The Department of Bioengineering offers students a broad education built on fundamentals in science, mathematics, and engineering, with a focus on the biological applications of engineering. The program is designed to provide a rigorous engineering training along with a comprehensive understanding of the biological constraints intrinsic to designing artificial systems to interface with, augment, replace, repair, or monitor living systems. These constraints depend on the properties of the biological system involved and the functionality that is being created. The living system may be the human body; an ecosystem; or, more broadly, a bioreactor, tissue culture system, or any system with living components. The presence of naturally occurring biological tissue places special constraints on the design and implementation of artificial constructs and their interface to living systems. Bioengineers are engineers with comprehensive understanding of the engineering requirements intrinsic to working within a biological context.

Bioengineering is a relatively new field driven by the recognition that engineering of biological systems or systems that interface with living systems requires a multidisciplinary approach that takes into account the mechanical, electrical, chemical, and materials properties of the biological system. With that in mind, the bioengineering program has been designed to provide a rigorous engineering education that endows a broad understanding of the quantitative analysis of biological systems and a deep expertise in one of four areas of engineering. The curriculum is structured around a core of six courses that quantitatively analyze biological systems from multiple points of view. The core provides the fundamentals of quantitative physiology, electrical engineering in the context of excitable tissues; basics of mechanical engineering in the context of the musculoskeletal system; and thermodynamics, heat transfer, and fluids mechanics within the context of physiological systems. On completion of the core, students choose one of four concentrations (bioimaging and biomedical devices) that provides the opportunity to develop a deep level of expertise in an important area of bioengineering. The curriculum culminates with a two-semester capstone course to provide experience in design and implementation of a novel bioengineering project.

The program is committed to providing a multidisciplinary education, making connections from the classroom and laboratory to research, co-op, and co-curricular experiences. The curriculum provides fundamentals in mathematics, physical sciences, and engineering science; laboratory experiences; as well as an emphasis on the special considerations intrinsic to design within a biological context. Through the university’s general educational requirements, students gain awareness of the impact of engineering decisions in a broader societal and ethical context. The department encourages professional development through active participation and leadership in student organizations, societies, and departmental activities. As a result, the bioengineering program prepares students for success in industrial careers; graduate programs; or professional medical, law, and business schools.

The bioengineering program seeks to enable students to apply knowledge of mathematics, science, and engineering to design of novel systems interfacing, replacing, augmenting, or repairing living systems; to conduct bioengineering experiments, as well as to analyze and interpret data; to design a system, component, or biological process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, safety, manufacturability, and sustainability; to function on teams, including multidisciplinary teams; to identify, formulate, and solve bioengineering problems; to understand professional and ethical responsibility, including protecting the public and the environment by performing work in a safe and environmentally conscious manner; to communicate effectively; to understand the impact of engineering solutions in a global and societal context; to recognize the need for and the ability to engage in lifelong learning; to understand professional behavior, culture, expectations, and contemporary issues; and to use the techniques, skills, and modern engineering tools intrinsic to bioengineering practice.

The bioengineering curriculum shown below is an innovative plan that is continuously and carefully assessed and evaluated to ensure that graduates of the program are fully prepared for success as professional bioengineers and are prepared for graduate or professional school.

**BSBioE—Bachelor of Science in Bioengineering**

Complete all courses listed below unless otherwise indicated. Also complete any corequisite labs, recitations, clinicals, or tools courses where specified.

**NU CORE REQUIREMENTS**

See page Error! Bookmark not defined. for requirement list.

**MAJOR GPA REQUIREMENT**

2.000 minimum required in BIOE courses

**MATHEMATICS/SCIENCE REQUIREMENT**

Complete 37 semester hours in mathematics and science as indicated below.

**Required Mathematics/Science**

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1115</td>
<td>General Biology 1 for Engineers</td>
<td>4 SH</td>
</tr>
<tr>
<td>BIOL 1116</td>
<td>Lab for BIOL 1115</td>
<td>1 SH</td>
</tr>
<tr>
<td>CHEM 1151</td>
<td>General Chemistry for Engineers</td>
<td>4 SH</td>
</tr>
<tr>
<td>CHEM 2311</td>
<td>Organic Chemistry 1</td>
<td>4 SH</td>
</tr>
</tbody>
</table>
REQUIRED COURSES
Concentration in Bioimaging and Signal Processing

Complete 20 semester hours in one of the following four concentrations:

Concentration in Bioimaging and Signal Processing

REQUIRED COURSES
- BIOL 5811: Biomedical Imaging
- BIOL 5820: Biomedical Engineering
- BIOL 5820: Biomedical Signal Processing
- BIOL 6811: Biomedical Electronics

ELECTIVE COURSES
- BIOL 6820: Biomedical Optics
- BIOL 6820: Biomedical Image Processing and Pattern Recognition

Supplemental Credit
Partial credit from the following courses counts toward the bioengineering core requirements:
- GE 1111: Engineering Problem Solving and Computation

BIOENGINEERING CORE REQUIREMENTS
Complete 38 semester hours in bioengineering core requirements as indicated below.

Required Courses
- BIOL 2355: Quantitative Physiology for Bioengineers
- BIOL 2356: Bioengineering Instrumentation, Measurement, and Imaging
- BIOL 2365: Lab for BIOL 2365
- BIOL 3380: (pending approval)
- BIOL 3310: (pending approval)
- BIOL 3210: (pending approval)

Bioengineering Capstone
- BIOL 4790: (pending approval)
- BIOL 4792: (pending approval)

Supplemental Credit
Partial credit from the following courses counts toward the bioengineering core requirements:
- GE 1110: Engineering Design
- GE 1111: Engineering Problem Solving and Computation

CONCENTRATION
Complete 20 semester hours in one of the following four concentrations:

Concentration in Bioimaging and Signal Processing

REQUIRED COURSES
- BIOL 5320: (pending approval)
- BIOL 5235: (pending approval)
ELECTIVE COURSES
Complete three of the following courses:
- BIOE 2200 (pending approval)
- BIOE 2060 Special Topics in Bioengineering 4 SH
- BIOE 4991 Research 4 SH
- BIOE 4992 Directed Study 4 SH
- BIOE 5850 (pending approval)
- CHME 5160 Drug Delivery: Engineering Analysis 4 SH
- EECE 5664 Biomedical Signal Processing 4 SH
- ME 2340 Introduction to Material Science 4 SH
- with ME 2341 Lab for ME 2340 1 SH
- ME 4555 System Analysis and Control 4 SH

PROFESSIONAL DEVELOPMENT
- GE 1000 Introduction to the Study of Engineering 1 SH
- BIOE 2000 Introduction to Engineering Co-op Education 1 SH
- BIOE 3000 (pending approval)

Additional Required Courses
Partial credit for the following courses counts toward requirements above:
- GE 1110 Engineering Design 4 SH
- GE 1111 Engineering Problem Solving and Computation 4 SH

ADDITIONAL NU CORE COURSES
Writing
A grade of C or higher is required:
- ENGW 1111 First-Year Writing 4 SH
- ENGW 3302 Advanced Writing in the Technical Professions 4 SH
- or ENGW 3315 Interdisciplinary Advanced Writing in the Disciplines 4 SH

Arts/Humanities Level 1
Complete one course from the NU Core arts/humanities level 1 domain, as described on page Error! Bookmark not defined.

Social Science Level 1
Complete one course from the NU Core social science level 1 domain, as described on page Error! Bookmark not defined.

REQUIRED GENERAL ELECTIVES
Complete five academic, nonremedial, nonrepetitive courses, each equivalent to 4 semester hours.

COURSE WORK THAT DOES NOT COUNT TOWARD THE ENGINEERING DEGREE
Students in engineering are allowed to count a maximum of two pass/fail courses toward their degree program. Only general electives outside the College of Engineering may be taken on a pass/fail grading basis. A maximum of one pass/fail course is allowed per semester.