Biomedical engineering (BME) is the application of engineering tools for solving problems in biology and medicine. It is an engineering discipline that is practiced by professionals trained primarily as engineers, but with a specialized focus on the medical and biological applications of classical engineering principles. 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, and in the medical profession and 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 M.S 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 the freshman year and every semester during the sophomore through senior years. 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 project, 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 neuroprosthetic 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 (pulmonary hypertension), 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 B.S. degree in BME with an overall GPA of 3.0 or a GPA of 3.25 for the last 60 credits of the B.S. program are eligible to apply for the one-year M.S. degree.

**BIOMEDICAL ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES**

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:

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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 neuroprosthetic and rehabilitation applications.

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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; and
4. demonstrate a continuing commitment to and interest in their own and others’ education.

HOW TO GET IN

ADMISSION TO THE COLLEGE AS A FRESHMAN

Students applying to UW–Madison (https://www.admissions.wisc.edu/apply/) need to indicate an engineering major (https://engineering.wisc.edu/degrees-programs/undergraduate/) as their first choice in order to be considered for direct admission to the College of Engineering. Direct admission 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 granting classifications. 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 Coordinator 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.

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 (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatesstudystext) 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>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
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<td>19</td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>General Education</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Engineering Courses:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Engineering</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Engineering Mechanics Core Courses</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Biomedical Engineering Core Courses</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>Biomedical Engineering Area Technical Elective Requirements</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Biomedical Advanced Technical Elective</td>
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<td>3</td>
</tr>
<tr>
<td>Engineering Technical Elective</td>
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<td>2</td>
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<tr>
<td>Total Credits</td>
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<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 &amp; MATH 234</td>
<td>Calculus and Analytic Geometry 1 and Calculus and Analytic Geometry 2 and Calculus--Functions of Several Variables</td>
<td>13</td>
</tr>
<tr>
<td>MATH 320 or MATH 319</td>
<td>Linear Algebra and Differential Equations or Techniques in Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>B M E 325 or STAT 324 or STAT/ MATH 431</td>
<td>Applied Statistics for Biomedical Engineers or Introductory Applied Statistics for Engineers or Introduction to the Theory of Probability</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits:** 19

### SCIENCE

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP SCI 220 or COMP SCI 200 or COMP SCI 300</td>
<td>Data Science Programming I or Programming I or Programming II</td>
<td>3-4</td>
</tr>
<tr>
<td>PHYSICS 202 or PHYSICS 208</td>
<td>General Physics or General Physics</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 109 &amp; CHEM 104 &amp; CHEM 343</td>
<td>Advanced General Chemistry or General Chemistry I and General Chemistry II or Organic Chemistry I</td>
<td>5-9</td>
</tr>
<tr>
<td>ZOOLOGY/ BIOLOGY/ BOTANY 101 &amp; 102</td>
<td>Animal Biology and Animal Biology Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>ZOOLOGY/ BIOLOGY/ BOTANY 151 &amp; BIOCORE 381 &amp; BIOCORE 383</td>
<td>Introductory Biology or Evolution, Ecology, and Genetics and Cellular Biology</td>
<td>5</td>
</tr>
<tr>
<td>ANAT&amp;PHY 335 &amp; BIOCORE 485 &amp; BIOCORE 486</td>
<td>Physiology or Principles of Physiology and Principles of Physiology Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>Advanced Biology/Life Science elective - select one option:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ANAT&amp;PHY 337 &amp; BIOCORE 587 &amp; BIOCHEM 501 &amp; BIOCHEM 507 &amp; BIOCHEM 508 &amp; BIOCHEM/ M M &amp; I 575 &amp; GENETICS 466 &amp; ZOOLOGY 470</td>
<td>Human Anatomy or Biological Interactions or Introduction to Biochemistry or General Biochemistry I or General Biochemistry II or Biology of Viruses or Principles of Genetics or Introduction to Animal Development</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits:** 32-37

### GENERAL EDUCATION

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSC 100 or COM ARTS 1 or ENGL 100 or ESL 118</td>
<td>Science and Storytelling or Introduction to Speech Composition or Introduction to College Composition or Academic Writing II</td>
<td>3</td>
</tr>
<tr>
<td>B M E 301</td>
<td>Biomedical Engineering Design and Communication (if taken Fall 2023 or later)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits:** 32-37
Introduction to Engineering

Required engineering mechanics core courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>E M A 201</td>
<td>Statics</td>
<td></td>
</tr>
<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>
</tr>
<tr>
<td>or M E 306</td>
<td>Mechanics of Materials</td>
<td></td>
</tr>
</tbody>
</table>

Required B M E core courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</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 Fundamentals</td>
<td></td>
</tr>
<tr>
<td>B M E 300</td>
<td>Biomedical Engineering Design and 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>
<td></td>
</tr>
<tr>
<td>B M E 402</td>
<td>Biomedical Engineering Capstone Design II</td>
<td></td>
</tr>
<tr>
<td>B M E/PHM SCI 430</td>
<td>Biological Interactions with Materials</td>
<td></td>
</tr>
</tbody>
</table>

Engineering area technical electives (see below)

<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></td>
</tr>
</tbody>
</table>

Area Electives in Bioinstrumentation

Choose from any ECE course, the courses below, and from the advanced BME electives in this area

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M E 445</td>
<td>Mechatronics in Control &amp; Product Realization</td>
<td></td>
</tr>
</tbody>
</table>

Advanced BME Area Technical Electives in Bioinstrumentation and Medical Devices

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>B M E/E C E 462</td>
<td>Medical Instrumentation</td>
<td></td>
</tr>
<tr>
<td>B M E/E C E 463</td>
<td>Computers in Medicine</td>
<td></td>
</tr>
<tr>
<td>B M E/MED PHYS 535</td>
<td>Introduction to Energy-Tissue Interactions</td>
<td></td>
</tr>
<tr>
<td>B M E 550</td>
<td>Introduction to Biological and Medical Microsystems</td>
<td></td>
</tr>
<tr>
<td>B M E 556</td>
<td>Systems Biology: Mammalian Signaling Networks</td>
<td></td>
</tr>
<tr>
<td>B M E 640</td>
<td>Medical Devices Ecosystem: The Path to Product</td>
<td></td>
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</tbody>
</table>

Biomedical Imaging and Optics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>E C E 330</td>
<td>Signals and Systems</td>
<td></td>
</tr>
</tbody>
</table>

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/E/COMP SCI 252 Introduction to Computer Engineering, G L E 171 Introduction to Geological Engineering, INTEREGR 170 Design Practicum, I SY 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 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.).
- Special topics courses must have prior approval of the B M E Curriculum Committee.

BIOMEDICAL ENGINEERING AREA TECHNICAL ELECTIVE REQUIREMENTS

- Choose 15 credits of area technical electives in one of the following areas below.
- Choose at least one advanced B M E elective from any area below.
- Introduction to engineering courses (CBE 150, E C E 210, E C E/E/COMP SCI 252, G L E 171, INTEREGR 170, I SY 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.
**Area Electives in Biomedical Imaging and Optics**  
Choose from the following and from the advanced BME electives in this area

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 203</td>
<td>Signals, Information, and Computation</td>
<td>3</td>
</tr>
<tr>
<td>ECE 331</td>
<td>Introduction to Random Signal Analysis and Statistics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 431</td>
<td>Digital Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>ECE/COMP SCI 533</td>
<td>Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>BME/HONCOL/MED PHYS/PHYSICS 501</td>
<td>Radiation Physics and Dosimetry</td>
<td>3</td>
</tr>
<tr>
<td>BME/MED PHYS 566</td>
<td>Physics of Radiotherapy</td>
<td>3</td>
</tr>
<tr>
<td>BME/MED PHYS 573</td>
<td>Mathematical Methods in Medical Physics</td>
<td>3</td>
</tr>
<tr>
<td>BME/MED PHYS 580</td>
<td>The Physics of Medical Imaging with Ionizing Radiation</td>
<td>4</td>
</tr>
<tr>
<td>NE 305</td>
<td>Fundamentals of Nuclear Engineering</td>
<td>3</td>
</tr>
<tr>
<td>NE 408</td>
<td>Ionizing Radiation</td>
<td>3</td>
</tr>
<tr>
<td>NE 427</td>
<td>Nuclear Instrumentation Laboratory</td>
<td>2</td>
</tr>
</tbody>
</table>

**Advanced BME Area Technical Electives in Biomedical Imaging and Optics**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME/MED PHYS 530</td>
<td>Medical Imaging Systems</td>
<td>3</td>
</tr>
<tr>
<td>BME/MED PHYS 535</td>
<td>Introduction to Energy-Tissue Interactions</td>
<td>3</td>
</tr>
<tr>
<td>BME/MED PHYS 578</td>
<td>Non-Ionizing Diagnostic Imaging</td>
<td>4</td>
</tr>
<tr>
<td>BME/MED PHYS/PHMCOL-M/PHYSICS/RADIO 619</td>
<td>Microscopy of Life</td>
<td>3</td>
</tr>
<tr>
<td>BME 651</td>
<td>Biophotonics Laboratory</td>
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</table>

**Biomechanics:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Area Elective</td>
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<td></td>
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<tr>
<td>EMA 202</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>or M 240</td>
<td>Dynamics</td>
<td>3</td>
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</table>

**Area Electives in Biomechanics**  
Choose from any EMA or ME course, the courses below, and from the advanced BME electives in this area

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M S &amp; E 350</td>
<td>Introduction to Materials Science</td>
<td>3</td>
</tr>
<tr>
<td>or M S &amp; E 351</td>
<td>Materials Science-Structure and Property Relations in Solids</td>
<td>3</td>
</tr>
<tr>
<td>M S &amp; E/CHEM 421</td>
<td>Polymeric Materials</td>
<td>3</td>
</tr>
<tr>
<td>CBE 320</td>
<td>Introductory Transport Phenomena</td>
<td>4</td>
</tr>
<tr>
<td>or BME 330</td>
<td>Engineering Principles of Molecules, Cells, and Tissues</td>
<td>3</td>
</tr>
<tr>
<td>CBE 324</td>
<td>Transport Phenomena Lab</td>
<td>3</td>
</tr>
<tr>
<td>CBE/MED 525</td>
<td>Macromolecular Hydrodynamics</td>
<td>3</td>
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**Advanced BME Area Technical Electives in Biomechanics**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BME/M 414</td>
<td>Orthopaedic Biomechanics - Design of Orthopaedic Implants</td>
<td>3</td>
</tr>
<tr>
<td>BME/M 415</td>
<td>Biomechanics of Human Movement</td>
<td>3</td>
</tr>
<tr>
<td>BME/M 505</td>
<td>Biofluidics</td>
<td>3</td>
</tr>
<tr>
<td>BME/M 516</td>
<td>Finite Elements for Biological and Other Soft Materials</td>
<td>3</td>
</tr>
<tr>
<td>BME/I SYE 564</td>
<td>Occupational Ergonomics and Biomechanics</td>
<td>3</td>
</tr>
<tr>
<td>BME/M 615</td>
<td>Tissue Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>BME/I SYE 662</td>
<td>Design and Human Disability and Aging</td>
<td>3</td>
</tr>
</tbody>
</table>

**Biomaterials, Cellular and Tissue Engineering:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Area Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BME 330</td>
<td>Engineering Principles of Molecules, Cells, and Tissues</td>
<td>4</td>
</tr>
<tr>
<td>or CBE 320</td>
<td>Introductory Transport Phenomena</td>
<td></td>
</tr>
</tbody>
</table>

**Area Electives in Biomaterials, Cellular and Tissue Engineering**  
Choose from any CBE or M S & E course, the courses below, and from the advanced BME electives in this area

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 417</td>
<td>Transport Phenomena in Polymer Processing</td>
<td>3</td>
</tr>
<tr>
<td>M 418</td>
<td>Engineering Design with Polymers</td>
<td>3</td>
</tr>
<tr>
<td>M/STAT 424</td>
<td>Statistical Experimental Design</td>
<td>3</td>
</tr>
<tr>
<td>BME 511</td>
<td>Tissue Engineering Laboratory</td>
<td>1</td>
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</table>

**Advanced BME Area Technical Electives in Biomaterials, Cellular and Tissue Engineering**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 510</td>
<td>Introduction to Tissue Engineering</td>
<td>3</td>
</tr>
<tr>
<td>BME 520</td>
<td>Stem Cell Bioengineering</td>
<td>3</td>
</tr>
<tr>
<td>BME 545</td>
<td>Engineering Extracellular Matrices</td>
<td>3</td>
</tr>
<tr>
<td>BME 550</td>
<td>Introduction to Biological and Medical Microsystems</td>
<td>3</td>
</tr>
<tr>
<td>BME 556</td>
<td>Systems Biology: Mammalian Signaling Networks</td>
<td>3</td>
</tr>
<tr>
<td>BME/CBE 560</td>
<td>Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>BME/M 615</td>
<td>Tissue Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>BME 630</td>
<td>Nanomaterials for Biomedical Applications</td>
<td>3</td>
</tr>
</tbody>
</table>

**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. Further information is available in the department office.
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.

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

FOUR-YEAR PLAN

SAMPLE FOUR-YEAR PLAN

<table>
<thead>
<tr>
<th>First Year</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 221</td>
<td>5</td>
<td>MATH 222</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 109 (or CHEM 103 &amp; CHEM 104)</td>
<td>5</td>
<td>E M A 201, PHYSICS 201, or PHYSICS 207</td>
<td>3</td>
</tr>
<tr>
<td>Communications A</td>
<td>3</td>
<td>CHEM 343</td>
<td>3</td>
</tr>
<tr>
<td>INTEREGR 170</td>
<td>3</td>
<td>INTEREGR 170</td>
<td>3</td>
</tr>
<tr>
<td>Second Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>Credits</td>
<td>Spring</td>
<td>Credits</td>
</tr>
<tr>
<td>B M E 200</td>
<td>2</td>
<td>B M E 201</td>
<td>3</td>
</tr>
<tr>
<td>MATH 234</td>
<td>4</td>
<td>MATH 320 or 319</td>
<td>3</td>
</tr>
<tr>
<td>PHYSICS 202 or 208</td>
<td>5</td>
<td>E M A 303 or M E 306</td>
<td>3</td>
</tr>
<tr>
<td>B M E 325, STAT 324, or STAT 431</td>
<td>3</td>
<td>Free-General Elective</td>
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<tr>
<td>Science Elective</td>
<td>3</td>
<td>B M E 310</td>
<td>3</td>
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<tr>
<td></td>
<td></td>
<td>Liberal Studies Elective</td>
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<tr>
<td>Third Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>Credits</td>
<td>Spring</td>
<td>Credits</td>
</tr>
<tr>
<td>B M E 300</td>
<td>3</td>
<td>Liberal Studies Elective</td>
<td>3</td>
</tr>
<tr>
<td>Liberal Studies Elective</td>
<td>3</td>
<td>Free-General Elective</td>
<td>2</td>
</tr>
<tr>
<td>B M E 315</td>
<td>3</td>
<td>Free-Engineering Technical Elective</td>
<td>2</td>
</tr>
<tr>
<td>Select one of the following options:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZOOLOGY/ BIOLOGY 101 &amp; ZOOLOGY/ BIOLOGY 102</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZOOLOGY/ BIOLOGY/ BOTANY 151</td>
<td>B M E 301</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BIOCORE 381 &amp; BIOCORE 382 (the first lab - 382 - is recommended not required)</td>
<td>BIOLOGY/ BOTANY 152</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Area-Required Engineering Technical Elective</td>
<td>3</td>
<td>BIOCORE 383 &amp; BIOCORE 384</td>
<td>3</td>
</tr>
<tr>
<td>E C E 230</td>
<td>B M E/PHM SCI 430</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>E C E 330</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E M A 202 or M E 240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B M E 330 or CBE 320</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourth Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>Credits</td>
<td>Spring</td>
<td>Credits</td>
</tr>
<tr>
<td>B M E 400</td>
<td>3</td>
<td>B M E 402</td>
<td>3</td>
</tr>
<tr>
<td>Select one of the following options</td>
<td>5</td>
<td>Liberal Studies Elective</td>
<td>3</td>
</tr>
<tr>
<td>ANAT&amp;PHY 335</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Zoology Elective, select one of the following:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOCORE 485 &amp; BIOCORE 486</td>
<td>ANAT&amp;PHY 337</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
Area-Engineering Technical Elective 3 GENETICS 466
Area-Engineering Technical Elective 3 ZOOLOGY 470
ZOOLOGY/PSYCH 523
ZOOLOGY 570
BIOCORE 587
Advanced Biomedical Engineering Technical Elective 3
Area-Engineering Technical Elective 3

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. If PHYSICS 201 is chosen instead of E M A 201, another engineering course from a degree—granting engineering program might need to be substituted for E M A 201. The excess 5 credits from PHYSICS 201 are counted as free—general elective credits. E M A 201 Statics is a requisite for E M A 303/M E 306 Mechanics of Materials and thus taking PHYSICS 201/PHYSICS 208 General Physics 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.

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 200—level or above additional engineering technical elective lab or design experience.

For more information on the unique design sequence see: http://bmedesign.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 BIOCORE lab process. If all the other BIOCORE 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.

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

ADVISNG AND CAREERS

ADVISING

Each College of Engineering program has academic advisors dedicated to serving its students. Program advisors can help current College of Engineering students with questions about accessing courses, navigating
degree requirements, resolving academic issues and more. Students can find their assigned advisor on the homepage of their student center.

ENGINEERING CAREER SERVICES

Engineering Career Services (ECS) assists students in identifying pre-professional work-based learning experiences such as co-ops and summer internships, considering and applying to graduate or professional school, and finding full-time professional employment during their graduation year.

ECS offers two major career fairs per year, assists with resume writing and interviewing skills, hosts workshops on the job search, and meets one-on-one with students to discuss offer negotiations.

Students are encouraged to utilize the ECS office early in their academic careers. For comprehensive information on ECS programs and workshops, see the ECS website or call 608-262-3471.

ACCREDITATION

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

Note: Undergraduate Program Educational Objectives and Student Outcomes are made publicly available at the Departmental website. (In this Guide, the program’s Student Outcomes are designated by our campus as “Learning Outcomes.”)

PEOPLE

FACULTY
Paul Campagnola (Chair)
Randolph Ashton
David Beebe
Walter Block
Christopher Brace
Kevin Eliceiri
Shaoqin ‘Sarah’ Gong
Aviad Hai
Melissa Kinney
Pamela Kreeger
Wan-ju Li
Kip Ludwig
Kristyn Masters
Megan McClean
Beth Meyerand
William Murphy
Krishanu Saha
Melissa Skala
Darryl Thelen
Justin Williams
Colleen Witzenburg
Filiz Yesilkoy

INSTRUCTIONAL STAFF AND TEACHING FACULTY
Amit Nimunkar
John Puccinelli
Tracy Jane Puccinelli
Darlis Suarez-Gonzalez
Aaron Suminski

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