

# BIOMEDICAL ENGINEERING, B.S.

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 cornerstone 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 (quantifying, adapting and restoring function for those who lost abilities).
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, and apoptosis.

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:

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://www.engr.wisc.edu/academics/undergraduate-academics/choosing-a-major/>) 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://www.engr.wisc.edu/academics/student-services/academic-advising/first-year-undergraduate-students/progression-requirements/>) 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 the course and credit requirements for admission to engineering degree granting classifications specified in the general college requirements (<https://www.engr.wisc.edu/academics/student-services/academic-advising/cross-campus-students/>). The requirements are the minimum for admission consideration. 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://www.engr.wisc.edu/academics/student-services/academic-advising/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://www.engr.wisc.edu/academics/student-services/academic-advising/transfer-students/>) 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 earned more than 80 transferable semester credits 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](mailto: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 students (<https://www.engr.wisc.edu/admissions/undergraduate-admissions/returning-adults-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/#requirementsforundergraduatestudytext>) section of the *Guide*.

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|-------------------|--|
| General Education | <ul style="list-style-type: none"> <li>• Breadth—Humanities/Literature/Arts: 6 credits</li> <li>• 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</li> <li>• Breadth—Social Studies: 3 credits</li> <li>• Communication Part A &amp; Part B *</li> <li>• Ethnic Studies *</li> <li>• Quantitative Reasoning Part A &amp; Part B *</li> </ul> |
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\* 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
	<i>Mathematics</i>	19
	<i>Science</i>	37
	<i>General Education</i>	27
	<i>Engineering Courses:</i>	
	Introduction to Engineering	3
	Engineering Mechanics Core Courses	6
	Biomedical Engineering Core Courses	18

Biomedical Engineering Area Technical Elective Requirements	15
Biomedical Advanced Technical Elective	3
Engineering Technical Elective	3
<b>Total Credits</b>	<b>At least 128</b>

## 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 or MATH 319	Linear Algebra and Differential Equations Techniques in Ordinary Differential Equations	3
B M E 325 or STAT 324 or STAT/ MATH 431	Applied Statistics for Biomedical Engineers Introductory Applied Statistics for Engineers Introduction to the Theory of Probability	3
<b>Total Credits</b>		<b>19</b>

## SCIENCE

Code	Title	Credits
COMP SCI 220 or COMP SCI 200 or COMP SCI 300 or COMP SCI 310	Data Science Programming I Programming I Programming II Problem Solving Using Computers	3-4
E M A 201 or PHYSICS 201 or PHYSICS 207	Statics (only statics counts for Engineering credits below) General Physics General Physics	3
PHYSICS 202 or PHYSICS 208	General Physics General Physics	5
One of the following:		5-9
CHEM 109	Advanced General Chemistry	
CHEM 103 & CHEM 104	General Chemistry I and General Chemistry II	
CHEM 343 or CHEM 341	Introductory Organic Chemistry Elementary Organic Chemistry	3
CHEM 345 & CHEM 344 or CHEM 327 or CHEM 329	Intermediate Organic Chemistry and Introductory Organic Chemistry Laboratory Fundamentals of Analytical Science Fundamentals of Analytical Science	5
ZOOLOGY/ BIOLOGY 101 & ZOOLOGY/ BIOLOGY 102	Animal Biology and Animal Biology Laboratory (or)	5
ZOOLOGY/ BIOLOGY/ BOTANY 151	Introductory Biology (or)	
BIOCORE 381 & BIOCORE 383	Evolution, Ecology, and Genetics and Cellular Biology	

ANAT&PHY 335	Physiology (or)	5
ANAT&PHY 435	Fundamentals of Human Physiology (or)	
BIOCORE 485 & BIOCORE 486	Principles of Physiology and Principles of Physiology Laboratory	
ANAT&PHY 337	Human Anatomy	3
or ZOOLOGY 430	Comparative Anatomy of Vertebrates	
or ZOOLOGY 470	Introduction to Animal Development	
or ZOOLOGY/ PSYCH 523	Neurobiology	
or ZOOLOGY 570	Cell Biology	
or ZOOLOGY 611	Comparative and Evolutionary Physiology	
or GENETICS 466	Principles of Genetics	
or BIOCORE 587	Biological Interactions	
<b>Total Credits</b>		<b>37-42</b>

## GENERAL EDUCATION

Code	Title	Credits
<i>Communications A</i>		3
LSC 100 or COM ARTS 1C or ENGL 100 or ESL 118	Science and Storytelling Introduction to Speech Composition Introduction to College Composition Academic Writing II	
<i>Communications B</i>		
INTEREGR 397 or ZOOLOGY/ BIOLOGY/ BOTANY 152 or BIOCORE 384	Engineering Communication (was EPD 397 before Fall 2020) Introductory Biology Cellular Biology Laboratory	3
At least 15 credits of liberal studies following the College of Engineering guidelines ( <a href="http://guide.wisc.edu/undergraduate/engineering/#requirementstext">http://guide.wisc.edu/undergraduate/engineering/#requirementstext</a> )		15
<b>Total Credits</b>		<b>21</b>

## ENGINEERING COURSES

Code	Title	Credits
<i>Introduction to Engineering</i>		3
INTEREGR 170	Design Practicum	
<i>Required engineering mechanics core courses</i>		6
E M A 201	Statics	
E M A 303 or M E 306	Mechanics of Materials Mechanics of Materials	
<i>Required B M E core courses</i>		18
B M E 200	Biomedical Engineering Design	
B M E 201	Biomedical Engineering Fundamentals and Design	
B M E 300	Biomedical Engineering Design	
B M E 301	Biomedical Engineering Design	
B M E 310	Bioinstrumentation	
B M E 315	Biomechanics	
B M E 400	Capstone Design Course in Biomedical Engineering	

B M E 402	Biomedical Engineering Design	
B M E/ PHM SCI 430	Biological Interactions with Materials	
<i>Engineering area technical electives (see below)</i>		<b>15</b>
<i>One advanced B M E technical elective from any area</i>		<b>3</b>
<i>Engineering technical elective: Any engineering course(s) from a degree-granting engineering program<sup>1</sup></i>		<b>3</b>
<b>Total Credits</b>		<b>48</b>

- <sup>1</sup>
- The number of credits in this area can range from 0 to 11 credits. 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 include (and are not limited to): Taking PHYSICS 201 General Physics instead of E M A 201 Statics adds 3 credits to this area. Taking B M E 325 Applied Statistics for Biomedical Engineers instead of STAT 324 Introductory Applied Statistics for Engineers removes 3 credits from this area. Transfer students are not required to take INTEREGR 170 Design Practicum and this adds 3 credits to this area. Students who study abroad may miss a 1-credit design course and this adds 1 credit to this area. Regardless of the choices made, all students must have at minimum 48 credits of engineering courses from degree-granting programs.
  - EPD courses are not included in this category.
  - InterEGR courses are not included in this category except INTEREGR 170 Design Practicum and INTEREGR 301 Engineering and Biology: Technological Symbiosis
  - 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.
  - B M E 325 Applied Statistics for Biomedical Engineers counts for engineering credits.

## BIOMEDICAL ENGINEERING AREA TECHNICAL ELECTIVE REQUIREMENTS

Choose 15 credits of area technical electives in one of the following tracks and at least one advanced B M E elective from any area:

### Bioinstrumentation and Medical Devices:

Code	Title	Credits
<b>Required Area Elective</b>		
E C E 230	Circuit Analysis	4
<b>Area Electives in Bioinstrumentation</b>		<b>11</b>
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
<b>Advanced BME Area Technical Electives in Bioinstrumentation and Medical Devices</b>		
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

### Biomedical Imaging and Optics:

Code	Title	Credits
<b>Required Area Elective</b>		
E C E 330	Signals and Systems	3
<b>Area Electives in Biomedical Imaging</b>		<b>12</b>
Choose from the following and from the advanced BME electives in this area		
E C E 203	Signals, Information, and Computation	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	Medical Image Science: Mathematical and Conceptual Foundations	3
B M E/ MED PHYS 574	Imaging in Medicine: Applications	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
<b>Advanced BME Area Technical Electives in Biomedical Imaging</b>		
B M E/ MED PHYS 530	Medical Imaging Systems	3
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/MED PHYS/ PHM COL-M/ PHYSICS/ RADIOL 619	Microscopy of Life	3
<b>Biomechanics:</b>		
<b>Required Area Elective</b>		
E M A 202 or M E 240	Dynamics	3
<b>Area Electives in Biomechanics</b>		<b>12</b>
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 or M S & E 351	Introduction to Materials Science Materials Science-Structure and Property Relations in Solids	3
M S & E/CHEM 421	Polymeric Materials	3
CBE 320	Introductory Transport Phenomena	4

or B M E/CBE 330	Engineering Principles of Molecules, Cells, and Tissues	
CBE 324	Transport Phenomena Lab	3
CBE/M E 525	Macromolecular Hydrodynamics	3
<b>Advanced B M E Area Technical Electives in Biomechanics</b>		
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/I SY E 564	Occupational Ergonomics and Biomechanics	3
B M E/M E 603	Topics in Bio-Medical Engineering	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
<b>Required Area Elective</b>		
B M E/CBE 330	Engineering Principles of Molecules, Cells, and Tissues	4
or CBE 320	Introductory Transport Phenomena	
<b>Area Electives in Biomaterials, Cellular and Tissue Engineering</b>		<b>12</b>
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
M E/BSE/FOOD SCI 441	Rheology of Foods and Biomaterials	3
B M E 511	Tissue Engineering Laboratory	1
<b>Advanced BME Area Technical Electives in Biomaterials, Cellular and Tissue Engineering</b>		
B M E/CBE 510	Introduction to Tissue Engineering	3
B M E/CBE 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/M E 615	Tissue Mechanics	3
B M E 630	Nanomaterials for Biomedical Applications	3

**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

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

## FOUR-YEAR PLAN

### SAMPLE FOUR-YEAR PLAN

#### First Year

Fall	Credits	Spring	Credits
MATH 221		5 MATH 222	4
CHEM 109 (or CHEM 103 & CHEM 104) <sup>1, Med</sup>		5 E M A 201, PHYSICS 201, or PHYSICS 207 <sup>3, Med</sup>	3
Communications A		3 CHEM 343 or 341 <sup>4, Med</sup>	3
INTEREGR 170 <sup>2</sup>		3 Liberal Studies Elective	3
		COMP SCI 200, 220, 300, or 310 <sup>5</sup>	3-4
	<b>16</b>		<b>16-17</b>

#### Second Year

Fall	Credits	Spring	Credits
B M E 200 <sup>6</sup>		1 B M E 201	2
MATH 234		4 MATH 320 or 319	3
PHYSICS 202 or 208 <sup>Med</sup>		5 E M A 303 or M E 306	3

CHEM 345 or 327 <sup>4, Med</sup>	3	Select one of the following options:	5
B M E 325, STAT 324, or STAT 431 <sup>5, Med</sup>	3	ZOOLOGY/ BIOLOGY 101 & ZOOLOGY/ BIOLOGY 102	
		ZOOLOGY/BIOLOGY/ BOTANY 151 <sup>Med</sup>	
		BIOCORE 381 & BIOCORE 382 (the first lab-382- is recommended not required) <sup>7, Med</sup>	
		B M E 310 <sup>8</sup>	3
	<b>16</b>		<b>16</b>

**Third Year**

Fall	Credits	Spring	Credits
B M E 300 <sup>6</sup>		1 B M E 301 <sup>6</sup>	1
CHEM 344 (or CHEM 327 in second year) <sup>Med</sup>	2	Liberal Studies Elective	1
INTEREGR 397 (if ZOOLOGY 152 or BIOCORE 384 is not taken) <sup>9</sup>	3	Free elective credits	3
Liberal Studies Elective	2	Select one of the following options: <sup>Med</sup>	5
Engineering Technical Elective	2	ANAT&PHY 335	
B M E 315 <sup>8</sup>	3	ANAT&PHY 435	
Area-Required Engineering Technical Elective	3	BIOCORE 485 & BIOCORE 486	
E C E 230		B M E/PHM SCI 430 <sup>8</sup>	3
E C E 330		Area-Engineering Technical Elective	3
E M A 202 or M E 240 B M E/CBE 330 or CBE 320			
	<b>16</b>		<b>16</b>

**Fourth Year**

Fall	Credits	Spring	Credits
B M E 400	3	B M E 402 <sup>6</sup>	1
Liberal Studies Elective	3	Liberal Studies Elective <sup>Med</sup>	3
Free elective credits	1	Liberal Studies Elective <sup>Med</sup>	3
Advanced Zoology Elective, select one of the following:	3	Free elective credits	2
ANAT&PHY 337		Engineering Technical Elective	1
GENETICS 466		Advanced Biomedical Engineering Technical Elective	3
ZOOLOGY 430		Area-Engineering Technical Elective	3

ZOOLOGY 470	
ZOOLOGY/ PSYCH 523	
ZOOLOGY 570	
ZOOLOGY 611	
BIOCORE 587	
Area-Engineering Technical Elective	3
Area-Engineering Technical Elective	3
	<b>16</b>
	<b>16</b>

**Total Credits 128-129****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 (such as CHEM 103/CHEM 104 vs. CHEM 109 or INTEREGR 397 vs. ZOOLOGY/BIOLOGY/BOTANY 152) will affect the total number of credits.

Medical schools have varying requirements. Liberal electives, free 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, UW—Madison and others require an intermediate humanities or social science with an intensive writing component (Comm B). 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/>.

<sup>1</sup> 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 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.

<sup>2</sup> INTEREGR 170 Design Practicum is required only for students directly admitted to B M E as freshmen and counts toward the 48 engineering credits.

<sup>3</sup> 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 must be substituted for E M A 201. The excess 5 credits from PHYSICS 201 are counted as free elective credits. PHYSICS 207 General Physics & PHYSICS 208 General Physics may be used to substitute for PHYSICS 201 General Physics & PHYSICS 202 General Physics.

<sup>4</sup> CHEM 341 Elementary Organic Chemistry may be substituted by those students who are not interested in satisfying premed requirements and who expect to take only one semester of organic chemistry (CHEM 341 is not permitted as a prerequisite for CHEM 344 Introductory Organic Chemistry Laboratory/CHEM 345 Intermediate Organic Chemistry).

Either CHEM 344/ CHEM 345 or CHEM 327 Fundamentals of Analytical Science (or CHEM 329 Fundamentals of Analytical Science) is required.

Premeds or students interested in biomaterials, cellular and tissue engineering should choose to take CHEM 343 Introductory Organic Chemistry, CHEM 344, and CHEM 345.

- <sup>5</sup> It is recommended that students take statistics and/or computer science in the freshman year for those needing additional core course options.
- <sup>6</sup> 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, B M E 300 Biomedical Engineering Design, or B M E 301 Biomedical Engineering Design 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 1 cr, engineering research credit, or any 200-level or above additional engineering technical elective lab experience. For more information on the unique design sequence see: <http://bmedesign.engr.wisc.edu/about/>.
- <sup>7</sup> Students very serious about medical school 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 INTEREGR 397 Engineering Communication.
- <sup>8</sup> 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.
- <sup>9</sup> ZOOLOGY/BIOLOGY/BOTANY 152 Introductory Biology, which satisfies Communication Part B, may be substituted for INTEREGR 397 Engineering Communication. For the Biocore program, BIOCORE 384 Cellular Biology Laboratory substitutes for INTEREGR 397 Engineering Communication. Students interested in going to medical school should use this space/credits for BIOCHEM 501 Introduction to Biochemistry which is required for the MCAT.

## ADVISING 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.

## 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  
 Jeremy Rogers  
 Krishanu Saha  
 Melissa Skala  
 Darryl Thelen  
 Justin Williams  
 Colleen Witzenburg  
 Filiz Yesilkoy

### INSTRUCTIONAL STAFF AND FACULTY ASSOCIATES

Amit Nimunkar  
 John Puccinelli  
 Tracy Jane Puccinelli  
 Darilis Suarez-Gonzalez  
 Aaron Suminski

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

## ACCREDITATION

Accreditation.

Accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org> (<http://www.abet.org/>).

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.")