BIOMEDICAL ENGINEERING: BIOMEDICAL INNOVATION, DESIGN, AND ENTREPRENEURSHIP, M.S.

This is a course-based named option within the Biomedical Engineering M.S. (http://guide.wisc.edu/graduate/biomedical-engineering/biomedical-engineering-ms/)

The Biomedical Innovation, Design, and Entrepreneurship named option in the Biomedical Engineering M.S. program is designed to provide additional graduate-level, project-based experiences in design, prototyping, and manufacturing, as well as an understanding of business fundamentals, entrepreneurship, and project management. Upon completion, students will be prepared for careers at the interface of engineering and business.

ADMISSIONS

Please consult the table below for key information about this degree program’s admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program’s website. Grad admissions is a two-step process between academic programs and the Graduate School. Applicants must meet the minimum requirements (https://grad.wisc.edu/apply/requirements/) of the Graduate School as well as the program(s).

Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/apply/).

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Deadline</td>
<td>December 15</td>
</tr>
<tr>
<td>Spring Deadline</td>
<td>October 1</td>
</tr>
<tr>
<td>Summer Deadline</td>
<td>December 15</td>
</tr>
<tr>
<td>GRE (Graduate Record Examinations)</td>
<td>Required*</td>
</tr>
</tbody>
</table>

| English Proficiency Test           | Every applicant whose native language is not English or whose undergraduate instruction was not in English must provide an English proficiency test score and meet the Graduate School minimum requirements (https://grad.wisc.edu/apply/requirements/#english-proficiency). |
| Other Test(s) (e.g., GMAT, MCAT)   | The MCAT may be accepted as an alternate to the GRE. |
| Letters of Recommendation Required| 3* |

* Not required for applicants with a UW–Madison Biomedical Engineering bachelor’s degree.

All applicants must satisfy requirements that are set forth by the Graduate School (https://grad.wisc.edu/). Students admitted to the program may be required to make up deficiency course requirements.

To apply to the BME program, complete applications (https://grad.wisc.edu/apply/), including supportive materials, must be submitted as described below and received by the following deadline dates:

- Fall Semester—December 15 (MS and Ph.D.)
- Spring Semester—October 1 (MS and Ph.D.)

OFFICIAL ACADEMIC TRANSCRIPT

Electronically submit one copy of your transcript of all undergraduate and previous graduate work along with your online application to the Graduate School. Unofficial copies of transcripts will be accepted for review, but official copies are required for admitted students. Please do not send transcripts or any other application materials to the Graduate School or the BME department unless requested. If you have questions, please contact bmegradadmission@engr.wisc.edu.

GRADUATE RECORD EXAMINATION (GRE)

Applicants should request ETS to send their official GRE scores by using institution code 1846.

MCAT scores may be substituted for GRE. Domestic applicants who choose to substitute MCAT scores for the GRE should send their MCAT score report to bmegradadmission@engr.wisc.edu.

TEST OF ENGLISH AS A FOREIGN LANGUAGE (TOEFL)

The TOEFL is required for international students unless a degree from a U.S. educational institution is held. Scores should be sent using institution code 1846.

An applicant whose TOEFL (paper-based) test score is below 580; TOEFL computer-based test (CBT) score below 237; (TOEFL internet-based iBT) test score below 92; IELTS score below 7; or MELAB below 82 must take an English assessment test upon arrival. Depending on your score, you may need to register for any recommended English as a Second Language (ESL) courses in the first semester you are enrolled.

Any international applicant who will hold a teaching assistantship (TA), and whose native language is not English must take the SPEAK test (https://esl.wisc.edu/ita-training/speak/) when arriving on campus.

THREE LETTERS OF RECOMMENDATIONS

These letters are requested from people who can accurately judge the applicant’s academic or research performance. Letters of recommendation are submitted electronically to graduate programs through the online application. Applicants should not send any more than three letters (if more than three are sent, only the first three will be...
considered). See the Graduate School for FAQs (https://grad.wisc.edu/apply/) regarding letters of recommendation.

**STATEMENT OF PURPOSE**
In this document, applicants should explain why they want to pursue further education in BME and discuss which UW faculty members they would be interested in doing research with during their graduate study (see the Graduate School for more advice on how to structure a personal statement (https://grad.wisc.edu/apply/prepare/)).

**RESUME (FOR PH.D. APPLICATIONS ONLY)**
Include your resume ONLY if applying for the Ph.D. program.

**APPLICATION FEE**
Submission must be accompanied by the one-time application fee. It is non-refundable and can be paid by credit card (Master Card or Visa) or debit/ATM. By state law, this fee can only be waived or deferred through the conditions outlined here by the Graduate School (https://grad.wisc.edu/apply/fee-grant/).

**GRADUATE SCHOOL ADMISSIONS**
Graduate admissions is a two-step process between academic degree programs and the Graduate School. Applicants must meet requirements of both the program(s) and the Graduate School. Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/admissions/).

**FUNDING**
Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (https://grad.wisc.edu/funding/) is available from the Graduate School. Be sure to check with your program for individual policies and restrictions related to funding.

**REQUIREMENTS**

**MINIMUM GRADUATE SCHOOL REQUIREMENTS**
Review the Graduate School minimum academic progress and degree requirements (http://guide.wisc.edu/graduate/#policiesandrequirementstext), in addition to the program requirements listed below.

**NAMED OPTION REQUIREMENTS**

**MODE OF INSTRUCTION**

<table>
<thead>
<tr>
<th>Face to Face</th>
<th>Evening/Weekend</th>
<th>Online</th>
<th>Hybrid</th>
<th>Accelerated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Mode of Instruction Definitions**
**Evening/Weekend:** These programs are offered in an evening and/or weekend format to accommodate working schedules. Enjoy the advantages of on-campus courses and personal connections, while keeping your day job. For more information about the meeting schedule of a specific program, contact the program.

**CURRICULAR REQUIREMENTS**

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>30 credits</td>
</tr>
<tr>
<td>Credit</td>
<td>Requirement</td>
</tr>
<tr>
<td>Minimum</td>
<td>16 credits</td>
</tr>
<tr>
<td>Residence</td>
<td>Credit</td>
</tr>
<tr>
<td>Requirement</td>
<td>Half of degree coursework (15 credits out of 30 total credits) must be completed graduate-level coursework; courses with the Graduate Level Coursework attribute are identified and searchable in the university’s Course Guide (<a href="https://registrar.wisc.edu/course-guide/">https://registrar.wisc.edu/course-guide/</a>).</td>
</tr>
<tr>
<td>Gradute GPA</td>
<td>Requirement</td>
</tr>
<tr>
<td>Overall</td>
<td>3.00 GPA required.</td>
</tr>
<tr>
<td>Other Grade</td>
<td>Requirements</td>
</tr>
<tr>
<td>Requirements</td>
<td>The Graduate School requires an average grade of B or better in all coursework (300 or above, not including research credits) taken as a graduate student unless conditions for probationary status require higher grades. Grades of Incomplete are considered to be unsatisfactory if they are not removed during the next enrolled semester.</td>
</tr>
<tr>
<td>Assessments</td>
<td>and Examinations</td>
</tr>
<tr>
<td>Language</td>
<td>n/a</td>
</tr>
<tr>
<td>Requirements</td>
<td>All assessments and examinations outside of those given in individual courses.</td>
</tr>
</tbody>
</table>

**REQUIRED COURSES**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>B M E 515</td>
<td>Therapeutic Medical Devices</td>
<td>9</td>
</tr>
<tr>
<td>B M E 601</td>
<td>Special Topics in Biomedical Engineering</td>
<td></td>
</tr>
<tr>
<td>B M E/M E 603</td>
<td>Topics in Bio-Medical Engineering</td>
<td></td>
</tr>
<tr>
<td>M E 449</td>
<td>Redesign and Prototype Fabrication</td>
<td></td>
</tr>
<tr>
<td>M E 514</td>
<td>Additive Manufacturing</td>
<td></td>
</tr>
<tr>
<td>M E 549</td>
<td>Product Design</td>
<td></td>
</tr>
</tbody>
</table>
M E 601  Special Topics in Mechanical Engineering
M E/I SY E 641  Design and Analysis of Manufacturing Systems
M E 748  Optimum Design of Mechanical Elements and Systems
I SY E 415  Introduction to Manufacturing Systems, Design and Analysis
I SY E 515  Engineering Management of Continuous Process Improvement
I SY E 517  Decision Making in Health Care
I SY E 552  Human Factors Engineering Design and Evaluation
I SY E 557  Human Factors Engineering for Healthcare Systems
I SY E 601  Special Topics in Industrial Engineering
I SY E 602  Special Topics in Human Factors
I SY E 603  Special Topics in Engineering Analytics and Operations Research
I SY E 604  Special Topics in Manufacturing and Supply Chain Management
I SY E 606  Special Topics in Healthcare Systems Engineering
INTEREGR 477  Tools for Prototyping and Manufacturing
INTEREGR 601  Topics in Interdisciplinary Engineering

9 credits of general business, entrepreneurship and strategic innovation courses:
GEN BUS 310  Fundamentals of Accounting and Finance for Non-Business Majors
GEN BUS 311  Fundamentals of Management and Marketing for Non-Business Majors
M HR/A AE 540  Intellectual Property Rights, Innovation and Technology
M HR 715  Strategic Management of Innovation
M HR 722  Entrepreneurial Management
M HR 734  Venture Creation
M HR 738  Weinert Applied Ventures in Entrepreneurship (WAVE)
R M I 650  Sustainability, Environmental and Social Risk Management

At most, 6 credits of other technical elective engineering courses:
B M E/M E 415  Biomechanics of Human Movement
B M E/ PHM SCI 430  Biological Interactions with Materials
B M E/E C E 462  Medical Instrumentation
B M E/E C E 463  Computers in Medicine
B M E/M E 505  Biofluidics
B M E/CBE 510  Introduction to Tissue Engineering
B M E 511  Tissue Engineering Laboratory
B M E/CBE 520  Stem Cell Bioengineering
B M E/MED PHYS 530  Medical Imaging Systems
B M E/MED PHYS 535  Introduction to Energy-Tissue Interactions
B M E 545  Engineering Extracellular Matrices
B M E 550  Introduction to Biological and Medical Microsystems
B M E 556  Systems Biology: Mammalian Signaling Networks
B M E/MED PHYS 573  Medical Image Science: Mathematical and Conceptual Foundations
B M E/MED PHYS 574  Imaging in Medicine: Applications
B M E/MED PHYS 578  Non-Ionizing Diagnostic Imaging
B M E/M E 615  Tissue Mechanics
B M E/MED PHYS/PHMCOL-M/PHYSICS/RADIOL 619  Microscopy of Life
B M E/CHEM/MED PHYS 750  Biological Optical Microscopy
B M E/CBE 560  Biochemical Engineering
CBE 540  Polymer Science and Technology
E C E/COMP SCI/I SY E 524  Introduction to Optimization
E C E/COMP SCI 533  Image Processing
E C E/COMP SCI/M E 539  Introduction to Artificial Neural Networks
M E 563  Intermediate Fluid Dynamics
M E/M A 570  Experimental Mechanics
M E 573  Computational Fluid Dynamics
M S & E 521  Advanced Polymeric Materials

At most, 3 credits of advanced design or research project: 1-3
B M E 799  Advanced Independent Study

Additional credits taken in consultation with advisor

POLICIES

GRADUATE SCHOOL POLICIES
The Graduate School’s Academic Policies and Procedures (https://grad.wisc.edu/acadpolicy/) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

NAMED OPTION-SPECIFIC POLICIES

PRIOR COURSEWORK
Graduate Work from Other Institutions
A student may transfer graduate coursework from other institutions with program approval. These courses may not be used toward the Graduate
School’s Minimum Graduate Residence Credit. Reach out to the BME Graduate Coordinator for more information.

**UW–Madison Undergraduate**
A student who has completed their bachelor's degree in Biomedical Engineering at UW–Madison may transfer 6 credits of coursework with program approval. These courses must be biomedical engineering department coursework numbered 300 level or above. These courses may not be used toward the Graduate School’s Minimum Graduate Residence Credit.

**UW–Madison University Special**
With program approval and payment of the difference in tuition (between Special and graduate tuition), students are allowed to count up to 15 credits of coursework numbered 300 or above taken as a UW–Madison Special student toward the minimum graduate residence credit requirement and the minimum graduate degree credit requirement; if that coursework is numbered 700 or above it may be used to satisfy the minimum graduate coursework (50%) requirement.

**PROBATION**
The Graduate School regularly reviews the record of any student who earned grades of BC, C, D, F, or Incomplete in a graduate course (300 or above), or grade of U in research credits. This review could result in academic probation with a hold on future enrollment or in being suspended from the Graduate School.

**ADVISOR / COMMITTEE**
Every BME graduate student must have a faculty advisor. A faculty advisor provides the graduate student with academic guidance in their course program and research oversight in their thesis, project, or engineering report. Graduate students should always seek advice from their advisor and other faculty in their interest area prior to enrolling for courses.

**CREDITS PER TERM ALLOWED**
15 credits maximum

**TIME CONSTRAINTS**
Master’s degree students who have been absent for five or more consecutive years lose all credits that they have earned before their absence. Individual programs may count the coursework students completed prior to their absence for meeting program requirements; that coursework may not count toward Graduate School credit requirements.

**GRIEVANCES AND APPEALS**
These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (https://dosu.students.wisc.edu/bias-or-hate-reporting/)
- Graduate Assistantship Policies and Procedures (https://hr.wisc.edu/policies/gapp/#grievance-procedure)
- Hostile and Intimidating Behavior Policies and Procedures (https://hr.wisc.edu/hrb/)
  - Office of the Provost for Faculty and Staff Affairs (https://facstaff.provost.wisc.edu/)
  - Dean of Students Office (https://dosu.students.wisc.edu/) (for all students to seek grievance assistance and support)
  - Employee Assistance (http://www.eao.wisc.edu/) (for personal counseling and workplace consultation around communication and conflict involving graduate assistants and other employees, post-doctoral students, faculty and staff)
- Employee Disability Resource Office (https://employeedisabilities.wisc.edu/) (for employed graduate students and post-docs, as well as faculty and staff)
- Ombuds Office for Faculty and Staff (http://www.ombuds.wisc.edu/) (for employed graduate students and post-docs, as well as faculty and staff)
- Title IX (https://compliance.wisc.edu/titleix/) (for concerns about discrimination)

**BME Grievance Procedures**
If a student feels unfairly treated or aggrieved by faculty, staff, or another student, the University offers several avenues to resolve the grievance. Students’ concerns about unfair treatment are best handled directly with the person responsible for the objectionable action. Options for grievance reporting beyond the research advisor include seeking out the graduate program coordinator, BME grievance committee (details below), CoE Assistant Dean for Graduate Affairs, and UW-Madison Ombuds. These are presented at increasing level of administration; the department encourages students to report to the lowest level they feel comfortable with and seek out higher levels if needed. For more information, students should consult the College of Engineering.

**Step 1**
The student is encouraged to speak first with the person toward whom the grievance is directed to see if a situation can be resolved at this level.

**Step 2**
Should a satisfactory resolution not be achieved, the student should contact the program’s Grievance Advisor, Professor Beth Meyerand, to discuss the grievance. The Grievance Advisor will facilitate problem resolution through informal channels and facilitate any complaints or issues of students.

The first attempt is to help students informally address the grievance prior to any formal complaint. Students are also encouraged to talk with their faculty advisors regarding concerns or difficulties if necessary.

University resources for sexual harassment, discrimination, disability accommodations, and other related concerns can be found on the UW Office of Equity and Diversity website.

**Step 3**
Other campus resources besides those listed above include the Assistant Dean for Graduate Affairs in the College of Engineering

**Step 4**
If the issue is not resolved to the student's satisfaction, the student can submit the grievance to the Grievance Advisor in writing, within 60 calendar days of the alleged unfair treatment.
Step 5
On receipt of a written complaint, a faculty committee will be convened by the Grievance Advisor to manage the grievance. The program faculty committee will obtain a written response from the person toward whom the complaint is directed. This response will be shared with the person filing the grievance.

Step 6
The faculty committee will determine a decision regarding the grievance. The Grievance Advisor will report on the action taken by the committee in writing to both the student and the party toward whom the complaint was directed within 15 working days from the date the complaint was received.

Step 7
At this point, if either party (the student or the person toward whom the grievance is directed) is unsatisfied with the decision of the faculty committee, the party may file a written appeal. Either party has 10 working days to file a written appeal to the School/College.

Step 8
Documentation of the grievance will be stored for at least 7 years. Significant grievances that set a precedent will be stored indefinitely. The Graduate School has procedures for students wishing to appeal a grievance decision made at the school/college level. These policies are described in the Graduate School’s Academic Policies and Procedures.

Other
Students enrolled in this program are not permitted to accept teaching assistantships, project assistantships, research assistantships or other appointments that would result in a tuition waiver without department approval. Students in this program may not take courses outside the prescribed curriculum without faculty advisor approval. Students in this program cannot enroll concurrently in other undergraduate, graduate or certificate programs.

Professional Development

Graduate School Resources
Take advantage of the Graduate School’s professional development resources (https://grad.wisc.edu/pd/) to build skills, thrive academically, and launch your career.

Program Resources

The Individual Development Plan (IDP)
An Individual Development Plan (IDP) (https://grad.wisc.edu/pd/idp/) helps graduate students and postdoctoral researchers:

- assess current skills, interests, and strengths;
- make a plan for developing skills to meet academic and professional goals; and
- communicate with supervisors, advisors, and mentors about evolving goals and related skills.

The IDP is a document to be revisited again and again, to update and refine as goals change and/or come into focus, and to record progress and accomplishments.

The university recommends IDPs for all postdoctoral researchers and graduate students, and requires IDPs for all postdoctoral researchers and graduate students supported by National Institutes of Health (NIH) funding. See the Graduate School for more information and IDP resources (https://grad.wisc.edu/pd/idp/).

Engineering Career Services
The Engineering Career Services (https://ecs.wisc.edu/) staff offers assistance to students searching or preparing for internships, co-ops, and jobs with well-recognized organizations.

Writing Center
The Writing Center (https://writing.wisc.edu/) is a campus-wide organization that provides free of charge, face-to-face and online consultations for students writing papers, reports, resumes, and applications.

People

Faculty
See also BME Faculty Directory (https://directory.engr.wisc.edu/bme/faculty/)

Professors
- David Beebe
- Walter Block
- Paul Campagnola
- Naomi Chesler
- Kevin Eliceiri
- Shaoqin (Sarah) Gong
- Kristyn Masters
- Beth Meyerand
- William Murphy
- Darryl Thelen
- Justin Williams

Associate Professors
- Randolph Ashton
- Christopher Brace
- Pamela Kreeger
- Wan-ju Li
- Kip Ludwig
- Krishanu Saha
- Melissa Skala

Assistant Professors
- Aviad Hai
- Melissa Kinney
- Megan McClean
- Jeremy Rogers
- Colleen Witzenburg
- Filiz Yesilkoy

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

EMERITUS
• Ed Bersu
• Willis Tompkins
• John Webster