

# BIOMEDICAL ENGINEERING DEGREE

Students must also complete the Undergraduate Registration Requirement (<https://catalogs.northwestern.edu/undergraduate/requirements-policies/undergraduate-registration-requirement/>) and the degree requirements of their home school.

## Requirements (48 units)

### Core Courses (27 units)<sup>1</sup>

**Course** **Title**  
**4 mathematics courses** (<https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext>)

#### 4 units of basic science:<sup>2</sup>

PHYSICS 135-2 & PHYSICS 135-3	General Physics and General Physics
CHEM 131-0 & CHEM 132-0 or CHEM 151-0 & CHEM 152-0 or CHEM 171-0 & CHEM 172-0	Fundamentals of Chemistry I and Fundamentals of Chemistry II General Chemistry I and General Chemistry II Advanced General Inorganic Chemistry and Advanced General Physical Chemistry

**4 engineering analysis and computer proficiency courses** (<https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext>)

**3 design and communications courses** (<https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext>)

**7 social sciences/humanities courses** (<https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext>)

**5 unrestricted electives** (<https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext>)

### Major Program (21 units)

**Course** **Title**

#### Basic Engineering (5 courses)

Take all of these courses:	
BMD_ENG 220-0 or IEMS 303-0	Introduction to Biomedical Statistics Statistics
BMD_ENG 270-0 or MECH_ENG 241-0	Fluid Mechanics Fluid Mechanics I
COMP_SCI 150-0	Fundamentals of Computer Programming 1.5
Take 2 of the following 3 courses:	
BMD_ENG 250-0 or MECH_ENG 222-0	Thermodynamics Thermodynamics & Statistical Mechanics - I
BMD_ENG 271-0	Introduction to Biomechanics
MAT_SCI 201-0	Introduction to Materials Science and Engineering Principles

#### Core courses (10 courses + 1 zero-credit seminar)

BMD_ENG 101-0	Introduction to Biomedical Engineering (noncredit)
BIOL_SCI 201-0	Molecular Biology
CHEM 215-1	Organic Chemistry I
BMD_ENG 207-0	BME Lab: Experimental Design
BMD_ENG 304-0	Quantitative Systems Physiology
BMD_ENG 305-0	Quantitative Systems Physiology
BMD_ENG 306-0	Quantitative Systems Physiology
BMD_ENG 308-0	Biomedical Signals and Circuits
BMD_ENG 309-0	Biomedical Systems Analysis

BMD_ENG 378-0	Transport Fundamentals
BMD_ENG 390-1	Biomedical Engineering Design

#### Biomedical engineering electives (4 courses)

2 category A courses (p. 1)

2 category B courses (p. 2)

#### Technical electives (2 courses)

Any engineering, science, or mathematics courses at the 300 level or higher, provided they are graded. The following courses may also be used:<sup>3</sup>

BIOL_SCI 202-0	Cell Biology
BIOL_SCI 301-0	Principles of Biochemistry
CHEM 215-2	Organic Chemistry II
CHEM 215-3	Organic Chemistry III
DSGN 240-0	Introduction to Solid Modeling: Solidworks (0.5 unit)
DSGN 321-0	Advanced Solid Modeling (0.5 unit)
COMP_SCI 211-0	Fundamentals of Computer Programming II

Three, 0.34 unit basic science and biology labs may also be combined and counted as a technical elective. Six total labs can be used.

BMD\_ENG 250-0, BMD\_ENG 271-0, or MAT\_SCI 201-0 may also be used as a technical elective course as long as it is not used as a basic engineering course.

<sup>1</sup> See general requirements (<https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext>) for details.

<sup>2</sup> PHYSICS 125-2 General Physics for ISP or PHYSICS 140-3 Fundamentals of Physics may be substituted for PHYSICS 135-2 General Physics. PHYSICS 125-3 General Physics for ISP or PHYSICS 140-3 Fundamentals of Physics may be substituted for PHYSICS 135-3 General Physics. Associated labs are PHYSICS 126-2 Physics Laboratory for ISP or PHYSICS 136-2 General Physics Laboratory and PHYSICS 126-3 Physics Laboratory for ISP or PHYSICS 136-3 General Physics Laboratory.

<sup>3</sup> These courses don't need to carry 100% engineering topics (<https://www.mccormick.northwestern.edu/academics/undergraduate/abet/course-partitioning.html>). Any 395 course must be approved; not all are acceptable. BME 399 Independent Study is only graded P/N and may not be used as a technical elective. BME 499 is graded and may be used as a technical elective.

## Biomedical Engineering Electives Category A Courses

Course	Title
BMD_ENG 311-0	Computational Genomics
BMD_ENG 312-0	Biomedical Applications in Machine Learning
BMD_ENG 317-0	Biochemical Sensors
BMD_ENG 325-0	Introduction to Medical Imaging
BMD_ENG 327-0	Magnetic Resonance Imaging
BMD_ENG 333-0	Modern Optical Microscopy & Imaging
BMD_ENG 340-0	Pharmaceutical Engineering: From Discovery to Therapeutics
BMD_ENG 343-0	Biomaterials and Medical Devices
BMD_ENG 344-0	Biological Performance of Materials
BMD_ENG 346-0	Tissue Engineering
BMD_ENG 347-0	Foundations of Regenerative Engineering
BMD_ENG 353-0	Bioelectronics
BMD_ENG 366-0	Biomechanics of Movement
BMD_ENG 371-0	Mechanics of Biological Tissue
BMD_ENG 377-0	Intermediate Fluid Mechanics

## Category B Courses

Course	Title
BIOI_SCI 202-0	Cell Biology *
BIOI_SCI 301-0	Principles of Biochemistry *
BMD_ENG 311-0	Computational Genomics
BMD_ENG 312-0	Biomedical Applications in Machine Learning
BMD_ENG 313-0	Wearable Devices: From Sensing to Biomedical Inference
BMD_ENG 317-0	Biochemical Sensors
BMD_ENG 323-0	Visual Engineering Science
BMD_ENG 325-0	Introduction to Medical Imaging
BMD_ENG 327-0	Magnetic Resonance Imaging
BMD_ENG 333-0	Modern Optical Microscopy & Imaging
BMD_ENG 340-0	Pharmaceutical Engineering: From Discovery to Therapeutics
BMD_ENG 343-0	Biomaterials and Medical Devices
BMD_ENG 344-0	Biological Performance of Materials
BMD_ENG 346-0	Tissue Engineering
BMD_ENG 347-0	Foundations of Regenerative Engineering
BMD_ENG 348-0	Applications of Regenerative Engineering
BMD_ENG 353-0	Bioelectronics
BMD_ENG 365-0	Control of Human Limbs and Their Artificial Replacements
BMD_ENG 366-0	Biomechanics of Movement
BMD_ENG 371-0	Mechanics of Biological Tissue
BMD_ENG 377-0	Intermediate Fluid Mechanics
BMD_ENG 380-0	Medical Devices, Disease & Global Health *
BMD_ENG 388-SA	Health Systems Engineering
CIV_ENV 327-0	Finite Element Methods in Mechanics
CHEM_ENG 361-0	Introduction to Polymers
CHEM_ENG 376-0	Principles of Synthetic Biology
CHEM_ENG 379-0	Computational Biology: Analysis and Design of Living Systems
COMP_SCI 211-0	Fundamentals of Computer Programming II
COMP_SCI 214-0	Data Structures & Algorithms
COMP_SCI 217-0	Data Management & Information Processing
COMP_SCI 339-0	Introduction to Database Systems
COMP_SCI 349-0	Machine Learning
DSGN 360-0	Design Competition
ELEC_ENG 302-0	Probabilistic Systems
ELEC_ENG 332-0	Introduction to Computer Vision
ELEC_ENG 335-0	Deep Learning Foundations from Scratch
ELEC_ENG 360-0	Introduction to Feedback Systems
ELEC_ENG 379-0	Lasers and Coherent Optics
ELEC_ENG 382-0	Photonic Information Processing
ES_APPM 370-1	Introduction to Computational Neuroscience
IEMS 304-0	Statistical Learning for Data Analysis
IEMS 385-0	Introduction to Health Systems Management
MAT_SCI 318-0	Materials Selection
MAT_SCI 360-0	Introduction to Electron Microscopy
MECH_ENG 301-0	Introduction to Robotics Laboratory
MECH_ENG 314-0	Machine Dynamics
MECH_ENG 315-0	Theory of Machines: Design of Elements
MECH_ENG 333-0	Introduction to Mechatronics
MECH_ENG 362-0	Stress Analysis
MECH_ENG 382-0	Experiments in Micro- and Nano Science and Engineering

MECH_ENG 390-0	Intro to Dynamic Systems
PHYSICS 357-0	Optics Laboratory *

\* Only one course that is less than 1 engineering unit can be counted toward the BME electives.