BIOMEDICAL ENGINEERING, BS

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin-Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (https://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the Guide.

General Education
- Breadth—Humanities/Literature/Arts: 6 credits
- Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth—Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

SUMMARY OF REQUIREMENTS

Code	Title	Credits
Mathematics		19
Science		32
General Education		21
Free Electives		4
Engineering Courses:		
Introduction to Engineering		3
Engineering Mechanics Core Courses		6
Biomedical Engineering Core Courses		23
Biomedical Engineering Area Technical Electives AND Advanced Biomedical Engineering Technical Elective		18
Engineering Technical Elective		2
Total Credits		**128**

MATHEMATICS

Code	Title	Credits
MATH 221 & MATH 222 & MATH 234	Calculus and Analytic Geometry 1 and Calculus and Analytic Geometry 2 and Calculus--Functions of Several Variables	13
MATH 320	Linear Algebra and Differential Equations	3
or MATH 319	Techniques in Ordinary Differential Equations	
B M E 325	Applied Statistics for Biomedical Engineers	3
or STAT 324	Introduction to Statistics for Science and Engineering	
or STAT/ MATH 431	Introduction to the Theory of Probability	
Total Credits		**19**

SCIENCE

Code	Title	Credits
COMP SCI 220	Data Science Programming I	3-4
or COMP SCI 200	Programming I	
or COMP SCI 300	Programming II	
PHYSICS 202	General Physics	5
or PHYSICS 208	General Physics	
General Chemistry - select one option:		5-9
CHEM 109	Advanced General Chemistry	
CHEM 103 & CHEM 104	General Chemistry I and General Chemistry II	
CHEM 343	Organic Chemistry I	3
Biology - select one option:		5-6
ZOOLOGY/ BIOLOGY 101 & ZOOLOGY/ BIOLOGY 102	Animal Biology and Animal Biology Laboratory	
ZOOLOGY/ BIOLOGY/ BOTANY 151	Introductory Biology	
BIOCORE 381 & BIOCORE 383	Evolution, Ecology, and Genetics and Cellular Biology	
Human Physiology/Systems Biology - select one option:		5
ANAT&PHY 335	Physiology	
BIOCORE 485 & BIOCORE 486	Principles of Physiology and Principles of Physiology Laboratory	
Advanced Biology/Life Science elective - select one option:		3
ANAT&PHY 337	Human Anatomy	
BIOCORE 587	Biological Interactions	
BIOCHEM 501	Introduction to Biochemistry	
BIOCHEM 507	General Biochemistry I	
BIOCHEM 508	General Biochemistry II	
BIOCHEM/ M M & I 575	Biology of Viruses	
GENETICS 466	Principles of Genetics	

ZOOLOGY 470	Introduction to Animal Development	
ZOOLOGY/ PSYCH 523	Neurobiology	
ZOOLOGY 570	Cell Biology	
Science Elective - select one option:		3
ANAT&PHY 337	Human Anatomy	
BIOCHEM 501	Introduction to Biochemistry	
BIOCHEM 507	General Biochemistry I	
BIOCHEM 508	General Biochemistry II	
BIOCHEM/ M M & I 575	Biology of Viruses	
CHEM 327	Fundamentals of Analytical Science	
CHEM 329	Fundamentals of Analytical Science	
CHEM 345	Organic Chemistry II	
CRB 640	Fundamentals of Stem Cell and Regenerative Biology	
CRB 650	Molecular and Cellular Organogenesis	
CRB/B M E 670	Biology of Heart Disease and Regeneration	
COMP SCI 300	Programming II	
COMP SCI 320	Data Science Programming II	
COMP SCI 400	Programming III	
GENETICS 466	Principles of Genetics	
GENETICS 467	General Genetics 1	
GENETICS 468	General Genetics 2	
GENETICS 520	Neurogenetics	
KINES 531	Neural Control of Movement	
MICROBIO 101	General Microbiology	
MICROBIO 303	Biology of Microorganisms	
M M & I 341	Immunology	
M M & I/PATH-BIO 528	Immunology	
ZOOLOGY 470	Introduction to Animal Development	
ZOOLOGY/ PSYCH 523	Neurobiology	
ZOOLOGY 570	Cell Biology	
Total Credits		**32-38**

GENERAL EDUCATION

Code	Title	Credits
Communications A		
Complete one of the following courses:		3
LSC 100	Science and Storytelling	
or COM ARTS 100	Introduction to Speech Composition	
or ENGL 100	Introduction to College Composition	
or ESL 118	Academic Writing II	
Communications B		
Complete one of the following courses:		3
B M E 301	Biomedical Engineering Design and Communication (if taken Fall 2023 or later)	
ZOOLOGY/ BIOLOGY/ BOTANY 152	Introductory Biology	
BIOCORE 384	Cellular Biology Laboratory	
At least 15 credits of liberal studies following the College of Engineering guidelines (https://guide.wisc.edu/undergraduate/engineering/#requirementstext)		15
Total Credits		**21**

ENGINEERING COURSES

Code	Title	Credits
Introduction to Engineering		
INTEREGR 170	Design Practicum [1]	3
Engineering Mechanics Core Courses		
E M A 201	Statics [2]	3
or PHYSICS 201	General Physics	
or PHYSICS 207	General Physics	
E M A 303	Mechanics of Materials	3
B M E Core Courses		
B M E 200	Biomedical Engineering Design	2
B M E 201	Biomedical Engineering Design and Fundamentals	3
B M E 300	Biomedical Engineering Design and Leadership	3
B M E 310	Bioinstrumentation	3
B M E 315	Biomechanics	3
B M E 400	Capstone Design Course in Biomedical Engineering	3
B M E 402	Biomedical Engineering Capstone Design II	3
B M E/PHM SCI 430	Biological Interactions with Materials	3
Biomedical Engineering Area Technical Electives (see below) AND		
One Advanced B M E Technical Elective from any area (see complete list below)		*18*
Engineering Technical Elective: Any engineering course(s) from a degree-granting engineering program [3]		*2*
Total Credits		**52**

1 Students transferring from other engineering majors may count their previous program's introduction to engineering course(s) here (CBE 150 Introduction to Chemical Engineering, E C E 210 Introductory Experience in Electrical Engineering, E C E/COMP SCI 252 Introduction to Computer Engineering, E M A 200 Introduction to Aerospace Engineering, G L E 171 Introduction to Geological Engineering, INTEREGR 170 Design Practicum, I SY E 191 The Practice of Industrial Engineering, M E 201 Introduction to Mechanical Engineering, M S & E 260 Materials Experience, and NAV SCI 301 Naval Engineering).

2 It is highly recommended that students take E M A 201 Statics instead of PHYSICS 201 General Physics. E M A 201 Statics is a requisite for E M A 303 Mechanics of Materials and thus taking PHYSICS 201/PHYSICS 207 General Physics alone is not recommended.

3 The number of credits in this area can range from 2 or more such that at least 2 credits are met here and 48 engineering credits are met overall. This number of credits depends on how students decide to fulfill various requirements when they enter or progress into program, and if

they study abroad. Examples that may add additional credits include (and are not limited to): Taking PHYSICS 201 General Physics instead of E M A 201 Statics may add 3 credits. Transfer students are not required to take INTEREGR 170 Design Practicum, which may add 3 credits. Students who study abroad may miss a design course which may add credit. Regardless of the choices made, all students must have at minimum 48 credits of engineering courses from degree-granting programs.

- InterEGR courses are not included in this category except INTEREGR 170 Design Practicum.
- Only 3 credits of an engineering independent study may count (e.g., B M E 399 Independent Study, B M E 489 Honors in Research , CBE 699 Advanced Independent Studies, etc.) toward the 48 engineering credit count.
- Special topics courses must have prior approval of the B M E Curriculum Committee.

BIOMEDICAL ENGINEERING AREA TECHNICAL ELECTIVE REQUIREMENTS

- Choose area technical electives from one of the following areas below and at least one advanced B M E elective from any area as shown in the complete list below for a total of 18 credits.
- Introduction to engineering courses (CBE 150, E C E 210, E C E/ COMP SCI 252, E M A 200, G L E 171, INTEREGR 170, I SY E 191, M E 201, M S & E 260, and NAV SCI 301), seminar courses, and research credits cannot count in these areas. Special topics courses must have prior approval of the BME Curriculum Committee. All courses must be numbered 200 or higher.

Bioinstrumentation and Medical Devices:

Code	Title	Credits
Required Area Elective		
E C E 230	Circuit Analysis	4
Area Electives in Bioinstrumentation		**11**
Choose from any ECE course, the courses below, and from the advanced BME electives in this area		
M E 445	Mechatronics in Control & Product Realization	3
Advanced B M E Area Technical Electives in Bioinstrumentation and Medical Devices		
B M E/E C E 462	Medical Instrumentation	3
B M E/E C E 463	Computers in Medicine	3
B M E/ MED PHYS 535	Introduction to Energy-Tissue Interactions	3
B M E 550	Introduction to Biological and Medical Microsystems	3
B M E 556	Systems Biology: Mammalian Signaling Networks	3
B M E 603	Special Topics in Bioinstrumentation and Medical Devices	1-3
B M E 640	Medical Devices Ecosystem: The Path to Product	3

Biomedical Imaging and Optics:

Code	Title	Credits
Required Area Elective		
E C E 330	Signals and Systems	3
Area Electives in Biomedical Imaging and Optics		
Choose from the following and from the advanced BME electives in this area		12
E C E 203	Signals, Information, and Computation	3
E C E 204	Data Science & Engineering	3
E C E 331	Introduction to Random Signal Analysis and Statistics	3
E C E 431	Digital Signal Processing	3
E C E/ COMP SCI 533	Image Processing	3
B M E/H ONCOL/ MED PHYS/ PHYSICS 501	Radiation Physics and Dosimetry	3
B M E/ MED PHYS 566	Physics of Radiotherapy	3
B M E/ MED PHYS 573	Mathematical Methods in Medical Physics	3
B M E/ MED PHYS 580	The Physics of Medical Imaging with Ionizing Radiation	4
N E 305	Fundamentals of Nuclear Engineering	3
N E 408	Ionizing Radiation	3
N E 427	Nuclear Instrumentation Laboratory	2
Advanced B M E Area Technical Electives in Biomedical Imaging and Optics		
B M E/ MED PHYS 535	Introduction to Energy-Tissue Interactions	3
B M E/ MED PHYS 578	Non-Ionizing Diagnostic Imaging	4
B M E 604	Special Topics in Biomedical Imaging and Optics	1-3
B M E/MED PHYS/ PHMCOL-M/PHYSICS/ RADIOL 619	Microscopy of Life	3
B M E 651	Biophotonics Laboratory	3

Biomechanics:

Code	Title	Credits
Required Area Elective		
E M A 202	Dynamics	3
Area Electives in Biomechanics		
Choose from any E M A or M E course, the courses below, and from the advanced B M E electives in this area		12
M S & E 350	Introduction to Materials Science	3
or M S & E 351	Materials Science-Structure and Property Relations in Solids	
M S & E/CHEM 421	Polymeric Materials	3
CBE 320	Introductory Transport Phenomena	4
or B M E 330	Engineering Principles of Molecules, Cells, and Tissues	
CBE 324	Transport Phenomena Lab	3
Advanced B M E Area Technical Electives in Biomechanics		

B M E/M E 414	Orthopaedic Biomechanics - Design of Orthopaedic Implants	3
B M E/M E 415	Biomechanics of Human Movement	3
B M E/M E 505	Biofluidics	3
B M E/M E 516	Finite Elements for Biological and Other Soft Materials	3
B M E/ MED PHYS 535	Introduction to Energy-Tissue Interactions	3
B M E/I SY E 564	Occupational Ergonomics and Biomechanics	3
B M E/M E 605	Special Topics in Biomechanics	1-3
B M E/M E 615	Tissue Mechanics	3
B M E/I SY E 662	Design and Human Disability and Aging	3

Biomaterials, Cellular and Tissue Engineering:

Code	Title	Credits
Required Area Elective		
B M E 330	Engineering Principles of Molecules, Cells, and Tissues	4
or CBE 320	Introductory Transport Phenomena	
Area Electives in Biomaterials, Cellular and Tissue Engineering		
Choose from any CBE or M S & E course, the courses below, and from the advanced B M E electives in this area		11
M E 417	Transport Phenomena in Polymer Processing	3
M E 418	Engineering Design with Polymers	3
M E/STAT 424	Statistical Experimental Design	3
B M E 511	Tissue Engineering Laboratory	1
Advanced B M E Area Technical Electives in Biomaterials, Cellular and Tissue Engineering		
B M E/M E 505	Biofluidics	3
B M E 510	Introduction to Tissue Engineering	3
B M E/M E 516	Finite Elements for Biological and Other Soft Materials	3
B M E 520	Stem Cell Bioengineering	3
B M E 545	Engineering Extracellular Matrices	3
B M E 550	Introduction to Biological and Medical Microsystems	3
B M E 556	Systems Biology: Mammalian Signaling Networks	3
B M E/CBE 560	Biochemical Engineering	3
B M E 606	Special Topics in Biomaterials, Cellular and Tissue Engineering	1-3
B M E/M E 615	Tissue Mechanics	3
B M E/MED PHYS/ PHMCOL-M/PHYSICS/ RADIOL 619	Microscopy of Life	3

One Advanced B M E Technical Elective from any area (complete list) - 1 course:

Code	Title	Credits
Required 1 course		3
B M E/M E 414	Orthopaedic Biomechanics - Design of Orthopaedic Implants	3
B M E/M E 415	Biomechanics of Human Movement	3
B M E/E C E 462	Medical Instrumentation	3
B M E/E C E 463	Computers in Medicine	3
B M E/M E 505	Biofluidics	3
B M E 510	Introduction to Tissue Engineering	3
B M E/M E 516	Finite Elements for Biological and Other Soft Materials	3
B M E 520	Stem Cell Bioengineering	3
B M E/ MED PHYS 535	Introduction to Energy-Tissue Interactions	3
B M E 545	Engineering Extracellular Matrices	3
B M E 550	Introduction to Biological and Medical Microsystems	3
B M E 556	Systems Biology: Mammalian Signaling Networks	3
B M E/CBE 560	Biochemical Engineering	3
B M E/I SY E 564	Occupational Ergonomics and Biomechanics	3
B M E/ MED PHYS 578	Non-Ionizing Diagnostic Imaging	4
B M E 603	Special Topics in Bioinstrumentation and Medical Devices	1-3
B M E 604	Special Topics in Biomedical Imaging and Optics	1-3
B M E/M E 605	Special Topics in Biomechanics	1-3
B M E 606	Special Topics in Biomaterials, Cellular and Tissue Engineering	1-3
B M E/M E 615	Tissue Mechanics	3
B M E/MED PHYS/ PHMCOL-M/PHYSICS/ RADIOL 619	Microscopy of Life	3
B M E 640	Medical Devices Ecosystem: The Path to Product	3
B M E 651	Biophotonics Laboratory	3
B M E/I SY E 662	Design and Human Disability and Aging	3

HONORS IN UNDERGRADUATE RESEARCH PROGRAM

Qualified undergraduates may earn an Honors in Research designation on their transcript and diploma by completing 8 credits of undergraduate honors research, including a senior thesis. For more information about the program and the application form, visit: https://go.wisc.edu/bme-honors-application (https://go.wisc.edu/bme-honors-application/)

TOTAL DEGREE CREDITS: AT LEAST 128

UNIVERSITY DEGREE REQUIREMENTS

Total Degree	To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.
Residency	Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. “In residence” credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.
Quality of Work	Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.