

# Biomedical Engineering Minor

This Minor is intended primarily for undergraduate students throughout the MSU College of Engineering who have an interest in biomedical applications of engineering. The minor curriculum will give students the interdisciplinary expertise required to thrive in biomedical industry, professional programs, and graduate programs.

**Minor requirements:** A minimum 27 credits total is required for the minor. The minor consists of 6 credits of two required courses (ECHM 461 – 3 cr and EMAT 464 – 3 cr), 6 credits of Biology electives, 6 credits of Engineering/Math electives and 9 credits of General electives which, depending on a student's particular interest and background may fall into one of the following focus areas: Computational Modeling, Instrumentation, Biomechanics/Biomaterials, Tissue Engineering, or Biotechnology. It is not required that students follow any of the suggested focus areas, rather focus areas are provided to only to illustrate ways in which students can prepare themselves for some of the many diverse aspects of biomedical engineering. Note that some of the Biology electives and Engineering/Math electives are duplicated under one or more of the focus areas. Courses taken to satisfy the Biology or Engineering/Math elective credits may not also be used to satisfy the general electives in the focus areas (i.e. no double counting).

## Required Courses

EBIO 461	Principles of Biomedical Engineering	3
EMAT 464	Biomedical Materials Engineering	3

## Biology Electives (6 credits) 6

BCH 380 & BCH 381	Biochemistry and Biochemistry Lab (5 cr)	
BIOB 260	Cellular and Molecular Biology (4 cr)	
BIOB 375	General Genetics (3 cr)	
BIOB 410	Immunology (3 cr)	
BIOB 425	Adv Cell & Molecular Biology (3 cr)	
BIOH 201	Human Anatomy and Physiology I (5cr)	
BIOH 211	Human Anatomy and Physiology II (4cr)	
BIOH 287	Intermediate Human Phys I (3 cr)	
BIOH 288	Intermediate Human Phys II	
BIOH 320	Biomedical Genetics (3 cr)	
BIOH 323	Human Developmental Biology (4 cr)	
BIOH 458	Human Pathophysiology	
BIOM 250	Microbiology for Health Sciences: Infectious Diseases (3 cr)	
BIOM 360	General Microbiology (5 cr)	
BIOM 400	Medical Microbiology (3 cr)	
NEUR 313	Neurophysiology	

## Engineering and Math Electives (6 credits) 6

EBIO 216	Elem Princ of Biological Engineering (3 cr)	
EBIO 324	Bioengineering Transport (3 cr)	
EBME 301	Engineering Analysis of Physiological Systems	
EBME 410	Fundamentals of Bioelectronics for Bioinstrumentation	
EMEC 424	Cellular Mechanotransduction (3 cr)	
EMEC 440	Biomechanics of Human Movement	
EMEC 465	Bio-inspired Engineering (3 cr)	
M 430	Mathematical Biology (3 cr)	

## Focus Area Electives (9 credits)

9

### Computational Modeling Focus Area

M 221	Introduction to Linear Algebra (3 cr)
M 441	Numerical Linear Algebra & Optimization (3 cr)
M 442	Numerical Solution of Differential Equations (3 cr)
EMEC 103	CAE I-Engineering Graphics Communications (2 cr)
EMEC 203	CAE II-Mechanical Engineering Computations (2 cr)
EMEC 303	CAE III-- Systems Analysis (3 cr)

### Instrumentation Focus Area

EBME 410	Fundamentals of Bioelectronics for Bioinstrumentation
EELE 201	Circuits I for Engineering (4 cr)
EELE 203	Circuits II for Engineering (4 cr)
EELE 261	Intro To Logic Circuits (4 cr)
EELE 308	Signals and Systems Analysis (3 cr)
EELE 334	Electromagnetic Theory I (3 cr)
EELE 407	Intro To Microfabrication (3 cr)
EMEC 360	Measurement & Instrumentation (3 cr)

### Biomechanics/Biomaterials Focus Area

EGEN 201	Engineering Mechanics-Statics (3 cr)
EGEN 202	Engineering Mechanics -- Dynamics (3 cr)
EGEN 205	Mechanics of Materials (3 cr)
BIOB 410	Immunology (3 cr)
EMEC 424	Cellular Mechanotransduction (3 cr)
EMEC 440	Biomechanics of Human Movement
EMEC 465	Bio-inspired Engineering (3 cr)

### Tissue Engineering Focus Area

EBME 301	Engineering Analysis of Physiological Systems
EMEC 424	Cellular Mechanotransduction (3 cr)
EMEC 465	Bio-inspired Engineering (3 cr)
BIOB 260	Cellular and Molecular Biology (4 cr)
BIOB 425	Adv Cell & Molecular Biology (3 cr)
NEUR 313	Neurophysiology

### Biotechnology Focus Area

BCH 380	Biochemistry (5 cr)
BCH 441	Biochemistry of Macromolecules (3 cr)
BCH 444R	Biochemistry & Molecular Biology Methods (3 cr)
BIOB 105CS	Introduction to Biotechnology (3 cr)
BIOB 205	Methods in Biotechnology (4 cr)
BIOB 476R	Gene Construction (4 cr)
BIOH 320	Biomedical Genetics (3 cr)
BIOH 422	Genes and Cancer (3 cr)
BIOH 465R	Gene Expression Lab: From Genes to Proteins to Cells (3 cr)
BIOM 405	Host-Associated Microbiomes (4 cr)
EELE 418	The Art of Biochips – An Introduction to BioMEMS (3 cr)