Biomedical engineering (BME) is the application of engineering tools for solving problems in biology and medicine. BMEs apply their multidisciplinary expertise to problems such as designing new medical instruments and devices, understanding and repairing the human body, and applying resourceful and cross-disciplinary approaches to age-old problems in the fields of medicine, biology, and beyond. A biomedical engineer can expect to work in a wide variety of multidisciplinary teams with professionals such as physicians, biologists, researchers, nurses, therapists, mathematicians, administrators, and many others while working in industry, as entrepreneurs, in the medical profession, and in academia.

To prepare students for such careers, the 128-credit, four-year BME undergraduate degree emphasizes engineering design; access to cooperatives/internships at local or national medical device manufacturers, hospitals, or laboratories; continuous advising; flexibility in engineering specialization areas; participation in program evaluation and improvement; study-abroad opportunities; and an option to complete a one-year MS degree following the undergraduate program.

The backbone of the BME program is its unique, seven-semester design curriculum. Students take an advising/design project course in their first year and every semester their fourth year (with options to work in industry and/or focus on pre-health requirements). A faculty member advises small teams of students, serving as advisor/consultant/mentor, to guide them through real-world design projects solicited from clients throughout the university, medical profession, industry, and the community. These clients serve as resources for students in their projects, conduct discussions, and expose the students to various aspects of the BME field. Over the course of each semester, teams design, fabricate, and ultimately present a product that meets the needs of the client. This novel approach gives students an exceptionally balanced education by incorporating clinical and biomedical industry experience, thus expanding their network. Overall, the design experiences highlight the very multidisciplinary nature of BME.

Within the program, BME students choose a course of study that emphasizes one of the following four specializations within the field:

1. **Bioinstrumentation and medical devices** is the application of electronics, measurement principles, and techniques to develop devices used in diagnosis and treatment of disease. Examples include the electrocardiogram, brain–computer interface, implantable electrodes, sensors, tumor ablation, and other medical devices. Neuroengineering, a subfield, involves using engineering technology to study the function of neural systems and the development of implantable technology for neuromotor and rehabilitation applications.

2. **Biomedical imaging and optics** involves the design and enhancement of systems for noninvasive anatomical, cellular, and molecular imaging. In addition to common imaging techniques such as magnetic resonance imaging (MRI), computed tomography (CT), and positron emission tomography (PET), biomedical imaging includes topics such as biophotonics, optics, and multimode imaging, and is now expanding to serve functional and therapeutic purposes as well. Advanced capabilities result when fundamentals of engineering, physics, and computer science are applied in conjunction with the expertise of clinical collaborators.

3. **Biomechanics** applies engineering mechanics for understanding biological processes and for solving medical problems at systemic, organ, tissue, cellular, and molecular levels. This includes the mechanics of connective tissues (ligament, tendon, cartilage, and bone) as well as orthopedic devices (fracture fixation hardware and joint prostheses), vascular remodeling, muscle mechanics with injury and healing, human motor control, neuromuscular adaptation (with age, injury, and disease), microfluidics for cellular applications, cellular motility and adhesion, and rehabilitation engineering.

4. **Biomaterials, cellular and tissue engineering** involves the characterization and use of structural materials, derived from synthetic or natural sources, to design medical products that safely interact with tissues for therapeutic or diagnostic purposes such as artificial blood vessels, heart valves, orthopedic joints, and drug delivery vehicles. Tissue engineers understand structure–function relationships in normal and pathological tissues to engineer living tissues and/or biological substitutes to restore, maintain, or improve function. At the cellular and molecular level this includes the study or manipulation of biological processes such as the cell’s differentiation, proliferation, growth, migration, apoptosis, and can involve genetic and stem cell engineering.

Although the various disciplines within BME can be separately defined, solving a biomedical program requires an overall understanding of the field. For example, the design of an artificial hip requires an understanding of the forces and biomechanics of human movement as well as the mechanical and material properties of the prosthetic device. The material choice and topography play a critical role in cellular and tissue integration, which ultimately leads to long-term stability of the implant. In addition, biomedical imaging techniques are required to characterize the morphology of the diseased hip and the success of the procedure. Finally, instrumentation devices are utilized during the hip replacement surgery.

Students choose the biomedical engineering field to be of service to people; for the excitement of working with living systems; and to apply advanced technology to the complex problems of medical care. Students in the BME program can expect to develop skills in innovative thinking, critical analysis of ethics, project management, and technical writing, all in an environment that cultivates creativity, teamwork, and curiosity. With many possible focuses within the major, BME students have the opportunity to explore and cultivate their interests in specific topics while applying the concepts of engineering to medical applications, hands-on projects, and cutting-edge research.

Students successfully completing the BS degree in BME with an overall GPA of 3.0 or a GPA of 3.25 for the last 60 credits of the BS program are eligible to apply for the one-year MS degree.

**HOW TO GET IN**

**ADMISSION TO THE COLLEGE AS A FIRST-YEAR STUDENTS**

Students applying to UW–Madison ([https://www.admissions.wisc.edu/apply/](https://www.admissions.wisc.edu/apply/)) need to indicate an engineering major ([https://engineering.wisc.edu/degrees-programs/undergraduate/](https://engineering.wisc.edu/degrees-programs/undergraduate/)) as their first choice in order to be considered for direct admission to the College of Engineering. Being directly admitted to a major means students will start...
in the program of their choice in the College of Engineering and will need to meet progression requirements (https://engineering.wisc.edu/student-services/undergraduate-student-advising/progression/) at the end of the first year to guarantee advancement in that program.

**CROSS-CAMPUS TRANSFER TO ENGINEERING**

UW–Madison students in other schools and colleges on campus must meet minimum admission requirements (https://engineering.wisc.edu/admissions/undergraduate/cross-campus-students/) for admission consideration to engineering degree programs. Cross-campus admission is competitive and selective, and the grade point average expectations may increase as demand trends change. The student’s overall academic record at UW–Madison is also considered. Students apply to their intended engineering program by submitting the online application by stated deadlines for spring and fall. The College of Engineering offers an online information tutorial and drop-in advising (https://engineering.wisc.edu/admissions/undergraduate/cross-campus-students/) for students to learn about the cross-campus transfer process.

**OFF-CAMPUS TRANSFER TO ENGINEERING**

With careful planning, students at other accredited institutions can transfer coursework that will apply toward engineering degree requirements at UW–Madison. Off-campus transfer applicants are considered for direct admission to the College of Engineering by applying to the Office of Admissions with an engineering major listed as their first choice. Those who are admitted to their intended engineering program must meet progression requirements (https://engineering.wisc.edu/admissions/undergraduate/transfer-from-off-campus/) at the point of transfer or within their first two semesters at UW–Madison to guarantee advancement in that program. A minimum of 30 credits in residence in the College of Engineering is required after transferring, and all students must meet all requirements for their major in the college. Transfer admission to the College of Engineering is competitive and selective, and students who have exceeded the 80 credit limit at the time of application are not eligible to apply.

The College of Engineering has dual degree programs with select four-year UW System campuses. Eligible dual degree applicants are not subject to the 80 credit limit.

Off-campus transfer students are encouraged to discuss their interests, academic background, and admission options with the Transfer & Academic Program Manager in the College of Engineering: ugtransfer@engr.wisc.edu or 608-262-2473.

**SECOND BACHELOR’S DEGREE**

The College of Engineering does not accept second undergraduate degree applications. Second degree student (https://engineering.wisc.edu/admissions/undergraduate/adult-students-second-degree-students/) might explore the Biological Systems Engineering program at UW–Madison, an undergraduate engineering degree elsewhere, or a graduate program in the College of Engineering.

### 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 (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatetext) 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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td><strong>Mathematics</strong></td>
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<td><strong>Science</strong></td>
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<td><strong>General Education</strong></td>
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<td>21</td>
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<tr>
<td><strong>Engineering Courses:</strong></td>
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<tr>
<td>Introduction to Engineering</td>
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<tr>
<td>Engineering Mechanics Core Courses</td>
<td></td>
<td>6</td>
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<tr>
<td>Biomedical Engineering Core Courses</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>Biomedical Engineering Area Technical Elective Requirements AND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Biomedical Technical Elective</td>
<td></td>
<td>18</td>
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<tr>
<td>Engineering Technical Elective</td>
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<tr>
<td><strong>Total Credits</strong></td>
<td>At least 128</td>
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### MATHEMATICS

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 221 &amp; MATH 222</td>
<td>Calculus and Analytic Geometry 1 and Calculus for Engineering</td>
<td>13</td>
</tr>
<tr>
<td>&amp; MATH 234</td>
<td>Geometry 2 and Calculus--Functions of Several Variables</td>
<td></td>
</tr>
<tr>
<td>MATH 320</td>
<td>Linear Algebra and Differential Equations</td>
<td>3</td>
</tr>
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</table>
or MATH 319 Techniques in Ordinary Differential Equations
B M E 325 Applied Statistics for Biomedical Engineers
or STAT 324 Introductory Applied Statistics for Engineers
or STAT/ MATH 431 Introduction to the Theory of Probability

Total Credits 19

SCIENCE

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>COMP SCI 220</td>
<td>Data Science Programming I</td>
<td>3-4</td>
</tr>
<tr>
<td>or COMP SCI 200</td>
<td>Programming I</td>
<td></td>
</tr>
<tr>
<td>or COMP SCI 300</td>
<td>Programming II</td>
<td></td>
</tr>
</tbody>
</table>

PHYSICS 202 General Physics 5
or PHYSICS 208 General Physics

General Chemistry - select one option: 5-9
CHEM 109 Advanced General Chemistry
CHEM 103 General Chemistry I
& CHEM 104 and General Chemistry II
CHEM 343 Organic Chemistry I 3

Biology - select one option: 5-6
ZOOLOGY/ BIOLOGY 101 Animal Biology
& ZOOLOGY/ BIOLOGY 102 and Animal Biology Laboratory

ZOOLOGY/ BIOLOGY/ BOTANY 151 Introductory Biology

BIOCORE 381 Evolution, Ecology, and Genetics
& BIOCORE 383 and Cellular Biology

Human Physiology/Systems Biology - select one option: 5
ANAT&PHY 335 Physiology
BIOCORE 485 Principles of Physiology
& BIOCORE 486 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 I
GENETICS 468 General Genetics 2
GENETICS 520 Neurogenetics
KINES 531 Neural Control of Movement
MICROBIO 101 General Microbiology
MICROBIO 303 Biology of Microorganisms
MICROBIO 330 Host-Parasite Interactions
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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications A</td>
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<td></td>
</tr>
<tr>
<td>LSC 100</td>
<td>Science and Storytelling</td>
<td>3</td>
</tr>
<tr>
<td>or COM ARTS 1</td>
<td>Introduction to Speech Composition</td>
<td></td>
</tr>
<tr>
<td>or ENGL 100</td>
<td>Introduction to College Composition</td>
<td></td>
</tr>
<tr>
<td>or ESL 118</td>
<td>Academic Writing II</td>
<td></td>
</tr>
</tbody>
</table>

Communications B (choose one): 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 (http://guide.wisc.edu/undergraduate/engineering/#requirements)

Total Credits 21
ENGINEERING COURSES

**Required Engineering Mechanics core courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>E M A 201</td>
<td>Statics</td>
<td>2</td>
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<tr>
<td>or PHYSICS 201 General Physics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or PHYSICS 207 General Physics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E M A 303</td>
<td>Mechanics of Materials</td>
<td></td>
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</tbody>
</table>

**Required B M E core courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>B M E 200</td>
<td>Biomedical Engineering Design</td>
<td></td>
</tr>
<tr>
<td>B M E 201</td>
<td>Biomedical Engineering Design and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fundamentals</td>
<td></td>
</tr>
<tr>
<td>B M E 300</td>
<td>Biomedical Engineering Design and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leadership</td>
<td></td>
</tr>
<tr>
<td>B M E 310</td>
<td>Bioinstrumentation</td>
<td></td>
</tr>
<tr>
<td>B M E 315</td>
<td>Biomechanics</td>
<td></td>
</tr>
<tr>
<td>B M E 400</td>
<td>Capstone Design Course in Biomedical Engineering</td>
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</tr>
<tr>
<td>B M E 402</td>
<td>Biomedical Engineering Capstone</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design II</td>
<td></td>
</tr>
<tr>
<td>B M E/</td>
<td>PHM SCI  430</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biological Interactions with Materials</td>
<td></td>
</tr>
</tbody>
</table>

**Biomedical Engineering Area Technical Electives (see below) AND**

**One Advanced B M E Technical Elective from any area (see complete list below)**

**Engineering Technical Elective: Any engineering course(s) from a degree-granting engineering program**

**Total Credits**

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, 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 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, 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 B M E Curriculum Committee.

**Bioinstrumentation and Medical Devices:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>E C E 230</td>
<td>Circuit Analysis</td>
<td>4</td>
</tr>
<tr>
<td>M E 445</td>
<td>Mechatronics in Control &amp; Product</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Realization</td>
<td></td>
</tr>
<tr>
<td>B M E/E C E 462</td>
<td>Medical Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>B M E/E C E 463</td>
<td>Computers in Medicine</td>
<td>3</td>
</tr>
<tr>
<td>B M E/</td>
<td>MED PHYS  535</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Introduction to Energy-Tissue</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interactions</td>
<td></td>
</tr>
<tr>
<td>B M E 550</td>
<td>Introduction to Biological and</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Medical Microsystems</td>
<td></td>
</tr>
<tr>
<td>B M E 556</td>
<td>Systems Biology: Mammalian</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Signaling Networks</td>
<td></td>
</tr>
<tr>
<td>B M E 603</td>
<td>Special Topics in Bioinstrumentation and Medical Devices</td>
<td>1-3</td>
</tr>
<tr>
<td>B M E 640</td>
<td>Medical Devices Ecosystem: The Path to Product</td>
<td>3</td>
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</tbody>
</table>

**Biomedical Imaging and Optics:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>E C E 230</td>
<td>Signals and Systems</td>
<td>3</td>
</tr>
<tr>
<td>E C E 203</td>
<td>Signals, Information, and</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Computation</td>
<td></td>
</tr>
<tr>
<td>E C E 204</td>
<td>Data Science &amp; Engineering</td>
<td>3</td>
</tr>
<tr>
<td>E C E 331</td>
<td>Introduction to Random Signal</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Analysis and Statistics</td>
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</tr>
</tbody>
</table>
B E C 431  Digital Signal Processing  3
B E C/ 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:**

**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

M S & E  350  Introduction to Materials Science  3
M S & E  351  Materials Science-Structure and Property Relations in Solids  3
M S & E/CHEM  421  Polymeric Materials  3
CBE  320  Introductory Transport Phenomena  4
CBE/M E  330  Engineering Principles of Molecules, Cells, and Tissues  3
CBE/M E  324  Transport Phenomena Lab  3
CBE/M E  525  Macromolecular Hydrodynamics  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:**

**Required Area Elective**

B M E  330  Engineering Principles of Molecules, Cells, and Tissues  4

**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

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:**

**Required 1 course**

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/C E  462  Medical Instrumentation  3
B M 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 SYE 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/MHCMOL-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 SYE 662  Design and Human Disability and Aging  3

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.

LEARNING OUTCOMES

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. 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
3. an ability to communicate effectively with a range of audiences
4. 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
5. 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
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

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

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. |

FOUR-YEAR PLAN

SAMPLE FOUR-YEAR PLAN

First Year

| Fall |
| Credits |
| INTEREGR 170\(^3\) | 3 |
| or Liberal Studies Elective\(^{\text{Med}}\) | 3 |
| MATH 221 | 5 |
| Communications A | 3 |
| CHEM 109 (or CHEM 103 and CHEM 104)\(^1\) | 5 |

Second Year

| Fall |
| Credits |
| B M E 200\(^5\) | 2 |
| MATH 234 | 4 |
| PHYSICS 202 or 208 | 5 |
| Science Elective\(^6,\text{Med}^{2}\) | 3 |

TOTAL 16 16
B M E 325, STAT 324, or STAT 431<sup>1</sup> 3 Free-General Elective Credits<sup>5, Med</sup> 2

B M E 310<sup>7</sup> 3

17 17

**Third Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>B M E 300&lt;sup&gt;5&lt;/sup&gt;</td>
<td>3 Select one of the following options:&lt;sup&gt;9, Med&lt;/sup&gt;</td>
<td>5</td>
</tr>
<tr>
<td>B M E 301 (3 cr) &amp; Free-General Elective (2 cr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZOOLOGY/BIOLOGY 101 &amp; ZOOLOGY/BIOLOGY 102</td>
<td>ZOOLOGY/BIOLOGY/BOTANY 152</td>
<td></td>
</tr>
<tr>
<td>ZOOLOGY/BIOLOGY/BOTANY 151&lt;sup&gt;Med&lt;/sup&gt;</td>
<td>BIOCORE 383 &amp; BIOCORE 384</td>
<td></td>
</tr>
<tr>
<td>BIOCORE 381 &amp; BIOCORE 382 (the first lab – 382 – is recommended not required)&lt;sup&gt;8&lt;/sup&gt;</td>
<td>Liberal Studies Elective</td>
<td></td>
</tr>
<tr>
<td>BIOCORE 485 Principles of Physiology</td>
<td>BIOCORE 486 Principles of Physiology</td>
<td></td>
</tr>
<tr>
<td>BIOCORE 384 Principles of Physiology Laboratory</td>
<td>BIOCORE 385 Principles of Physiology Laboratory</td>
<td></td>
</tr>
<tr>
<td>B M E 310&lt;sup&gt;7&lt;/sup&gt;</td>
<td>3 B M E/PHM SCI 430&lt;sup&gt;7&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Area-Required Engineering Technical Elective</td>
<td>3 Area-Engineering Technical Elective</td>
<td></td>
</tr>
</tbody>
</table>

| Credits | 17 | 16 |

**Fourth Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>B M E 400</td>
<td>3 B M E 402&lt;sup&gt;5&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>Select one of the following options:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANAT&amp;PHY 335</td>
<td>Advanced Biology/Life Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>BIOCORE 485 &amp; BIOCORE 486</td>
<td>Advanced Biomedical Engineering Technical Elective</td>
<td>3</td>
</tr>
<tr>
<td>Area-Engineering Technical Elective</td>
<td>Area-Engineering Technical Elective</td>
<td>3</td>
</tr>
<tr>
<td>Area-Engineering Technical Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Credits | 14 | 15 |

**Total Credits 128**

**FOOTNOTES**

Med These courses are identified as requirements for most medical schools and are included within the 128 degree credits. Students not wishing to attend medical school may choose any of the listed options. Choosing other options will affect the total number of credits.

Medical schools have varying requirements. Liberal electives, free-
general electives, and zoology electives can often be used to satisfy these. Check requirements early. For example, to prepare for the MCAT it is recommended that students take psychology and sociology. In addition, some schools require an intermediate humanities or social science with an intensive writing component (Comm B) or credits in the English department. All these can be fulfilled within the liberal studies requirements and thus early planning starting freshman year is important. A good resource is: http://prehealth.wisc.edu/.

1 CHEM 103 General Chemistry I & CHEM 104 General Chemistry II may be substituted for CHEM 109 Advanced General Chemistry. For this choice, the excess 4 credits are counted as free-general electives. Most medical schools require one year of basic chemistry. UW–Madison’s medical school (and others) accepts CHEM 109 as a full-year equivalent.

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 and thus taking PHYSICS 201/PHYSICS 207 General Physics alone is not recommended.

3 INTEREGR 170 Design Practicum is required only for students directly admitted to B M E as freshmen and counts toward the 48 engineering credits.

4 It is recommended that students take statistics and/or computer science in the freshman year for those needing additional core course options. B M E 325 Applied Statistics for Biomedical Engineers is open to first year students. MATH/STAT 431 Introduction to the Theory of Probability is only recommended for students interested in a math certificate or second major.

5 Students who are admitted late to the program and/or students who take part in another experience (such as co-op and/or study abroad), missing B M E 200 Biomedical Engineering Design or B M E 300 Biomedical Engineering Design and Leadership, or students who may graduate early missing B M E 402 Biomedical Engineering Capstone Design II on a rare approved exception, may substitute for up to two of these courses for the semester they are not in the program or at UW-Madison.

Approved substitutions include: B M E 1 Cooperative Education Program, engineering research credit, or any course numbered 200 or above additional engineering technical elective lab or design experience.

For more information on the unique design sequence see: http://bm speedy.engr.wisc.edu/about/.

6 Premeds or students interested in biomaterials, cellular and tissue engineering should choose to take CHEM 345 and it is recommended to use Free-General Electives for CHEM 344.

7 The three core courses are all required: B M E 310 Bioinstrumentation, B M E 315 Biomechanics, B M E/PHM SCI 430 Biological Interactions with Materials, but they can be taken in any order. It is recommended that students take the one in their track of interest first, or as early as possible.

8 Students very serious about medical school or a career in research and learning about biology may select to apply for BIOCORE, a rigorous biology honors program:

- BIOCORE 381 Evolution, Ecology, and Genetics
- BIOCORE 382 Evolution, Ecology, and Genetics Laboratory
- BIOCORE 383 Cellular Biology
- BIOCORE 384 Cellular Biology Laboratory
- BIOCORE 485 Principles of Physiology
- BIOCORE 486 Principles of Physiology Laboratory

The BIOCORE courses have limited enrollment and students must be accepted into this program (applying as freshman). It is generally advisable to complete the entire sequence once it is started.

Only BIOCORE 382 Evolution, Ecology, and Genetics Laboratory is not required and is not necessary to fulfill premed requirements; however, it is recommended as it has been helpful in understanding...
the BICORE lab process. If all the other BICORE courses are taken (a total of 16 cr), this will replace the ZOOLOGY/BIOLOGY 101 Animal Biology and ZOOLOGY/BIOLOGY 102 Animal Biology Laboratory, the Advanced Life Science Elective, ANAT&PHY 335 Physiology, and fulfill the Communication B requirement.

Students interested in pre-health programs should take ZOOLOGY/BIOLOGY/BOTANY 152 Introductory Biology or BICORE 384 Cellular Biology Laboratory to satisfy Communication Part B instead of BME 301 Biomedical Engineering Design and Communication.

ADVISING AND CAREERS

ADVISING
Every College of Engineering undergraduate has an assigned academic advisor (https://engineering.wisc.edu/student-services/undergraduate-student-advising/). Academic advisors support and coach students through their transition to college and their academic program all the way through graduation.

Advisors help students navigate the highly structured engineering curricula and course sequencing, working with them to select courses each semester.

When facing a challenge or making a plan toward a goal, students can start with their academic advisor. There are many outstanding resources at UW–Madison, and academic advisors are trained to help students navigate these resources. Advisors not only inform students about the various resources, but they help reduce the barriers between students and campus resources to help students feel empowered to pursue their goals and communicate their needs.

Students can find their assigned advisor in their MyUW Student Center.

ENGINEERING CAREER SERVICES

Engineering Career Services (https://ecs.wisc.edu) (ECS) assists students in finding work-based learning experiences such as co-ops and summer internships, exploring and applying to graduate or professional school, and finding full-time professional employment.

ECS offers two large career fairs per year, assists students with resume building and developing interviewing skills, hosts skill-building workshops, and meets one-on-one with students to discuss offer negotiations.

Students are encouraged to engage with the ECS office early in their academic careers. For more information on ECS programs and workshops, visit: https://ecs.wisc.edu.

PEOPLE

FACULTY
Paul Campagnola (Chair)
Randolph Ashton
Randy Bartels
David Beebe
Walter Block
Christopher Brace
Joshua Brockman

Kevin Eliceiri
Shaoqin ‘Sarah’ Gong
Aviad Hai
Pamela Keeger
Wan-ju Li
Kip Ludwig
Megan McClean
Beth Meyerand
William Murphy
Krishanu Saha
Melissa Skala
Darryl Thelen
Pallavi Tiwari
Justin Williams
Colleen Witzenburg
Filiz Yesilkoy

INSTRUCTIONAL STAFF AND TEACHING FACULTY
Amit Nimunkar
John Puccinelli
Tracy Jane Puccinelli
Dailis Suarez-Gonzalez
Christa Wille

See also Biomedical Engineering Faculty Directory (http://directory.engr.wisc.edu/bme/).

ACCREDITATION

Accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the commission’s General Criteria and Program Criteria for Bioengineering and Biomedical and Similarly Named Engineering Programs.

PROGRAM EDUCATIONAL OBJECTIVES FOR THE BACHELOR OF SCIENCE IN BIOMEDICAL ENGINEERING

We recognize that our graduates will choose to use the knowledge and skills that they have acquired during their undergraduate years to pursue a wide variety of career and life goals, and we encourage this diversity of paths. Whatever path graduates choose, be it a job, postgraduate education, or volunteer service, be it in engineering or another field, we have for our graduates the following objectives, that they will:

1. exhibit strong skills in problem solving, leadership, teamwork and communication;
2. use these skills to contribute to their communities;
3. make thoughtful, well-informed career choices;
4. demonstrate a continuing commitment to and interest in their own and others’ education

Note: Undergraduate Student Outcomes, number of degrees conferred, and enrollment data are made publicly available at the Biomedical Engineering Undergraduate Program website. (In this Guide, the program's Student Outcomes are available through the "Learning Outcomes" tab.)