Biomedical Engineering, M.S.

Biomedical engineering 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, who specialize in medical and biological applications. The area of study combines fundamentals of the biomedical sciences with advanced engineering methods of analysis and design, and brings together these two fields in order to contribute to the design of new medical instruments and devices, apply engineering principles for understanding and repairing the human body and other biological systems, and use engineering tools for decision making and cost containment.

The interdisciplinary degree program offers a course of graduate study leading to the master of science or the doctor of philosophy degrees in biomedical engineering. The Department of Biomedical Engineering should be of interest to students who wish to practice engineering or engage in research in an engineering specialization in medicine and biology. An individualized course of study is planned with a faculty advisor. Biomedical engineering faculty and affiliated faculty come from the various colleges and professional schools throughout the university. They specialize in biomedical engineering areas as diverse as biomechanics, bioinstrumentation, biomedical imaging and biophotonics, micro and nano technology, systems biology, biomaterials, cellular engineering, tissue engineering, neuroengineering, and rehabilitation and human performance. A list of biomedical engineering faculty, affiliated faculty, and their respective areas of specialization is available from the department website.

Admissions

Applicants should have a bachelor’s degree in engineering (biomedical, chemical, electrical, industrial, mechanical, etc.) or science (biology, biochemistry, chemistry, genetics, immunology, physics, etc.). Each application is judged on the basis of:

- official academic transcripts
- Graduate Record Examinations (GRE) (http://www.ets.org/gre) scores or Medical College Admission Test (MCAT) scores for the general test
- TOEFL (http://www.toefl.org) examination for international students
- three letters of recommendation
- a statement of purpose (https://grad.wisc.edu/prospective/prepare/statement)
- a resume (for Ph.D. applicants only)

Students admitted to the program may be required to make up deficiency course requirements. In addition, all applicants must satisfy requirements that are set forth by the Graduate School (http://www.wisc.edu/grad).

Application Deadlines & Fee

Complete applications (including supportive materials) must be submitted as described below and received by the below dates. Submission must be accompanied by the one-time application fee of $75; 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/admissions/feegrants):

- Fall Semester—December 1 (Ph.D.), January 1 (M.S)
- Spring Semester—October 1 (both M.S & Ph.D. programs)
- Summer Session 1—December 1 (Ph.D.), January 1 (M.S)

1Please note that summer admissions are generally limited to continuing BME students at UW–Madison or applicants who have research assistantships already arranged with UW faculty.

Application Materials

To apply to the the BME program, applicants should complete the Graduate School’s online application (https://grad.wisc.edu/apply) with the following materials:

Official Academic Transcripts

Electronically submit one copy of your official transcript of all undergraduate and previous graduate work along with your online application with 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. If questions, please contact bme admissions (bmegradadmission@engr.wisc.edu).

Graduate Record Examination (GRE) and Test of English as a Foreign Language (TOEFL) Scores

- GRE Scores
  - The GRE General Test is required for admission of applicants; exemption is only possible for the following: domestic applicants who choose to substitute MCAT scores for the GRE (send MCAT score report to BME graduate admissions email: bmegradadmission@engr.wisc.edu)
  - Applicants should request ETS to forward GRE scores by using institution code 1846 and department code 1603.

- TOEFL Scores
  - The TOEFL is required for international students unless a degree from a U.S. educational institution is held; scores should be forwarded using institution code 1846 and department code 69. 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 if accepted to the program. The student may also need to register for an English as a Second Language (ESL) course in the first semester that they are enrolled.
  - Any international applicant who will hold a teaching assistantship (TA) and whose native language is not English must take the SPEAK (https://esl.wisc.edu/ita-training/speak) test when arriving on campus.

Three Letters of Recommendation

These letters are required 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 3 letters (if more than three are sent, only the first three will be considered). See the Graduate School for FAQs regarding letters of recommendation (https://grad.wisc.edu/admissions/faq/#rec).

**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/prospective/prepare/statement)).

**Resume (for Ph.D. applicants only)**

ONLY if applying for the PhD program.

**Application fee**—online through the application, it is nonrefundable and can be paid by credit card (Master Card or Visa), 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/admissions/feegrants).

**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**

**GRADUATE SCHOOL RESOURCES**

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 processes 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.

**MAJOR REQUIREMENTS**

**MODE OF INSTRUCTION**

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

**Online**: These programs are offered primarily online. Many available online programs can be completed almost entirely online with all online programs offering at least 50 percent or more of the program work online. Some online programs have an on-campus component that is often designed to accommodate working schedules. Take advantage of the convenience of online learning while participating in a rich, interactive learning environment. For more information about the online nature of a specific program, contact the program.

**Hybrid**: These programs have innovative curricula that combine on-campus and online formats. Most hybrid programs are completed on-campus with a partial or completely online semester. For more information about the hybrid schedule of a specific program, contact the program.

**Accelerated**: These on-campus programs are offered in an accelerated format that allows you to complete your program in a condensed time-frame. Enjoy the advantages of on-campus courses with minimal disruption to your career. For more information about the accelerated nature of a specific program, contact the program.

**CURRICULAR REQUIREMENTS**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Minimum Credit Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Residence Credit Requirement</td>
<td>16 credits</td>
</tr>
</tbody>
</table>
| Minimum Graduate Coursework Requirement | 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 (https://registrar.wisc.edu/course-guide/).

<table>
<thead>
<tr>
<th>Grade Requirement</th>
<th>Overall Graduate GPA Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Grade Requirements</td>
<td>3.00 GPA required.</td>
</tr>
<tr>
<td>Assessments and Examinations</td>
<td>There are no degree-specific assessments and examinations outside of those given in individual courses. If an M.S. student should decide to extend their studies and pursue a Ph.D. in BME, they will need to take Qualifying and Preliminary Examinations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Requirement</th>
<th>n/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>Requirements</td>
</tr>
</tbody>
</table>

**REQUIRED COURSES**

Specific course selection is very flexible and draws upon a variety of courses. The required coursework is designed to complement each student’s interests and background in biomedical engineering and meet the spirit of a BME degree; deviations from the requirements should be discussed with the associate chair of graduate advising and will be decided on a case-by-case basis.

- Two semesters of BME 701 Seminar in Biomedical Engineering
• At least one course in bioscience (such as PHYSIOL 335 or a cell biology course; if not from a bioscience or BME background)
• At least 12 credits of engineering courses, 400 level or above
• At least 15 credits in one area of specialization (https://www.engr.wisc.edu/department/bme/research), 400 level or above (any program)
• At least 15 credits that are graduate level (700 or above or from the approved list)
• Optional, but recommended: 3–6 credits of independent study project experience or master’s thesis research in the student’s area of specialization (a maximum of 6 credits can be applied to the MS although students may take more). These credits may count toward your area of specialization.

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.

MAJOR-SPECIFIC POLICIES
GRADUATE PROGRAM HANDBOOK
The Graduate Program Handbook (https://www.engr.wisc.edu/app/uploads/2016/01/bme_grad_handbook_2017-2.pdf) is the repository for all of the program’s policies and requirements.

PRIOR COURSEWORK
Graduate Work from Other Institutions
The Graduate School’s minimum credit requirement for graduation can ONLY be satisfied with graduate-level courses taken as a graduate student at UW-Madison. The minimum credit requirement is 16 credits for master’s degree students and 32 credits for Ph.D. students. Master’s degree students who have been absent for five or more years lose all degree credits earned before their absence. The BME department will allow the student to use up to 6 credits of graduate course work from another institution toward his/her degree requirements. See Graduate Student Coordinator Pam Peterson for more information.

UW-Madison Undergraduate
Fulfillment of Minimum Graduate Degree Credit Requirement with prior UW-Madison undergraduate coursework is allowed up to 6 credits numbered 700 or above in engineering-degree-granting programs or from the approved list. Coursework earned five or more years prior to admission to a M.S. degree is not allowed to satisfy requirements. Prior coursework from the UW-Madison undergraduate career may not count toward the minimum graduate residence credit requirement.

UW-Madison University Special
A maximum of 15 credits from the UW-Madison University Special student career may count toward program requirements. Minimum graduate resident credits requirement and minimum graduate degree credit requirement: allowed up to 15 credits numbered 300 or above. Minimum graduate coursework (50%) requirement: allowed up to 15 credits numbered 700 or above. Coursework earned five or more years prior to admission to a master’s degree is not allowed to satisfy requirements.

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.

1. Good standing (progressing according to standards; any funding guarantee remains in place).
2. Probation (not progressing according to standards but permitted to enroll; loss of funding guarantee; specific plan with dates and deadlines in place in regard to removal of probationary status).
3. Unsatisfactory progress (not progressing according to standards; not permitted to enroll, dismissal, leave of absence or change of advisor or program).

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

TIME CONSTRAINTS
Full-time students usually complete an M.S. in BME in one year.

OTHER
n/a

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.

THE 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.

LEARNING OUTCOMES

1. Demonstrate a strong understanding of mathematical, scientific, and engineering principles in the field.

2. Demonstrate an ability to formulate, analyze, and solve advanced engineering problems.

3. Demonstrate creative, independent problem solving skills.

4. Apply the latest scientific and technological advancements, advanced techniques, and modern engineering tools to these problems.

5. Recognize and apply principles of ethical and professional conduct.

PEOPLE

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

PROFESSORS:
- Justin Williams (Chair)
- David Beebe
- Walter Block
- Paul Campagnola
- Naomi Chesler
- Shaqin (Sarah) Gong
- Jan Huisken
- Beth Meyerand
- William Murphy
- Darryl Thelen
- Ray Vanderby

ASSOCIATE PROFESSORS:
- Jeremy Rogers
- Krishanu Saha

FACULTY ASSOCIATES
- Christopher Brace
- Pamela Kreeger
- Wan-ju Li
- Melissa Skala

EMERITUS
- Ed Bersu
- Willis Tompkins
- John Webster

ASSISTANT PROFESSORS:
- Randolph Ashton
- Megan McClean