

Bioengineering

<http://www.eng.iastate.edu/bioengineering/>

Minor supervised by an interdisciplinary faculty committee, administered by Chemical and Biological Engineering.

The Bioengineering minor is a unique opportunity for engineering students to acquire a multi-disciplinary engineering and life sciences background for entering the field of biomedical engineering.

Undergraduate Study

The program is open to all undergraduate engineering students at Iowa State University. This minor will provide students with a foundation of core biology and engineering relevant to further study in biomedical engineering along with an introduction to the application of engineering principles to biomedical problems from a multidisciplinary perspective as well as the applications within the majors of the participating departments. Minor requirements are as follows:

A minimum of 16 cr. meeting the six requirements below with a minimum of 9 of those credits not being used to meet degree requirements and a minimum of 6 cr. at the 300 level or above. For most students this last stipulation will probably result in 18 cr. being taken.

BIOL 212	Principles of Biology II	3
BIOE/CH E 220	Introduction to Biomedical Engineering	3
BIOL 256	Fundamentals of Human Physiology	3
INTRO ENGR ELEC *		3
ADV ENGR ELEC **		3
PROF ELEC ***		1-3

*A second (Introductory) engineering course from a department other than that of your major that is not duplicative of material in a course taken in your own department. The topic of the course should have ready application to later BME-related electives in that discipline (MATE 273; E M 274 or 324; CH E 210, E E 201 or 230; or other courses approved by Minor Chair).

** 300-500 level engineering course with clear biomedical engineering application (BIOE 325, 341, 341L, 352, 411, 428, 450, 450L, 490; CH E 440, 542; MAT E 456; IE 571; or other courses approved by Minor Chair).

*** 300-500 level engineering or life sciences course with clear biomedical engineering application OR BIOE 490 OR departmental 490 with biomedical engineering topic OR 200+-level life sciences laboratory course (If a 200-level course is chosen here, the student will need to meet the required 6 cr. of 300+ courses by substitution of a higher-level course for the other requirements or by taking an additional course.), OR 300-500 level BME courses, which may be offered on-line from the University of Iowa.

Courses primarily for undergraduates:

BIOE 220. Introduction to Biomedical Engineering.

(Cross-listed with CH E). (3-0) Cr. 3. S. Prereq: BIOL 212, ENGR 160 or equiv, MATH 166, CHEM 167 or 178, PHYS 222

Engineering analysis of basic biology and engineering problems associated with living systems and health care delivery. The course will illustrate biomedical engineering applications in such areas as: biotechnology, biomechanics, biomaterials and tissue engineering, and biosignal and image processing, and will introduce the basic life sciences and engineering concepts associated with these topics.

BIOE 325. Systems Biology for Engineering.

(Cross-listed with E E). (3-0) Cr. 3. Prereq: BIOE 210, MATH 267

Review of systems approaches for modeling. Introduction or review of methods for gene regulation in cells and how to model them. Auto regulation of gene networks. Feedforward modeling, timing considerations. Feedback mechanisms. Kinetic and rate-limiting steps.

BIOE 341. BioMEMs and Nanotechnology.

(3-0) Cr. 3. Prereq: BIOE 220

Overview of Micro-Electro-Mechanical-System (MEMS) technologies for bioengineering, fundamentals of microfluidic device design, fabrication, and characterization, survey of microfluidic functional building blocks for lab-on-a-chip applications including mixers, valves, channels, and chambers. Topics of nanotechnology in bioengineering, nanoscale building block technologies for bioengineering including self-assembling, surface chemical treatment, nano-imprinting, nano-particles, nano-tubes, nano-wires, and stimuli-responsive biomaterials.

BIOE 341L. BioMEMS and Nanotechnology Laboratory.

(0-3) Cr. 1. Prereq: BIOE 220, concurrent enrollment in BIOE 341

Introductory laboratory course accompanying BioE 341. Design, fabrication, and characterization of BioMEMS lab-on-a-chip devices and nanoscale techniques for bioengineering. Student group projects. BioE341L not a necessary corequisite with BioE341.

BIOE 352. Molecular, Cellular and Tissue Biomechanics.

(3-0) Cr. 3. Prereq: BIOE 220, E M 324, MAT E 273

Introduction to the anatomy of the musculoskeletal system and connective tissue. Range of movement, joint dislocation, bone deformity and fracture. Application of continuum mechanics to both living and non-living systems. Laws of motion, free-body diagrams and simple force analysis of musculoskeletal system. Biomechanical response of soft and hard tissues with emphasis on microstructure and mechanical properties. Applications to bioengineering design.

BIOE 411. Bioprocessing and Bioproducts.

(Dual-listed with BIOE 511). (Cross-listed with A E, C E, BSE). (3-0) Cr. 3. F. Prereq: A E 216, C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification

Sustainability, cleaner production. Taxonomy, kinetics, metabolism, microbial cultivation, aerobic and anaerobic fermentation. Antibiotics, food supplements, fermented foods, vitamin production. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

BIOE 428. Image Processing with Biomedical Applications.

(3-0) Cr. 3. Prereq: E E 324

Review of signal processing, linear algebra, probability. Image sampling and quantization. Image transforms, image enhancement, image denoising/restoration. Tomographic reconstruction, segmentation and registration, recognition and shape analysis and applications in Computer Aided disease Detection (CAD).

BIOE 440. Biomedical Applications of Chemical Engineering.

(Dual-listed with BIOE 540). (Cross-listed with CH E). (3-0) Cr. 3. Alt. F., offered 2013. Prereq: CH E 210, MATH 266, PHYS 222

Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging. Nonmajor graduate credit.

BIOE 450. Biosensing.

(3-0) Cr. 3. Prereq: BIOE 220

Overview of biosensors and bioanalytical challenges; designing for performance including various analytical problems, ion-selective membranes, characteristics of enzymes and basics of bioaffinity sensing; fundamentals of bioselective layers including depositing films and membranes, surfaces for immobilization and bioselective agents; survey of different biosensing technologies including electroanalytical, biomembrane, optical, and acoustic-wave based sensors.

BIOE 450L. Biosensing Laboratory.

(0-3) Cr. 1. Prereq: BIOE 220, concurrent enrollment in BIOE 450

Laboratory course accompanying BioE 450. Design, fabrication, and characterization of various electrical, chemical, polymer, optical and acoustic sensors. Lab is not a necessary corequisite with BioE 450.

BIOE 456. Biomaterials.

(Dual-listed with BIOE 556). (Cross-listed with MAT E). (3-0) Cr. 3. F. Prereq: MAT E 216 or MAT E 273 or MAT E 392

Presentation of the basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

BIOE 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: chair for the Bioengineering Minor*

Investigation of biomedical engineering topics of special interest to student and supervising faculty member with a final written report.