BIOENGINEERING

The bioengineering curriculum provides both breadth and depth across the range of engineering domains such as mechanical, electrical, computer or software engineering. The program prepares graduates to have an understanding of biology and physiology, as well as the capability to apply advanced mathematics, science and engineering to solve the problems at the interface of engineering and biology. The bioengineering curriculum prepares graduates with the ability to make measurements on and interpret data from living systems and to address the problems associated with the interaction between living and non-living materials and systems. The bioengineering curriculum blends theoretical knowledge with hands-on experiential learning that culminates with a year-long, interdisciplinary team-based capstone design project.

The Program Educational Objectives are broad statements that describe what alumni do within a few years following graduation. The Bioengineering program is committed to graduating engineers who within a few years of their graduation are expected to:

1. Utilize their interdisciplinary training to have successful careers in industry, research and development and in regulatory agencies, academia, or clinical work.
2. Demonstrate the organizational, leadership, and communication skills to achieve success in their chosen careers.
3. Employ critical thinking and problem solving skills to support interdisciplinary teams that may include physicians, molecular biologists, physiologists, and other engineers.
4. Utilize life-long learning skills and the ethical tools for successful adaptation to the rapidly changing field of bioengineering.
5. Build upon their sound training in mathematics, biological sciences, the liberal arts and engineering to facilitate successful pursuit of advanced degrees in medicine, law, business, engineering, or related fields.

For the first year of study, all our engineering programs place major emphasis on the fundamentals of engineering and computer science, mathematics, and the basic sciences to provide the background for later engineering science and design courses. Following preparatory work, the fundamentals of electrical, computer, mechanical, and materials engineering concepts are developed. Advanced courses in bioengineering further develop knowledge in the discipline. The bioengineering curriculum program places much emphasis on design assignments. Students may specialize in a specific area of bioengineering by taking elective courses. Also, students on a pre-medicine track can prepare for medical school entrance by taking their elective courses in psychology, sociology, organic chemistry, biology, and biochemistry.

Programs

- Bioengineering Major (https://catalog.fairfield.edu/undergraduate/engineering/bioengineering/bioengineering-major)

Courses

BEN 0201 Biomechanics **3 Credits**
Prerequisites: MA 0145, PS 0115.
This course covers solid mechanics of bone with a focus on stress, strain, stiffness, and strength. Joint forces and muscle attachments will be analyzed using free-body diagrams. Introductory musculoskeletal physiology will be covered and Biopac Student Lab software will be used for gait and muscle force analysis.

BEN 0300 Biomedical Instrumentation **4 Credits**
Attributes: HSST Health Studies: Science and Technology
Prerequisites: BI 0107 or BI 0170; EE 0213.
Instrumentation and techniques used in acquisition, processing, and presentation of biomedical signals: transducers, sensors, Fourier analysis, flow measurement, biosensors, amplifiers, bridge circuits, and measurement of physical parameters and electrophysiological signals.

BEN 0331 Biomedical Signal Processing **3 Credits**
Attributes: HSST Health Studies: Science and Technology
Prerequisites: CS 0131 or CS 0142 or SW 0407; MA 0146.
This course presents an overview of different methods used in biomedical signal processing. Signals with bioelectric origin are given special attention and their properties and clinical significance are reviewed. In many cases, the methods used for processing and analyzing biomedical signals are derived from a modeling perspective based on statistical signal descriptions. The purpose of the signal processing methods ranges from reduction of noise and artifacts to extraction of clinically significant features. The course gives each participant the opportunity to study the performance of a method on real, biomedical signals.

BEN 0332 Biomedical Imaging **3 Credits**
Attributes: HSST Health Studies: Science and Technology
Prerequisite: BEN 0331 or CR 0331.
This course presents the fundamentals and applications of common medical imaging techniques, for example: x-ray imaging and computed tomography, nuclear medicine, magnetic resonance imaging, ultrasound, and optical imaging. In addition, as a basis for biomedical imaging, introductory material on general image formation concepts and characteristics are presented, including human visual perception and psychophysics.

BEN 0333 Biomedical Visualization **3 Credits**
Prerequisite: CS 0131.
This course is an introduction to 3-D biomedical visualization. Various technologies are introduced, including UltraSound, MRI, CAT scans, PET scans, etc. Students will learn about spatial data structures, computational geometry and solid modeling with applications in 3-D molecular and anatomical modeling.

BEN 0390 Bioengineering Design Project I **3 Credits**
Prerequisite: Completion of all non-elective program courses; completion of other program requirements to enable graduation within the year of completion of BEN 0391.
In this capstone course, students work in teams on advanced projects that emphasize engineering design with due attention to design constraints and engineering standards. The overarching scope of this course is to transform engineering students to practicing engineers. Under the guidance of a faculty instructor and a mentor, each team conducts literature searches, write a technical proposal and its members develop skills in information analysis and synthesis; they model and test prototypes of their devices, and make frequent oral and poster presentations of their work to faculty and peers, and submit timely progress reports. In the process, they receive instruction in effective communication and presentation practices, and develop an appreciation of teamwork and collective success. This two-semester course begins in the fall of the academic year and concludes at the end of the spring term with a final team oral presentation and a final written report, and a working prototype of the team's project.

BEN 0391 Bioengineering Design Project II **3 Credits**
Prerequisite: EG 0390.
In this capstone course, students work in teams on advanced projects that emphasize engineering design with due attention to design constraints and engineering standards. The overarching scope of this course is to transform engineering students to practicing engineers. Under the guidance of a faculty instructor and a mentor, each team conducts literature searches, write a technical proposal and its members develop skills in information analysis and synthesis; they model and test prototypes of their devices, and make frequent oral and poster presentations of their work to faculty and peers, and submit timely progress reports. In the process, they receive instruction in effective communication and presentation practices, and develop an appreciation of teamwork and collective success. This two-semester course begins in the fall of the academic year and concludes at the end of the spring term with a final team oral presentation and a final written report, and a working prototype of the team's project.

Faculty

Professors

Etemad
Lyon

Associate Professors

Rusu, Amalia

Professors of the Practice

Hoffman, *chair*

Lecturers

Freudzon
Speretta