

# BIOENGINEERING

- Master of Science in Bioengineering (p. 1)

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## Master of Science in Bioengineering (BIE)

The program of study leading to the Master of Science in Bioengineering must include a minimum of 30 semester hours consisting of the following:

### Bioengineering Core:

BIE 501	Introduction to Bioengineering <sup>1</sup>	3
BIE 503	Principles of Biology for Bioengineers	3
BIE 505	Principles of Engineering for Bioengineers <sup>2</sup>	3
BIE 507	Bioengineering Experimentation Techniques	3
MTH 527	Biostatistics	3

Select one emphasis from: 6

### Biomaterials/Biomechanics:

MAT 595	Special Problems in Materials Engineering	
BIE 521	Biomechanical Engineering	
BIE 511	Biomaterials	

### Bioprocess:

BIE 533	Biofuel	
CME 560	Biological Processing of Wastewater	

### Biosystems:

BIE 551	Transport Phenomena in Biological Systems	
BIE 561	Biomedical Engineering I	

Electives (as approved by advisor and program director) 6

Choose thesis or non-thesis: 6

Thesis: approved thesis project, a final examination is required at completion of thesis

Non-thesis:

Electives (3 hours)	
Capstone project (3 hours)	

Total Hours 33

<sup>1</sup> Or Biology undergraduate.

<sup>2</sup> Or Engineering undergraduate.

See also Master's Degree Requirements under School of Engineering in the catalog and consult with the advisor. The program has faculty with joint appointments in various programs within the School of Engineering and the College of Arts and Sciences.

## Courses

### BIE 501. Introduction to Bioengineering. 3 Hours

This class provides an introduction to bioengineering - a branch of engineering focusing on biological systems, biomaterials, engineering applications in living systems, and many other areas. By the end of this course, students will be able to understand bioengineering applications and processes, and properly apply engineering fundamentals, including transport phenomena and reaction kinetics, to these systems. Prerequisite(s): BIO 151, CME 324 or MEE 308 or permission of instructor.

### BIE 503. Principles of Biology for Bioengineers. 3 Hours

This course is designed for students with undergraduate majors in engineering or non-biological sciences. The focus of the course is to provide a common broad base of basic knowledge and terminology in the biological sciences required for coursework in the bioengineering emphasis tracts. Prerequisite(s): (BIO 151, BIO 152) or permission of instructor.

### BIE 505. Principles of Engineering for Bioengineers. 3 Hours

This course is designed for students with an undergraduate degree in science. The focus of the course is to provide a common broad base of basic knowledge and terminology in engineering required for coursework in the bioengineering emphasis tracts. It will cover basic mass and energy conservation and provide an introduction to thermodynamics, fluid mechanics, and heat and mass transfer. Prerequisite(s): MTH 219 or permission of instructor.

### BIE 507. Bioengineering Experimentation Techniques. 3 Hours

Lecture/laboratory based course in basic biology laboratory techniques, generating testable hypotheses, formulating experimental design, report writing, and scientific presentation. Students will be introduced to basic techniques in DNA cloning, protein purification, RNA isolation, and bioengineering applications. Corequisite(s): (BIE 503 or equivalent) or permission of instructor.

### BIE 511. Biomaterials. 3 Hours

The course introduces students with engineering materials used in dentistry, manufacture of surgical devices, prosthetics, and repair of tissues. Topics include bonding and atomic arrangement in materials, material selection, testing, and characterization, biocompatibility, tissue response to materials, and failure analysis. A spectrum of materials including metals, polymers, ceramics, and composites used in biomedical applications will be considered.

### BIE 521. Biomechanical Engineering. 3 Hours

Application of engineering principles to clinical, occupational, and sports biomechanics topics. The course focuses on biomechanical analysis, particularly kinematics and kinetics of human movement, with emphasis on both research and product design. Prerequisite(s): (EGM 202; EGR 201) or permission of instructor.

### BIE 529. Computational Chemistry. 3 Hours

Introduction to computational chemistry including a discussion of ab initio, semiempirical, and DFT methods and an overview of molecular mechanics and molecular simulation methods. Lectures are supplemented by simulation exercises using commercial programs such as Gaussian and Milecular Studio. Prerequisite(s): CHM 124 or consent of instructor.

### BIE 533. Biofuel. 3 Hours

The course will provide an overview of the range of fuels derived from biological materials and processes, with a focus on anaerobic digestion, bioethanol and biodiesel and production of synthetic fuel from biological materials. The course will include an overview of the biochemistry of energy production in biological systems, discussions of the economics and environmental sustainability of biofuels, and a review of reactor and separation systems concepts relevant to biofuel production. Prerequisite(s) EGR 202, CHM 123 or consent of instructor.

### BIE 551. Transport Phenomena in Biological Systems. 3 Hours

An integrated interdisciplinary systems-based examination of biological transport phenomena (momentum, heat and mass) and hemodynamics through mathematical modeling and biological processes as applied to physiological systems, with a focus on the cardiovascular, respiratory, and renal systems. Prerequisite(s): (BIE 503 or BIE 505; BIO 151, BIO 152; MTH 218) or permission of instructor.

**BIE 560. Biological Processing of Wastewater. 3 Hours**

Measuring the characteristics of wastewater produced from domestic and industrial sources. Principles of designing and operating microbiological processes for the treatment of wastewater. Mechanism and kinetics of biological reactions emphasized. Prerequisite(s): CHM 124.

**BIE 561. Biomedical Engineering I. 3 Hours**

Introduction to the fundamental concepts in biomedical engineering with specific focus on chemical engineering applications. Biomedical topics include overviews of areas such as biomaterials, tissue engineering, biosensors and biomedical engineering technology. Prerequisite(s): BIO 151 and CME 324 or BIE 501 or permission of instructor.

**BIE 590. Selected Readings in Bioengineering. 1-3 Hours**

Directed readings in selected areas of bioengineering to be arranged and approved by the advisor and the program director.

**BIE 595. Special Problems in Bioengineering. 1-6 Hours**

Special assignments in bioengineering to be arranged and approved by the advisor and the program director.

**BIE 597. Research Methods. 3 Hours**

This course will provide students the ability to apply research methods and problem solving skills to identify and define a research problem, develop hypotheses and research plans to test those hypotheses. Students will write and present an original research proposal.

**BIE 598. Capstone Project. 1-3 Hours**

This is a capstone project to be used by non-thesis students. Students must submit a proposal and a final report.

**BIE 599. Thesis. 1-6 Hours**

This is a two course sequence to cover the research and thesis preparation of the graduate student.