202 Foundations of Mechanical Systems
 - 3 - M E 203 Found. of Thermal and Fluid Systems
 - 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
 - 3 - Numerical Analysis Requirement²
- 16

Junior Year

First Semester

- 3 - M E 302 Mechanics of Materials
 - 3 - M E 303 Thermodynamics
 - 3 - M E 305 Model. and Analysis of Dynamic Syst.
 - 3 - M E 308 Fluid Mechanics
 - 2 - M E 333 Mechanical Engineering Lab. II
 - 3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹
- 17

Second Semester

- 3 - M E 304 Heat Transfer
 - 3 - M E 306 Fundamentals of Machine Design
 - 3 - M E 312 Manufacturing Proc. and Their Appl.
 - 3 - Advanced Writing Requirement²
 - 3 - Statistics Requirement²
- 15

Senior Year

First Semester

- 3 - M E 401 Mechanical Engineering Design
 - 3 - M E 403 Control and Integration of Multi-Domain Dynamic Systems
 - 2 - M E 444 Mechanical Engineering Lab. III
 - 6 - Technical Requirement²
- 14

Second Semester

- 1 - M E 400 Senior Seminar
 - 3 - M E 402 Internship in Engineering Design
 - 6 - Arts and Humanities Requirement¹ or
6 - Social Science Requirement¹
 - 3 - Technical Requirement²
- 13

124–126 Total Semester Hours

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

²See advisor. Select from department-approved list.

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 from those listed on page 102. 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 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
1 - PHYS 223 Physics Lab. II
4 - Foreign Language Requirement²
16

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
15

Junior Year

First Semester

3 - BIOCH 301 Molecular Biochemistry or
3 - BIOCH 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
15

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) Requirement¹
3 - Elective
15

Senior Year

First Semester

3 - CH 402 Inorganic Chemistry
2 - CH 403 Advanced Synthetic Techniques
3 - CH 443 Research Problems
3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹
3 - Chemistry Requirement³
14

Second Semester

3 - CH 444 Research Problems
3 - CH 450 Chemistry Capstone
1 - CH 452 Chemistry Communication II
3 - Arts and Humanities Requirement¹ or
3 - Social Science Requirement¹
3 - Chemistry Requirement³
3 - Elective
16

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.

²One semester (through 102) in any modern foreign language is required.

³See 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 Requirement³
6 - Minor Requirement
13

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.

²Four semesters (through 202) of the same modern foreign language are required.

³See 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 Requirement^{1,2}
- 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.) Requirement^{1,2}
 - 3 - Social Science Requirement^{1,2}
- 17

Sophomore Year**First Semester**

- 4 - CP SC 212 Algorithms and Data Structures
 - 3 - Arts and Humanities (Literature) Requirement¹
 - 3 - Humanities or Social Science Requirement^{2,3}
 - 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 II⁵
 - 3 - Advanced Writing Requirement¹
 - 3 - Business Requirement⁶
 - 3 - Computer Science Requirement⁷
 - 3 - Information Systems Requirement⁸
- 16

Second Semester

- 3 - MGT 312 Decision Models for Management
 - 3 - MKT 301 Principles of Marketing
 - 3 - Business Requirement⁶
 - 3 - Computer Science Requirement⁷
 - 1 - Elective
- 13

122 Total Semester Hours

¹See General Education Requirements.²Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.³Select 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.⁴Select from one of the following sequences: BIOL 103/105, 104/106; 110, 111; CH 101, 102; 105, 106; PHYS 122/124, 221/223; 207/209, 208/210.⁵CP SC H395 may be substituted.⁶FIN 306, MGT 390, or 400⁷Select from 300–400-level CP SC courses.⁸MGT 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.

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 Requirement¹
- 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
 - 3 - Social Science Requirement¹
- 17

Sophomore Year**First Semester**

- 4 - CP SC 212 Algorithms and Data Structures
 - 3 - PHYS 122 Physics with Calculus I
 - 3 - Arts and Humanities Requirement² *or*
 - 3 - Social Science Requirement²
 - 3 - Arts and Humanities (Literature) Requirement¹
 - 3 - Oral Communication Requirement¹
- 16

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*
 - 3 - MTHSC 302 Stats. for Science and Engr.
 - 3 - PHYS 221 Physics with Calculus II
- 14

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 Requirement³
- 16

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 Requirement⁴
 - 4 - Natural Science Requirement³
- 16

Senior Year**First Semester**

- 3 - CP SC 428 Design and Implementation of Programming Languages
 - 3 - Advanced Writing Requirement¹
 - 3 - Computer Science Requirement⁵
 - 3 - Emphasis Area Requirement⁴
 - 3 - Elective
- 15

Second Semester

- 1 - CP SC 491 Seminar in Professional Issues II⁶
 - 3 - Arts and Humanities Requirement¹ *or*
 - 3 - Social Science Requirement¹
 - 3 - Computer Science Requirement⁵
 - 3 - Emphasis Area Requirement⁴
 - 4 - Elective
- 14

122 Total Semester Hours

¹See 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.

²Select 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.

³Two-semester sequence in the same physical or biological science, each including a laboratory is required. Select from BIOL 103/105, 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, BIOSC, CH, GEOL, MICRO, PHYS, or EN SP 200.

⁴Select nine hours from any single University approved minor.

At least three hours must be at the 300 level or above.

⁵Select from 400-level CP SC courses. At least three hours must be selected from CP SC 405, 411, 462, 472.

⁶CP SC H395 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.

COMPUTER SCIENCE

Bachelor of Arts

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

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

Freshman Year

First Semester

- 4 - CP SC 101 Computer Science I
 - 3 - ENGL 103 Accelerated Composition
 - 4 - MTHSC 106 Calculus of One Variable I
 - 4 - Foreign Language Requirement¹
- 15

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 Requirement¹
- 15

Sophomore Year

First Semester

- 4 - CP SC 212 Algorithms and Data Structures
 - 3 - Arts and Humanities (Literature) Requirement²
 - 3 - Foreign Language Requirement¹
 - 4 - Natural Science Requirement³
 - 3 - Oral Communication Requirement²
- 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 - Foreign Language Requirement¹
 - 4 - Natural Science Requirement³
- 15

Junior Year

First Semester

- 6 - Computer Science Requirement⁴
 - 3 - Mathematical Sciences Requirement⁵
 - 3 - Minor Requirement
 - 3 - Social Science Requirement^{2,6}
- 15

Second Semester

- 3 - Advanced Writing Requirement²
 - 3 - Arts and Humanities (Non-Lit.) Requirement^{2,6}
 - 3 - Computer Science Requirement⁴
 - 6 - Minor Requirement
- 15

Senior Year

First Semester

- 6 - Computer Science Requirement⁴
 - 3 - Departmental Humanities Requirement^{6,7}
 - 3 - Minor Requirement
 - 3 - Social Science Requirement^{2,6}
- 15

Second Semester

- 1 - CP SC 491 Seminar in Professional Issues II⁸
 - 3 - Computer Science Requirement⁴
 - 3 - Fine Arts Requirement⁹
 - 3 - Minor Requirement
 - 5 - Elective
- 15

122 Total Semester Hours

⁴Four semesters (through 202) in the same modern foreign language are required.

²See General Education Requirements.

³Eight credit hours, including labs, in the same science selected from BIOL 103/105, 104/106; 110, 111; CH 101, 102; 105, 106; GEOL 101, 103; 102 or 112, 114; PHYS 122/124, 221/223; 207/209, 208/210

⁴Select from CP SC courses numbered 300 or higher.

⁵MTHSC 301, 302, or 311

⁶Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.

⁷Select from courses in A A H, ANTH, ART, CHIN, DANCE, ENGL, FR, GER, HUM, ITAL, JAPN, MUSIC, P A, PHIL, REL, RUSS, SPAN, THEA.

⁸CP SC H395 may be substituted.

⁹MUSIC 210 or any course in A A H, ART, or THEA

Notes:

1. For graduation, a candidate for the BA degree in Computer Science must have earned a grade of C or better in each CP SC course applied to the degree.

2. A grade of C or better must be earned in all prerequisite courses (including CP SC and MTHSC courses) before enrolling in the next CP SC course.

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 - MTHSC 108 Calculus of One Variable II
 - 3 - Arts and Humanities (Non-Lit.) Requirement¹
- 15

Sophomore Year

First Semester

- 3 - BIOL 103 General Biology I
 - 1 - BIOL 105 General Biology Lab. I
 - 3 - GEOL 205 Mineralogy and Intro. Petrology
 - 2 - GEOL 208 Min. and Intro. Petrography Lab.
 - 4 - GEOL 211 Geoanalysis I²
 - 1 - GEOL 291 Introduction to Research I
 - 1 - Elective
- 15

Second Semester

4 - CSENV 202 Soils
 4 - GEOL 212 Geoanalysis II²
 1 - GEOL 292 Introduction to Research II
 3 - PHYS 122 Physics with Calculus I
 3 - Social Science Requirement¹
 15

Junior Year**First Semester**

3 - EN SP 200 Intro. to Environmental Science
 4 - GEOL 302 Structural Geology
 3 - GEOL 316 Igneous and Metamorphic Petrol.
 1 - GEOL 391 Research Methods I
 3 - Arts and Humanities (Literature) Requirement¹
 14

Second Semester

3 - GEOL 300 Environmental Geology
 4 - GEOL 313 Sedimentology and Stratigraphy
 1 - GEOL 392 Research Methods II
 3 - Geology Requirement³
 3 - Social Science Requirement¹
 2 - Elective
 16

Summer

6 - Summer Geology Field Course⁴

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 Requirement³
 1 - Elective
 12

121 Total Semester Hours

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

²MTHSC 206 and 208 or 301 or EX ST 301 may be substituted.

³Select from department-approved list.

⁴See advisor.

**ENVIRONMENTAL SCIENCE
CONCENTRATION****Freshman Year****First Semester**

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

Second Semester

4 - CH 102 General Chemistry
 4 - GEOL 102 Earth History
 4 - MTHSC 108 Calculus of One Variable II
 3 - Arts and Humanities (Non-Lit.) Requirement¹
 15

Sophomore Year**First Semester**

3 - BIOL 103 General Biology I
 1 - BIOL 105 General Biology Lab. I
 3 - GEOL 205 Mineralogy and Intro. Petrology
 1 - GEOL 207 Mineral. and Intro. Petrology Lab.
 4 - GEOL 211 Geoanalysis I²
 1 - GEOL 291 Introduction to Research I
 3 - Arts and Humanities (Literature) Requirement¹
 16

Second Semester

3 - BIOL 104 General Biology II
 1 - BIOL 106 General Biology Lab. II
 4 - GEOL 212 Geoanalysis II²
 1 - GEOL 292 Introduction to Research II
 3 - GEOL 300 Environmental Geology
 3 - PHYS 122 Physics with Calculus I
 15

Junior Year**First Semester**

3 - EN SP 200 Intro. to Environmental Science
 1 - GEOL 391 Research Methods I
 9 - Environmental Science Requirement³
 3 - Social Science Requirement¹
 16

Second Semester

3 - GEOL 318 Introduction to Geochemistry
 1 - GEOL 392 Research Methods II
 9 - Environmental Science Requirement³
 3 - Social Science Requirement¹
 16

Summer

3 - Field Experience⁴

Senior Year**First Semester**

3 - EN SP 400 Studies in Environmental Science
 3 - GEOL 408 Geohydrology
 4 - GEOL 491 Research Synthesis I
 3 - Environmental Science Requirement³
 13

Second Semester

3 - CH 223 Organic Chemistry or
 3 - CH 413 Chemistry of Aqueous Systems
 4 - GEOL 492 Research Synthesis II
 6 - Environmental Science Requirement³
 13

122 Total Semester Hours

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

²MTHSC 206 and 208 or 301 or EX ST 301 may substitute.

³Select from department-approved list. At least three credit hours must be from geology courses.

⁴Field course in geology, ecology, or related area. Must be at least three credits. Students desiring to become registered professional geologists should take a six-credit summer geology field course.

**HYDROGEOLOGY
CONCENTRATION****Freshman Year****First Semester**

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

Second Semester

4 - CH 102 General Chemistry
 4 - GEOL 102 Earth History
 4 - MTHSC 108 Calculus of One Variable II
 3 - Arts and Humanities (Non-Lit.) Requirement¹
 15

Sophomore Year**First Semester**

3 - GEOL 205 Mineralogy and Intro. Petrology
 1 - GEOL 207 Mineral. and Intro. Petrology Lab.
 4 - GEOL 211 Geoanalysis I²
 1 - GEOL 291 Introduction to Research I
 3 - Arts and Humanities (Literature) Requirement¹
 3 - Technical Requirement³
 15

Second Semester

4 - GEOL 212 Geoanalysis II²
 1 - GEOL 292 Introduction to Research II
 3 - GEOL 300 Environmental Geology
 3 - PHYS 122 Physics with Calculus I
 1 - PHYS 124 Physics Lab. I
 3 - Social Science Requirement¹
 15

Junior Year**First Semester**

4 - GEOL 302 Structural Geology
 1 - GEOL 391 Research Methods I
 3 - GEOL 408 Geohydrology
 3 - PHYS 221 Physics with Calculus II
 3 - Geology Requirement⁴
 14

Second Semester

4 - GEOL 313 Sedimentology and Stratigraphy
 3 - GEOL 318 Introduction to Geochemistry
 1 - GEOL 392 Research Methods II
 3 - Social Science Requirement¹
 3 - Technical Requirement³
 14

Summer

6 - GEOL 475 Summer Geology Field Camp

Senior Year**First Semester**

3 - GEOL 421 GIS Applications in Geology
 4 - GEOL 491 Research Synthesis I
 3 - Geology Requirement⁴
 3 - Technical Requirement³
 13

Second Semester

3 - EE&S 401 Environmental Engineering
 4 - GEOL 409 Subsurface Methods
 4 - GEOL 492 Research Synthesis II
 3 - Technical Requirement³
 14

121 Total Semester Hours

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

²MTHSC 206 and 208 or 301 or EX ST 301 substitute.

³Select from department-approved list.

⁴Any 300- or 400-level geology course

GEOLOGY**Bachelor of Arts****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.
 3 - Mathematics Requirement¹
 14

Second Semester

4 - CH 102 General Chemistry
 3 - GEOG 103 World Regional Geography
 4 - GEOL 102 Earth History
 3 - Mathematics Requirement¹
 2 - Elective
 16

Sophomore Year**First Semester**

3 - BIOL 103 General Biology
 1 - BIOL 105 General Biology Lab. I
 3 - GEOL 205 Mineralogy and Intro. Petrology
 1 - GEOL 207 Mineral. and Intro. Petrology Lab.
 1 - GEOL 291 Introduction to Research I
 3 - Arts and Humanities (Non-Lit.) Requirement²
 4 - Foreign Language Requirement³
 16

Second Semester

3 - BIOL 104 General Biology II
 1 - BIOL 106 General Biology Lab. II
 1 - GEOL 292 Introduction to Research II
 3 - GEOL 300 Environmental Geology
 4 - Foreign Language Requirement³
 3 - Minor Requirement⁴
 15

Junior Year**First Semester**

1 - GEOL 391 Research Methods I
 3 - Foreign Language Requirement³
 3 - Geology Requirement³
 3 - Minor Requirement⁴
 3 - Social Science Requirement²
 3 - Technical Requirement⁶
 16

Second Semester

1 - GEOL 392 Research Methods II
 3 - Foreign Language Requirement³
 3 - Geology Requirement⁵
 3 - Minor Requirement⁴
 6 - Elective
 16

Senior Year**First Semester**

4 - GEOL 491 Research Synthesis I
 3 - Arts and Humanities (Literature) Requirement²
 3 - Minor Requirement⁴
 3 - Elective
 13

Second Semester

4 - GEOL 492 Research Synthesis II
 3 - Minor Requirement⁴
 3 - Technical Requirement⁶
 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 300- 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, intern experience, etc.) and an oral or poster presentation by each student.

Combined Bachelor's/Master's Plan

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

Freshman Year**First Semester**

3 - ECON 211 Principles of Microeconomics
 3 - ENGL 103 Accelerated Composition
 4 - MTHSC 106 Calculus of One Variable I
 3 - Arts and Humanities (Non-Lit.) Requirement¹
 3 - Foreign Language Requirement²
 16

Second Semester

4 - MTHSC 108 Calculus of One Variable II
 3 - MTHSC 129 Prob. Solving in Discrete Math.
 3 - PHYS 122 Physics with Calculus I
 3 - Computer Science Requirement³
 3 - Social Science Requirement¹
 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 Requirement⁴
 15

Second Semester

4 - MTHSC 208 Intro. to Ordinary Diff. Equations
 3 - MTHSC 302 Statistics for Science and Engr.
 3 - Arts and Humanities (Literature) Requirement¹
 4 - Natural Science Requirement⁴
 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
 3 - Science Requirement⁵
 15

Second Semester

3 - MTHSC 412 Introduction to Modern Algebra
 3 - MTHSC 454 Advanced Calculus II
 3 - Emphasis Area Requirement⁶
 3 - Science Requirement⁵
 3 - Elective
 15

Senior Year**First Semester**

3 - COMM 250 Public Speaking
 3 - Capstone Experience⁷
 6 - Emphasis Area Requirement⁶
 3 - Science and Tech. in Society Requirement¹
 15

Second Semester

1 - MTHSC 492 Professional Development
 3 - Capstone Experience⁷
 3 - Emphasis Area Requirement⁶
 3 - Mathematical Sciences Requirement⁸
 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

³CPSC 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.

⁶Select from Abstract Mathematics, Actuarial Science/Financial Mathematics, Applied and Computational Mathematics, Computer Science, Operations Research/Management Science, or Statistics.

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 Mathematics¹**

6 - Abstract Mathematics Requirement²
 6 - Mathematical Sciences Requirement³
 12

Actuarial Science/Financial Mathematics⁴

3 - FIN 312 Financial Management II
 3 - MTHSC 403 Intro. to Statistical Theory
 3 - MTHSC 407 Regress. and Time-Ser. Analysis
 3 - MTHSC 431 Theory of Interest
 12

Applied and Computational Mathematics

3 - MTHSC 434 Advanced Engineering Math.
 3 - MTHSC 460 Intro. to Numerical Analysis I
 6 - Applications Area¹
 12

Computer Science

3 - CP SC 215 Tools and Tech. for Software Dev.
 9 - Computer Science 300-Level Requirement⁵
 12

Operations Research/Management Science

3 - IE 384 Engineering Economic Analysis *or*
 4 - IE 482 Systems Modeling
 3 - MGT 402 Operations Planning and Control
 3 - MTHSC 407 Regress. and Time-Ser. Analysis
 3 - MTHSC 441 Intro. to Stochastic Models
 12-13

Statistics

3 - MTHSC 403 Intro. to Statistical Theory
 3 - MTHSC 405 Statistical Theory and Meth. II
 3 - MTHSC 406 Sampling Theory and Methods
 3 - MTHSC 407 Regress. and Time-Ser. Analysis
 12

¹See advisor.

²MTHSC 408, 410, 419, or 435

³Any 400-level MTHSC course

⁴See advisor. Students are advised to take ACCT 204, ECON 211, FIN 311, MTHSC 430, 432 as electives and FIN 405, MTHSC 441 as capstone experience.

⁵Any 300–400-level CP SC course

BIOLOGY CONCENTRATION**Freshman Year****First Semester**

5 - BIOL 110 Principles of Biology I
 3 - ENGL 103 Accelerated Composition
 4 - MTHSC 106 Calculus of One Variable I
 3 - Foreign Language Requirement¹
 15

Second Semester

5 - BIOL 111 Principles of Biology II
 4 - MTHSC 108 Calculus of One Variable II
 3 - MTHSC 129 Prob. Solving in Discrete Math.
 3 - Computer Science Requirement²
 15

Sophomore Year**First Semester**

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

Second Semester

4 - CH 102 General Chemistry
 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
 3 - MTHSC 311 Linear Algebra
 3 - PHYS 208 General Physics II
 1 - PHYS 210 General Physics II Lab.
 15

Junior Year**First Semester**

3 - CH 223 Organic Chemistry
 1 - CH 227 Organic Chemistry Lab.
 3 - ENGL 314 Technical Writing
 3 - MTHSC 360 Intermediate Math. Computing
 3 - MTHSC 440 Linear Programming
 3 - Arts and Humanities (Literature) Requirement³
 16

Second Semester

3 - CH 224 Organic Chemistry
 1 - CH 228 Organic Chemistry Lab.
 3 - COMM 250 Public Speaking
 3 - MTHSC 302 Statistics for Science and Engr.
 3 - Arts and Humanities (Non-Lit.) Requirement³
 3 - Math Science Requirement⁴
 16

Senior Year**First Semester**

3 - MTHSC 400 Theory of Probability
 3 - MTHSC 453 Advanced Calculus I *or*
 3 - MTHSC 463 Mathematical Analysis I
 3 - Animal or Plant Diversity Requirement⁵
 3 - Capstone Experience⁶
 3 - Social Science Requirement³
 15

Second Semester

3 - MTHSC 412 Introduction to Modern Algebra
 3 - MTHSC 454 Advanced Calculus II
 1 - MTHSC 492 Professional Development
 3 - Biological Sciences Requirement⁷
 3 - Capstone Experience⁶
 13

121 Total Semester Hours

¹Three credits in any foreign language, including American Sign Language, numbered 102 or above

²CP SC 101, 111, or 120

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

⁴Any 400-level MTHSC course approved by advisor

⁵BIOSC 302, 303, 304, or 305

⁶May 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 advisor.

⁷BIOCH 301, GEN 302/303, MICRO 305, or any 300–400-level BIOSC course

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.

MATHEMATICAL SCIENCES**Bachelor of Arts****Freshman Year****First Semester**

3 - ECON 200 Economic Concepts *or*
 3 - ECON 211 Principles of Microeconomics
 3 - ENGL 103 Accelerated Composition
 4 - MTHSC 106 Calculus of One Variable I
 3 - Foreign Language Requirement¹
 1 - Elective
 14

Second Semester

- 4 - MTHSC 108 Calculus of One Variable II
- 3 - MTHSC 129 Prob. Solving in Discrete Math.
- 3 - Computer Science Requirement²
- 3 - Foreign Language Requirement¹
- 3 - Social Science Requirement³

16

Sophomore Year**First Semester**

- 4 - MTHSC 206 Calculus of Several Variables
- 1 - MTHSC 250 Intro. to Mathematical Sciences
- 3 - MTHSC 360 Intermed. Math. Computing or
3 - EDSEC 437 Technology in Sec. Math.
- 3 - Arts and Humanities (Literature) Requirement³
- 3 - Elective

14

Second Semester

- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations
- 3 - MTHSC 302 Statistics for Science and Engr.
- 3 - MTHSC 311 Linear Algebra
- 3 - Arts and Humanities (Non-Lit.) Requirement³
- 3 - Minor Requirement⁴ or
3 - Second Major Requirement

16

Junior Year**First Semester**

- 3 - ENGL 314 Technical Writing
- 3 - MTHSC 412 Introduction to Modern Algebra
- 3 - Math Science Requirement⁵
- 4 - Natural Science Requirement³
- 3 - Elective

16

Second Semester

- 3 - COMM 250 Public Speaking
- 3 - Math Science Requirement⁵
- 3 - Minor Requirement⁴ or
3 - Second Major Requirement
- 4 - Natural Science Requirement³
- 3 - Elective

16

Senior Year**First Semester**

- 3 - MTHSC 453 Advanced Calculus I
- 3 - Arts and Humanities Requirement³ or
3 - Education Requirement⁶
- 3 - Capstone Experience⁷
- 3 - Minor Requirement⁴ or
3 - Second Major Requirement
- 3 - Science and Tech. in Society Requirement³

15

Second Semester

- 1 - MTHSC 492 Professional Development
- 3 - Capstone Experience⁷
- 3 - Math Science Requirement⁵
- 6 - Minor Requirement⁴ or
6 - Second Major Requirement
- 2 - Elective

15

122 Total Semester Hours

¹Six credits in any foreign language, including American Sign Language, numbered 200 or above²CP SC 101, 111, or 120³See General Education Requirements. Three of these credit hours must also satisfy the Cross-Cultural Awareness Requirement.⁴See page 102 for approved minors.⁵MTHSC 308 or any 400-level MTHSC course⁶See advisor.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; (3) completion of three credits of MTHSC 450 and three credits of an additional course approved by advisor; or (4) EDSEC 446 for students seeking a double major in Secondary Education–Mathematics.**Notes:**

1. For graduation, a candidate for the BA 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.

PHYSICS**Bachelor of Science**

Physics, the most fundamental of the natural sciences, forms the basis of study upon which the other branches of science are founded. Physics is concerned with the fundamental behavior of matter and energy. Classical physics encompasses the fields of mechanics, heat and thermodynamics, electricity and magnetism, acoustics and optics. Modern physics is concerned with the study of atoms and molecules, atomic nuclei, elementary particles and the properties of liquids, crystalline solids, and other materials, as well as the areas of relativity, cosmology, and the large-scale structure of the universe.

The undergraduate Physics curricula provide students with a strong background in the classical areas of physics as well as an introduction into the more important aspects of modern physics. The BS curriculum is directed toward preparing students for graduate study ultimately leading to the PhD degree or toward research and development work in industrial or governmental laboratories. It also provides a good background for graduate study or industrial work in many areas or engineering physics and applied science.

Freshman Year**First Semester**

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

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.) Requirement¹

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 Requirement²
- 3 - Oral Communication Requirement¹

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 Requirement²
- 3 - Social Science Requirement¹

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 Requirement¹
- 3 - Emphasis Area Requirement³

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 Requirement³

17

Senior Year**First Semester**

- 3 - PHYS 401 Senior Thesis
- 3 - PHYS 442 Electromagnetics II
- 3 - PHYS 455 Quantum Physics I
- 3 - Emphasis Area Requirement³
- 3 - Science Requirement⁴

15

Second Semester

- 3 - HIST 172 The West and the World I or
3 - HIST 173 The West and the World II
- 3 - PHYS 456 Quantum Physics II
- 3 - PHYS 465 Thermodynamics and Statistical Mechanics
- 3 - Arts and Humanities (Literature) Requirement⁵
- 3 - Emphasis Area Requirement³

15

122 Total Semester Hours¹See General Education Requirements. Six of these credit hours must also satisfy the Science and Technology in Society Requirement and, if HIST 173 is not selected, the Cross-Cultural Awareness Requirement.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 course⁵Select 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.) Requirement¹
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 223 Physics Lab. II
3 - Oral Communication Requirement¹
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 - Biophysics Requirement²
3 - Social Science Requirement¹
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 - Biophysics Requirement²
4 - Foreign Language Requirement³
16

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 - PHYS 441 Electromagnetics I
3 - Biophysics Requirement²
4 - Foreign Language Requirement³
18

Senior Year**First Semester**

3 - PHYS 442 Electromagnetics II
3 - PHYS 455 Quantum Physics I
3 - Advanced Writing Requirement¹
3 - Biophysics Requirement²
3 - Science Requirement⁴
15

Second Semester

3 - HIST 172 The West and the World I *or*
3 - HIST 173 The West and the World II
3 - PHYS 456 Quantum Physics II
3 - PHYS 465 Thermodynamics and Statistical
Mechanics⁵
3 - Arts and Humanities (Literature) Requirement⁶
3 - Biophysics Requirement²
15

125 Total Semester Hours

¹See General Education Requirements. Six of these credit hours must also satisfy the Science and Technology in Society Requirement and, if HIST 173 is not selected, the Cross-Cultural Awareness Requirement.

²Select from department-approved list of courses in biological sciences, chemistry, mathematical sciences, and physics. At least six credit hours must be in biological sciences.

³Two semesters (through 102) in same modern foreign language are required.

⁴Any 200–400-level science course

⁵An approved physics course may be substituted if CH 331 and 332 have been completed.

⁶Select any ENGL course from General Education Arts and Humanities (Literature) Requirement.

PHYSICS**Bachelor of Arts**

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

Freshman Year**First Semester**

3 - ASTR 105 Physics of the Universe
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.) Requirement¹
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 Requirement²
3 - Oral Communication Requirement¹
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 Requirement²
3 - Social Science Requirement¹
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 Requirement²
3 - Minor Requirement³
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 - PHYS 441 Electromagnetics I
3 - Foreign Language Requirement²
3 - Minor Requirement³
17

Senior Year**First Semester**

3 - PHYS 455 Quantum Physics I
3 - Advanced Writing Requirement¹
6 - Minor Requirement³
3 - Physics Requirement⁴
15

Second Semester

3 - HIST 172 The West and the World I *or*
3 - HIST 173 The West and the World II
3 - Arts and Humanities (Literature) Requirement⁵
3 - Minor Requirement³
3 - Physics Requirement⁴
3 - Elective
15

122 Total Semester Hours

¹See General Education Requirements. Six of these credit hours must also satisfy the Science and Technology in Society Requirement and, if HIST 173 is not selected, the Cross-Cultural Awareness Requirement.

²Four semesters (through 202) in the same modern foreign language are required.

³See advisor.

⁴Any 300- or 400-level physics course

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

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.

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 Requirement¹

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.) Requirement²

14

Sophomore Year

First Semester

- 3 - CH 223 Organic Chemistry
- 1 - CH 227 Organic Chemistry Lab.
- 4 - MTHSC 206 Calculus of Several Variables
- 3 - PHYS 221 Physics with Calculus II
- 1 - PHYS 223 Physics Lab. II
- 3 - Arts and Humanities (Literature) Requirement³

15

Second Semester

- 3 - CH 224 Organic Chemistry
- 1 - CH 228 Organic Chemistry Lab.
- 3 - ECON 200 Economics Concepts
- 3 - EN SP 200 Intro. to Environmental Science *or*
 - 3 - HIST 122 History, Tech., and Science *or*
 - 3 - HIST 124 Environmental History Survey
- 1 - MS&E 251 Materials Science Portfolio I
- 4 - MTHSC 208 Intro. to Ordinary Diff. Equations

15

Junior Year

First Semester

- 3 - CH 331 Physical Chemistry
- 3 - ENGL 314 Technical Writing
- 3 - PFC 415 Intro. to Polymer Science and Engr.
- 1 - PFC 417 Polymer and Fiber Lab.
- 4 - TEXT 201 Yarn Structures and Formation

14

Second Semester

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

16

Senior Year

First Semester

- 3 - PFC 457 Dyeing and Finishing I
- 1 - PFC 459 Dyeing and Finishing I Lab.
- 3 - TEXT 421 Fiber Science
- 5 - Approved Requirement⁴
- 3 - Departmental Requirement⁴

15

Second Semester

- 1 - MS&E 451 MS&E Portfolio II
- 3 - MS&E 491 Undergraduate Research
- 3 - PFC 458 Dyeing and Finishing II
- 1 - PFC 460 Dyeing and Finishing II Lab.
- 3 - TEXT 422 Properties of Textile Structures
- 3 - Departmental Requirement⁴

14

120 Total Semester Hours

¹HIST 172 or 173

²See General Education Requirements. This course must also satisfy the Cross-Cultural Awareness Requirement.

³Select any 200-level ENGL course from General Education Arts and Humanities (Literature) Requirement.

⁴See advisor.

TEXTILE MANAGEMENT

Bachelor of Science

Freshman Year

First Semester

- 4 - CH 101 General Chemistry *or*
 - 4 - CH 105 Chemistry in Context I
- 3 - ENGL 103 Accelerated Composition
- 3 - MTHSC 102 Intro. to Mathematical Analysis
- 3 - TEXT 175 Intro. to Textile Manufacturing
- 3 - Arts and Humanities Requirement¹ *or*
 - 3 - Social Science Requirement¹

16

Second Semester

- 4 - CH 102 General Chemistry *or*
 - 4 - CH 106 Chemistry in Context II
- 3 - CP SC 120 Intro. to Information Technology
- 3 - ECON 200 Economic Concepts
- 3 - MTHSC 207 Multivariable Calculus
- 4 - TEXT 176 Natural and Man-Made Fibers

17

Sophomore Year

First Semester

- 3 - ACCT 201 Financial Accounting Concepts
- 3 - COMM 250 Public Speaking
- 3 - PSYCH 201 Introduction to Psychology
- 4 - TEXT 201 Yarn Structures and Formation
- 3 - Arts and Humanities Requirement¹ *or*
 - 3 - Social Science Requirement¹

16

Second Semester

- 3 - ACCT 202 Managerial Accounting Concepts
- 3 - MGT 201 Principles of Management
- 3 - MS&E 324 Statistics for MS&E
- 4 - TEXT 202 Fabric Struct., Des., and Analysis
- 3 - Arts and Humanities Requirement¹ *or*
 - 3 - Social Science Requirement¹

16

Junior Year

First Semester

- 3 - FIN 306 Corporation Finance
- 3 - LAW 322 Legal Environment of Business
- 3 - MKT 301 Principles of Marketing
- 4 - Concentration Requirement²
- 3 - Emphasis Area Requirement³

16

Second Semester

- 3 - ENGL 314 Technical Writing
- 3 - MGT 307 Human Resource Management
- 7 - Concentration Requirement²
- 3 - Emphasis Area Requirement³

16

Senior Year

First Semester

- 3 - TEXT 470 Textile Costing and Inventory Control
- 6 - Concentration Requirement²
- 3 - Emphasis Area Requirement³

12

Second Semester

- 3 - MGT 415 Business Strategy
- 2 - MS&E 450 MS&E Portfolio
- 3 - TEXT 429 Textile Research
- 3 - Concentration Requirement²
- 3 - Emphasis Area Requirement³

14

123 Total Semester Hours

¹See 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.)

²Chemical—PFC 303/305, 304/306, 405, 406, 416, 457/459 *Manufacturing*—TEXT 308, 314, 403, 411, 422, 426

³See 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 | Legal Studies |
| Adult/Extension Education | Management |
| Aerospace Studies | Management Information Systems |
| Agricultural Business Management | Mathematical Sciences |
| Agricultural Mechanization and Business | Microbiology |
| American Sign Language Studies | Military Leadership |
| Animal and Veterinary Sciences | Modern Languages |
| Anthropology | Music |
| Athletic Leadership | Natural Resource Economics |
| Biochemistry | Nonprofit Leadership |
| Bioengineering | Packaging Science |
| Biological Sciences | Pan African Studies |
| Business Administration | Park and Protected Area Management |
| Chemistry | Philosophy |
| Cluster | Physics |
| Communication Studies | Plant Pathology |
| Community Recreation, Sport, and Camp Management | Political Science |
| Computer Science— <i>not open to Computer Information Systems majors</i> | Psychology |
| Crop and Soil Environmental Science | Public Policy |
| East Asian Studies | Religion |
| Economics | Russian Area Studies |
| Education | Science and Technology in Society |
| English | Screenwriting |
| Entomology | Sociology |
| Entrepreneurship | Spanish-American Area Studies |
| Environmental Engineering | Textiles— <i>not open to Polymer and Fiber Chemistry or Textile Management majors</i> |
| Environmental Science and Policy | Theatre |
| Equine Business | Therapeutic Recreation |
| Film Studies | Travel and Tourism |
| Financial Management | Turfgrass |
| Food Science | Urban Forestry |
| Forest Products | Wildlife and Fisheries Biology |
| Forest Resource Management | Women's Studies |
| Genetics | Writing |
| Geography | |
| Geology | See pages 36–39 for details. |
| Global Politics | |
| Great Works | |
| History | |
| Horticulture | |
| International Engineering and Science | |