

Biomedical Engineering Minor

Overview:

Biomedical Engineering is an interdisciplinary field that combines principles of biology and medicine with engineering design to produce healthcare innovations. Biomedical engineers contribute to medical technologies in a variety of areas including diagnostics, therapeutics, imaging, bioinformatics, and rehabilitation. Accordingly, biomedical engineers typically possess a broad biology background and strong engineering design and problem solving principles. The purpose of this minor in Biomedical Engineering is to prepare students studying engineering or the life sciences for careers in industries that develop technologies to advance medicine.

The following curriculum is accessible to students from any major degree program in the College of Engineering and Applied Science (CEAS). Major-specific tracks anticipating the most appropriate groupings of electives are provided to the CEAS advising center. Specialized, more comprehensive programs of study are proposed for students with a particular interest in medical school preparation.

Learning Outcomes:

A student who has completed the Biomedical Engineering Minor will have:

1. experience and proficiency in applying principles of engineering, biology, human physiology, chemistry, calculus-based physics, differential equations and statistics;
2. experience and proficiency in solving biomedical engineering problems, including those associated with the interaction between living and nonliving systems;
3. experience and proficiency in analyzing, modeling, designing, and realizing medical (biomedical engineering) devices, systems, components, or processes;
4. experience and proficiency in making measurements on and interpreting data from living systems
5. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
6. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
7. an ability to communicate effectively with a range of audiences.
8. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
9. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
10. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
11. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Coursework:

Minimum required coursework consists of 18 credits of electives. The course of study can be self-direct or tailored to a student's major degree program. Example coursework tracks are provided below for students pursuing specific engineering majors.

Chemical Engineering

Chemical Engineering draws upon fundamentals of chemistry, physics, and biology to analyze and design processes. Chemical Engineers work in a variety of biomedical disciplines including pharmaceutical production, biomedical devices, tissue engineering, and medical sensing. The following coursework covers biological fundamental and materials with a focus on process and device design.

CHE 3100 - Fundamentals of Bioengineering* (3)
CHE 4100 - Biochemical Engineering (3)
CHE 4160 - Biomedical Engineering Transport Phenomena (3)
CHE 4165 - Biomaterials (3)
+6 credits of approved coursework

Electrical Engineering

Electrical Engineering can be applied to problems of environmental science, wildlife studies, biology and medicine. This minor prepares students for careers focusing upon the use of telemetry for wildlife management, environmental monitoring, design and development of biological and medical instrumentation, and clinical engineering.

BE 4810 - Bioinstrumentation (3)
BE 4820 - Biodata Systems (3)
EE 5410 - Rehabilitation Engineering (3)
CHE 3100 - Fundamentals of Bioengineering (3)
CHE 4165 - Biomaterials (3)
MOLB 4495 - Bioinformatics (3)

Mechanical Engineering

With a focus upon biomaterials and biomechanics, this minor combines biology and physiology with mechanical engineering. This coursework helps students apply mechanical engineering principles to biological challenges including prosthetics, robotic surgery instruments, and medical device design.

CHE 3100 - Fundamentals of Bioengineering (3)
CHE 4100 - Biochemical Engineering (3)
CHE 4160 - Biomedical Engineering Transport Phenomena (3)
CHE 4165 - Biomaterials (3)
KIN 2040 - Human Anatomy (3)
KIN 3042 - Biomechanics of Human Movement (3)

Medical School Preparation:

Engineers are highly sought by medical schools and the following curriculum is designed to prepare any engineering student for the Medical College Admission Test and the rigors of medical school.

MOLB 2240 - Medical Microbiology (4)
MOLB 3610 Principles of Biochemistry (4)

CHE 4160 - Biomedical Engineering Transport Phenomena (3)
CHE 4165 - Biomaterials (3)
PHCY 3450 - Foundational Pathophysiology (4)*

Plus the following suggested coursework:

ZOO 3115 - Human Systems Physiology (4)
ZOO 4125 - Integrative Physiology (5)
MOLB 3000 - Introduction to Molecular Biology (3)
PSYC 1000 - General Psychology (3)
SOC 1000 - Sociological Principles (3)
* *or* PHCY 6120 - Advanced Pathophysiology (3)

In addition to the suggested tracks above, individual programs may be customized or augmented by selecting from any of the following approved credits, which may be counted in fulfillment of technical elective requirements within the major degree program.

Select 18 credit hours from the following:

CHE 3100 - Fundamentals of Bioengineering* (3)
CHE 4100 - Biochemical Engineering (3)
CHE 4160 - Biomedical Engineering Transport Phenomena (3)
CHE 4165 - Biomaterials (3)
CHE 3900 - Undergraduate Research in an appropriate laboratory (1-6)
CHE 4220 - Metabolic and Protein Engineering (3)
BE 4800 - Topics in Bioengineering (3)
BE 4810 - Bioinstrumentation (3)
BE 4820 - Biodata Systems (3)
EE 4800 - Problems in Bioengineering (1-6)
EE 5410 - Rehabilitation Engineering (3)
KIN 2040 - Human Anatomy (3)
KIN 2041 - Human Anatomy Laboratory (1)
KIN 3042 - Biomechanics of Human Movement (3)
LIFE 3050 - Genetics (4)
LIFE 3600 - Cell Biology (4)
MOLB 2240 - Medical Microbiology (4)
MOLB 3000 - Introduction to Molecular Biology (3)
MOLB 4100 - Clinical Biochemistry (3)
MOLB 4600 - Biochemistry 1: Bioenergetics and Metabolism (3)
MOLB 4610 - Biochemistry 2: Molecular Mechanisms (3)
MOLB 4260 - Quantitative Microscopy (1)
MOLB 4400 - Immunology (3)
MOLB 4495 - Bioinformatics (3)
PHCY 3450 - Foundational Pathophysiology (4)
PHCY 6120 - Advanced Pathophysiology (3)
ZOO 3115 - Human Systems Physiology (4)
ZOO 4125 - Integrative Physiology (5)

* CHE 3100 fulfills the LIFE 2021 & 3050 pre-requisite requirements for CHE 4100, 4160, and 4165. Alternatively, students may take the following in lieu of CHE 3100:

MICR 2021 Microbiology (4) or MOLB 3610 Principles of Biochemistry (4)