Biomedical Engineering (BME)

Credit Hours: 2
Prerequisites: Sophomore standing

BME 2080: Introduction to Programming for Engineers (same as BIOL_EN 2080). This course teaches how to write scientific programs for analysis of data and simulation of physical phenomena using MATLAB. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MATH 1500

BME 2180: Engineering Analysis of Bioprocesses (same as BIOL_EN 2180). Material and Energy Balances. Integrating principles of physics, chemistry and mathematics to analyze steady state and transient biological/biomedical processes. Graded on A-F basis only.
Credit Hours: 3
Recommended: MATH 1700, CHEM 1320, PHYSCS 2750

BME 3070: Biological Fluid Mechanics (same as BIOL_EN 3070). Basic principles of fluid mechanics applied to transport processes in biological systems. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 2750 and MATH 1700

BME 3075: Introduction to Materials Engineering (same as BIOL_EN 3075). Course covers concepts and techniques in materials engineering from an engineering design perspective, materials requirements for design, and fundamentals; intended for undergraduate engineering students. Graded on A-F basis only. Corequisites: One of the following: BIOL_EN 3180, CH_ENG 3261, MAE 4231, MAE 4300, or instructor consent.
Credit Hours: 3
Prerequisites: MATH 2300, ENGINR 1200, ENGINR 2200, or instructor’s consent

BME 3170: Biomaterials (same as BIOL_EN 3170). Engineering sciences and design will be leverage for the study and design of biomaterials. Understanding the structure-property relationship between biomaterials and tissue will be addressed for implant design. Graded on A-F basis only.
Credit Hours: 3
Prerequisites or Corequisites: BIOL_EN 2180, ENGINR 2200, or instructor’s consent

BME 3170W: Biomaterials - Writing Intensive (same as BIOL_EN 3170W). Engineering sciences and design will be leverage for the study and design of biomaterials. Understanding the structure-property relationship between biomaterials and tissue will be addressed for implant design. Graded on A-F basis only.
Credit Hours: 3
Prerequisites or Corequisites: BIOL_EN 2180, ENGINR 2200, or instructor’s consent

Credit Hours: 3
Prerequisites or Corequisites: ENGINR 2300 or CH_ENG 3261
Prerequisites: BIOL_EN 2180 or CH_ENG 2225

BME 4001: Topics in Biomedical Engineering
Current and new technical developments in biomedical engineering.
Credit Hour: 3-9
Prerequisites: instructor’s consent

BME 4002: Scientific Discovery Leading to Life Science Innovations
The overarching goal of this course is to introduce the concept of biomedical innovation and the pathways to succeed in drug or device product development. The importance of identifying appropriate unmet clinical needs, understanding stake holder perspectives, recording and protecting their ideas, and the commercialization potential of a product will be explained. The recent, innovation-based, life science research that is carried out in academic institutions, as well as the pathways involved in translating those fundamental discoveries into products and services that affect healthcare, will be explained. We will provide an outline about drug-discovery, device development, intellectual property protection, conflict of interests, ethical perspectives, and regulatory issues, as well as the transitions from initial discovery concepts to product development. An introduction to essential disciplines and interactions that enable scientific discoveries to move forward into novel drug and device development will be provided. Graded on A-F basis only.
Credit Hours: 3

BME 4003: Design and Development of Biomedical Innovation
The overarching goal of this course is to help participants understand the design and development (drug or device) process in biomedical innovation. This course will help participants to understand the process of choosing unmet clinical needs, articulate a need statement without integrating solution, design and develop a solution. Participants will learn to assess the commercial potential of clinical needs by performing market analysis and valuing customer needs. A conceptual understanding about development of a prototype for a device and also drug development by different brainstorming process will be provided. Details of regulatory, reimbursement, patenting process required for product development will be explained with examples. An overview about how to evaluate preliminary designs, define product specifications, comply with manufacturing principles and methods, costs, cGMP requirements will be explained. Quality control and Quality assurance necessities for drug/device will be elucidated with case studies. Participants will gain knowledge about different business models for drug and devices, estimate market penetration and how to make profitable, patient-driven products. Graded on A-F basis only.
BME 4004: Regulatory Issues in Clinical Trials
The overarching goal of this course is to help participants understand the essentials of compliance issues as it is related to conducting clinical trials using drugs and devices that have been or yet to be approved by FDA. This course will also help biomedical innovators recognize the importance of Human Subject Protection (HSP) and abide by the FDA regulations to conduct clinical trials with the new drugs/devices that are being designed to advance patient-care. The course will describe regulatory standpoints for human subject protection, how to obtain approvals and develop clinical protocols for conducting clinical trials. An overview about clinical epidemiology, biostatistics and data management and analysis will be provided. Graded on A-F basis only.
Credit Hours: 3

Prerequisites: BIOL_EN 3170, ENGINR 1200, or instructor's consent

BME 4380: Applied Electronic Instrumentation
(same as BIOL_EN 4380; cross-leveled with BIOL_EN 7380). Fundamental concepts and theories, basic electronics, analog and digital circuits, signal conditioning, computer interfacing, measurement principles and techniques used in developing computer-based instrumentation systems. Graded on A-F basis only.
Credit Hours: 4
Prerequisites: PHYSCS 2750

BME 4420: Introduction to Biomedical Imaging
(same as BIOL_EN 4420, PHYSCS 4420; cross-leveled with BIOL_EN 7420, PHYSCS 7420). This course offers a broad introduction to medical imaging. Topics to be covered include the physics basics and instrumentation of X-ray CT, PET, SPECT, ultrasound, MRI and Optical Imaging, as well as recent developments in biomedical imaging.
Credit Hours: 3
Prerequisites: MATH 1700, PHYSCS 2760, CHEM 2100
Recommended: Senior/graduate standing or instructor's consent

BME 4470: Biomolecular Engineering and Nanobiotechnology
(same as BIOL_EN 4470; cross-leveled with BIOL_EN 7470). Generation of biotechnological products, devices through integration of engineering approaches with contemporary biology, chemistry and nanotechnology starting at the molecular level. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MATH 1700, PHYSCS 2760, CHEM 2100
Recommended: Senior/graduate standing or instructor's consent

BME 4470H: Biomolecular Engineering and Nanobiotechnology - Honors
(same as BIOL_EN 4470H; cross-leveled with BIOL_EN 7470). Generation of biotechnological products, devices through integration of engineering approaches with contemporary biology, chemistry and nanotechnology starting at the molecular level. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MATH 1700, PHYSCS 2760, CHEM 2100. Honors eligibility required
Recommended: Senior/graduate standing or instructor's consent

BME 4480: Physics and Chemistry of Materials
(same as BIOL_EN 4480, PHYSCS 44190, NU_ENG 4319, CHEM 4490; cross-leveled with BIOL_EN 7480, PHYSCS 7190, CHEM 7490, NU_ENG 7319). Physics and Chemistry of Materials is a 3 credit hours course offered every spring semester for students from Physics, Chemistry, Engineering and Medical Departments and consists of lectures, laboratory demonstrations, two mid-term and one final exam. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 2750, CHEM 1320 or equivalent, or instructor's consent

BME 4570: Fluorescent Imaging
(same as BIOL_EN 4570; cross-leveled with BIOL_EN 7570). Principles and applications of the modern technology of fluorescent imaging. The course covers image formation in microscope; Fundamentals
of fluorescence and fluorescent microscopy; Fluorescent probe and applications of molecular and cellular fluorescent imaging in life science research. Graded on A-F basis only.

**Credit Hours:** 3  
**Prerequisites:** BIO_SC 1500, BIO_SC 2180

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**BME 4590: Computational Neuroscience**
(same as BIOL_EN 4590, BIO_SC 4590, ECE 4590; cross-leveled with BIOL_EN 7590, BIO_SC 7590, ECE 7590). An interdisciplinary course with a strong foundation in quantitative science for students in biological-behavioral sciences. Graded on A-F basis only.

**Credit Hours:** 4  
**Prerequisites:** BIO_SC 1010, BIO_SC 1500; MATH 1500  
**Recommended:** PHYSCS 2760

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**BME 4770: Biomedical Optics**
(same as BIOL_EN 4770, Cross-leveled with BIOL_EN 7770). Essential concepts and methods for applying optical techniques to biomedical diagnosis and therapy will be covered with major application examples being discussed.

**Credit Hours:** 3  
**Prerequisites:** PHYSCS 2760  
**Recommended:** BIOL_EN 3180

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**BME 4940: Engineering Internship**
(same as BIOL_EN 4940). Problem course following prior approved work experience. Problem selected by internship company representative, faculty problem adviser and student. Supervised by faculty problem advisor and presented in engineering report form. Graded on S/U basis only.

**Credit Hours:** 1-3  
**Prerequisites:** advisor's consent

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**BME 4970: Nuclear Magnetic Resonance and Magnetic Resonance Imaging**
(same as BIOL_EN 4971). Nuclear Magnetic Resonance (NMR) is one of the most powerful methods of investigating the structure, composition, and dynamics of atoms and molecules. It is now ubiquitous in chemistry and engineering labs, and has blossomed into one of the most successful medical imaging modalities - Magnetic Resonance Imaging (MRI). This course is an in-depth examination of the relevant physical principles behind this technology: basic spin physics, spectrometer design and implementation, what it can be used to measure, and how it is currently being used in laboratory and clinical settings. In particular, students will gain a working knowledge of basic nuclear physics, spin precession, T1 and T2 weighting mechanisms, the pulse/acquire NMR experiment, the influence of magnetic field gradients, Fourier theory and k-space, imaging principles, and the many pulse sequences currently employed in NMR/MRI research labs around the world.

**Credit Hours:** 3  
**Prerequisites:** Senior Standing or instructor consent

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**BME 4980: Biomedical Engineering Design**
(same as BIOL_EN 4980). Capstone design course for the biomedical engineering major. Design of biomedical devices or processes. Graded on A-F basis only.

**Credit Hours:** 3  
**Prerequisites:** Senior standing

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**BME 4990: Undergraduate Research in Biomedical Engineering**
Supervised independent study at the undergraduate level. Graded on A-F basis only.

**Credit Hour:** 1-6  
**Prerequisites:** Department consent

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**BME 4995H: Undergraduate Honors Research in Biomedical Engineering**
(same as BIOL_EN 4995H). Open only to honor students in Biological Engineering and Biomedical Engineering. Independent investigation in biological engineering to be presented as a thesis.

**Credit Hour:** 1-5  
**Prerequisites:** Instructor consent, Honors eligibility required

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**BME 4980W: Biomedical Engineering Design - Writing Intensive**
(same as BIOL_EN 4980W). Capstone design course for the biomedical engineering major. Design of biomedical devices or processes. Graded on A-F basis only.

**Credit Hours:** 3  
**Prerequisites:** Senior standing

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**BME 4985: Bioengineering Design II**
(same as BIOL_EN 4985). This course is intended to serve as the second term of our capstone, or senior design experience, for the Bachelor of Science in Biological Engineering or Biomedical Engineering degree programs. During this term, students will be expected to continue the design project begun by their team in the fall semester, carrying it through to prototyping, testing, and redesign. Students will continue their project under the advisement of the same faculty mentor and industrial cooperator who led their first term capstone experience. Graded on A-F basis only.

**Credit Hour:** 1-5  
**Prerequisites:** BIOL_EN 4980 or BME 4980

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**BME 4990: Undergraduate Research in Biomedical Engineering**
Supervised independent study at the undergraduate level. Graded on A-F basis only.

**Credit Hour:** 1-6  
**Prerequisites:** Department consent