Change of Major into General Engineering

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

Graduation Requirements

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

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

BIOENGINEERING

Bachelor of Science

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

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

Combined Bachelor’s/Master’s Plan

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

BIOELECTRICAL CONCENTRATION

Freshman Year

First Semester

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

Second Semester

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

Sophomore Year

First Semester

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

Second Semester

3 - PHYS 2210 Physics with Calculus II
3 - Arts and Humanities Requirement
3 - BIOE 3000 Bioengineering Ethics and Engineering
3 - BIOE 3210 Bioinstrumentation and Bioimaging
3 - ECE 3200 Electronics I
2 - ENGR 2080 Engineering Graphics and Machine Design
4 - MATH 2080 Intro. to Ordinary Diff. Equations
3 - MSE 2100 Introduction to Materials Science

Junior Year

First Semester

4 - BIOL 3150 Functional Human Anatomy
3 - CH 2010 Survey of Organic Chemistry1 and 2
1 - CH 2020 Survey of Organic Chemistry Lab.1
1 - ECE 3110 Electrical Engineering Lab. II
3 - ECE 2620 Electric Circuits II
2 - ENGR 2080 Engineering Graphics and Machine Design
4 - MATH 2080 Intro. to Ordinary Diff. Equations
3 - MSE 2100 Introduction to Materials Science

Second Semester

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

Senior Year

First Semester

3 - BIOE 3200 Biomechanics
3 - BIOE 4010 Bioengineering Design Theory
3 - BIOL 4610 Cell Biology
3 - Arts and Humanities Requirement3 or 4
3 - Social Science Requirement3
3 - BIOE or ECE Technical Requirement4

Second Semester

1 - BIOE 4000 Bioengineering Leadership and MedTech Commercialization
1 - BIOE 4030 Applied Biomedical Design
1 - BIOE 4480 Tissue Engineering
3 - Arts and Humanities Requirement3 or 4
3 - Social Science Requirement3
6 - BIOE or ECE Technical Requirement4

128 Total Semester Hours

1ENGR 1050 and 1060 may be substituted for ENGR 1020
2See Policy on Humanities and Social Sciences for Engineering Curricula. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Society and Technology in Society Requirements.
3ENGR 1070, 1080 and 1090 may be substituted for ENGR 1410
4Students planning to enter medical school should take CH 2230/2270 instead of CH 2100/2020 and take CH 2240/2280 as an additional course sequence. Students planning to enter medical school should also take physics laboratories as additional courses (PHYS 1210 course with PHYS 1240 lab and PHYS 2210 course with PHYS 2230 lab).
5Select from BIOE 1010, BIOL 1030, 1040, 1100, 1110
6Students must take at least six credits from courses with a lecture designation. The other six credits may be selected from courses with the lecture or the non-lecture designation.

Non-Lecture Courses—BIOE 3230, 4220, 4230, 4240, 4250, 4260, 4320, 4330, 4350, 4360, 4400, 4450, 4470, 4500, 4610, 4700, 4820, BMOL 4250, 4260, ECE 2720/2730, 3170, 3130/3120, 3170/3170, 3810, 4090, 4170, 4320, 4470, 4500, MATH 3650, MSE 4550, PHYS 4470

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

BIOMATERIALS CONCENTRATION

Freshman Year

First Semester

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

Second Semester

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

Sophomore Year

First Semester

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

Second Semester

3 - PHYS 2210 Physics with Calculus II
3 - Arts and Humanities Requirement
3 - BIOE 3000 Bioengineering Ethics and Engineering
3 - BIOE 3700 Bioinstrumentation and Bioimaging
3 - ECE 3800 Electromagnetics
3 - BIOE or ECE Technical Requirement

Junior Year

First Semester

4 - BIOL 3150 Functional Human Anatomy
3 - CH 2010 Survey of Organic Chemistry1 and 2
1 - CH 2020 Survey of Organic Chemistry Lab.1
1 - ECE 3110 Electrical Engineering Lab. II
3 - ECE 2620 Electric Circuits II
2 - ENGR 2080 Engineering Graphics and Machine Design
4 - MATH 2080 Intro. to Ordinary Diff. Equations
3 - MSE 2100 Introduction to Materials Science

Second Semester

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

Senior Year

First Semester

3 - BIOE 3200 Biomechanics
3 - BIOE 4010 Bioengineering Design Theory
3 - BIOL 4610 Cell Biology
3 - Arts and Humanities Requirement3 or 4
3 - Social Science Requirement3
Second Semester
- CH 1020 General Chemistry
- ENGR 1410 Programming and Problem Solving
- MATH 1080 Calculus of One Variable II
- PHYS 1220 Physics with Calculus I
- Arts and Humanities Requirement
- Social Science Requirement
- Biology Requirement
- Engineering Core Requirement

Sophomore Year
First Semester
- BIOE 2010 Intro. to Biomedical Engineering
- CH 2010 Survey of Organic Chemistry
- MATH 2060 Calculus of Several Variables
- MSE 2100 Introduction to Materials Science
- PHYS 2210 Physics with Calculus II

Second Semester
- BIOE 2000 Bioengineering Professional Development
- BIOE 3020 Biomaterials
- CE 3100 Statics
- ECE 2070 Basic Electrical Engineering
- ECE 2080 Basic Electrical Engineering Lab.
- ENGR 2080 Engineering Graphics and Machine Design
- MATH 2080 Intro. to Ordinary Diff. Equations

Junior Year
First Semester
- BIOE 3200 Biomechanics
- BIOL 3150 Functional Human Anatomy
- BIOL 3210 Biostatistics
- BIOL 3270 Transport Phenomena

Second Semester
- BCHM 3050 Essential Elements of Biochem.
- BIOE 3200 Biofluid Mechanics
- BIOE 3210 Biostatistics
- MATH 3200 Statistics for Science and Engr.
- Bioengineering Technical Requirement

Senior Year
First Semester
- BIOE 4010 Bioengineering Design Theory
- BIOE 4100 Biomedical Measurement and Systems
- BIOL 4200 Biostatistics
- Arts and Humanities Requirement
- Social Science Requirement
- Bioengineering Technical Requirement

Second Semester
- BIOE 3210 Biofluid Mechanics
- BIOL 4480 Tissue Engineering
- Arts and Humanities Requirement
- Social Science Requirement
- Bioengineering Technical Requirement

128 Total Semester Hours

1ENGR 1050 and 1060 may be substituted for ENGR 1020
2See 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.
3ENGR 1070, 1080 and 1090 may be substituted for ENGR 1110
4Students planning to enter medical school should take CH 2230/2270 instead of CH 1010/1020 and take CH 2240/2280 as an additional course sequence. Students planning to enter medical school should also take physics laboratories as additional courses (PHYS 1220 course with PHYS 1240 lab and PHYS 2210 course with PHYS 2230 lab).
5Select from BIOE 1010, BIOL 1030, 1040, 1100, 1110
6Students must take at least six credits from courses with a lecture designation. The other six credits may be selected from courses with the lecture or the non-lecture designation.

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

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

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

Additional information is available from the departmental offices or at: http://www.clemson.edu/majors/biosystemsengineering.

Combined Bachelor’s/Master’s Program
Under this plan, students may reduce the time necessary to earn both degrees by applying graduate credits to both undergraduate and graduate program requirements.

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

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

Freshman Year
First Semester
- CH 1010 General Chemistry
- ENGL 1030 Composition and Rhetoric
- ENGR 1020 Engineering Disciplines and Skills
- MATH 1060 Calculus of One Variable I
- Arts and Humanities Requirement
- Social Science Requirement

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

Sophomore Year
First Semester
- CE 2100 Statics
- MATH 2060 Calculus of Several Variables
- PHYS 2210 Physics with Calculus II
- Biology Requirement

Second Semester
- BIOL 2100 Intro. to Biosystems Engineering
- CE 2080 Dynamics
- MATH 2080 Intro. to Ordinary Diff. Equations
- ME 3100 Thermodynamics and Heat Transfer
- MICR 3050 General Microbiology

Junior Year
First Semester
- BIOL 3200 Principles and Practices of Geomatics
- BIOL 4100 Biokinetics and Reactor Modeling
- BIOL 4410 Ecology
- CE 3410 Introduction to Fluid Mechanics
- ECE 2070 Basic Electrical Engineering
- ECE 2080 Basic Electrical Engineering Lab.

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