

# BIOMEDICAL ENGINEERING (BME)

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Courses primarily for undergraduates:

## **BME 1040: Biomedical Engineering First-Year Learning Community**

Credits: Required. Contact Hours: Lecture 1.

Curriculum and career planning; academic course support for first-year students. Restricted to BME majors. Offered on a satisfactory-fail basis only. (Typically Offered: Fall)

## **BME 1600: Biomedical Engineering Problems with Computer Applications Laboratory**

Credits: 3.

*Prereq:* MATH 1430 or satisfactory scores on mathematics placement examinations; credit or enrollment in MATH 1650

Formulation and solution of engineering problems; significant figures; use of SI units; graphing and curve-fitting; flowcharting; introduction to material balances, statics, and electric circuits in the context of biomedical engineering problems; use of spreadsheet programs to solve and present engineering problems; solution of engineering problems using computer programming languages. Only one of ENGR 1600, ABE 1600, AERE 1600, BME 1600, CHE 1600, CE 1600, CPRE 1850, EE 1850, IE 1480, ME 1600 and SE 1850 may count towards graduation. (Typically Offered: Fall, Spring)

## **BME 2200: Introduction to Biomedical Engineering**

(Cross-listed with CHE 2200).

Credits: 3. Contact Hours: Lecture 3.

*Prereq:* BIOL 2120; (CHEM 1670 or CHEM 1770); (ABE 1600 or AERE 1600 or BME 1600 or CE 1600 or CHE 1600 or CPRE 1850 or EE 1850 or ENGR 1600 or IE 1480 or ME 1600 or SE 1850); MATH 1660; PHYS 2320

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. (Typically Offered: Spring)

## **BME 3410: BioMEMs and Nanotechnology**

(Cross-listed with EE 3410).

Credits: 3. Contact Hours: Lecture 3.

*Prereq:* BME 2200

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.

## **BME 3520: Molecular, Cellular and Tissue Biomechanics**

Credits: 3. Contact Hours: Lecture 3.

*Prereq:* BME 2200; EM 3240; MATE 2730

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.

## **BME 4400: Biomedical Applications of Chemical Engineering**

(Dual-listed with CHE 5400). (Cross-listed with CHE 4400).

Credits: 3. Contact Hours: Lecture 3.

*Prereq:* CHE 2100 or CHE 2200, MATH 2660 or MATH 2670, PHYS 2320  
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.

## **BME 4470: Biomedical Design and Manufacturing**

(Dual-listed with IE 5470). (Cross-listed with IE 4470).

Credits: 3. Contact Hours: Lecture 3.

Exploration of biology, materials, body mechanics, manufacturing, quality control, and ethics and the intersection of these subjects as they relate to biomedical manufacturing. Study of medical data (CT, MRI, etc.) processing, biomedical design, 3D bioprinting and additive manufacturing concepts.

**BME 4500: Biosensors**

(Cross-listed with EE 4500).

Credits: 3. Contact Hours: Lecture 3.

*Prereq:* BME 2200

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.

**BME 4500L: Biosensors Laboratory**

(Cross-listed with EE 4500L).

Credits: 1. Contact Hours: Laboratory 3.

*Prereq:* BME 2200; *concurrent enrollment in* BME 4500 *or* EE 4500

Laboratory course accompanying BME 4500. Design, fabrication, and characterization of various electrical, chemical, polymer, optical and acoustic sensors.

**BME 4560: Biomaterials**

(Dual-listed with MSE 5560). (Cross-listed with MATE 4560).

Credits: 3. Contact Hours: Lecture 3.

*Prereq:* CHEM 1780 *and* (MATE 2160 *or* MATE 2730 *or* MATE 3920)

Presentation of the basic chemical and physical properties of biomaterials, with special emphasis on metallic, ceramic, polymeric, and composite biomaterials, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure and properties needed to select and design biomaterials used in medical devices, artificial organs, implants, and prostheses. Overview of medical science vis-à-vis materials science. (Typically Offered: Fall)

**BME 4900: Independent Study**

Credits: 1-6. Repeatable, maximum of 6 credits.

*Prereq:* Department Permission for Course

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

(Typically Offered: Fall, Spring, Summer)