

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, student 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.

Graduate 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/>).

Requirements	Detail
Fall Deadline	December 15
Spring Deadline	September 1*
Summer Deadline	December 15
GRE (Graduate Record Examinations)	Not required.
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)	n/a
Letters of Recommendation Required	3**

* Complete spring applications as of September 1 are guaranteed review, but domestic applicants are welcome to apply up to November 1 and will be reviewed as space is available.

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

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
- English Proficiency Test scores (<https://grad.wisc.edu/apply/requirements/#english-proficiency>) (if applicable)
- Three letters of recommendation
- Statement of purpose (<https://grad.wisc.edu/apply/prepare/>)
- Resume

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 deadline.

OFFICIAL ACADEMIC TRANSCRIPT

Electronically submit one copy of your transcript of all undergraduate and previous graduate work in your online application to the Graduate School. Unofficial copies of transcripts will be accepted for review. Official copies are required after an applicant is recommended for admission. 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.

ENGLISH PROFICIENCY TEST SCORES (IF APPLICABLE)

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 (iBT) score is below 92; TOEFL (PBT) score is below 580; or IELTS score is below 7 must take an English assessment test upon arrival. Depending on the result, an applicant may need to register for recommended English as a Second Language (ESL) courses in the first semester of enrollment.

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 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. See the Graduate School for more advice on

how to structure a personal statement (<https://grad.wisc.edu/apply/prepare/>).

RESUME

Upload your resume in your application.

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. This fee cannot be waived or deferred. Fee grants (<https://grad.wisc.edu/apply/fee-grant/>) are available through the Graduate School under certain conditions.

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 restrictions related to funding.

PROGRAM INFORMATION

Students enrolled in this program are not eligible to receive tuition remission from graduate assistantship appointments at this institution.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (<http://guide.wisc.edu/graduate/#policiesandrequirements>), in addition to the program requirements listed below.

NAMED OPTION REQUIREMENTS

MODE OF INSTRUCTION

Face to Face	Evening/ Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	Yes

Mode of Instruction Definitions

Accelerated: Accelerated programs are offered at a fast pace that condenses the time to completion. Students typically take enough credits aimed at completing the program in a year or two.

Evening/Weekend: Courses meet on the UW–Madison campus only in evenings and/or on weekends to accommodate typical business

schedules. Students have the advantages of face-to-face courses with the flexibility to keep work and other life commitments.

Face-to-Face: Courses typically meet during weekdays on the UW–Madison Campus.

Hybrid: These programs combine face-to-face and online learning formats. Contact the program for more specific information.

Online: These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.

CURRICULAR REQUIREMENTS

Requirement Detail	
Minimum Credit Requirement	30 credits
Minimum Residence Credit Requirement	16 credits
Minimum Graduate Coursework Requirement	15 credits must be graduate-level coursework. Details can be found in the Graduate School's Minimum Graduate Coursework (50%) policy (https://policy.wisc.edu/library/UW-1244 (https://policy.wisc.edu/library/UW-1244/)).
Overall Graduate GPA Requirement	3.00 GPA required. This program follows the Graduate School's policy: https://policy.wisc.edu/library/UW-1203 (https://policy.wisc.edu/library/UW-1203/).
Other Grade Requirements	n/a
Assessments and Examinations	There are no degree-specific assessments and examinations outside of those given in individual courses.
Language Requirements	n/a

REQUIRED COURSES

Code	Title	Credits
2 semesters of B M E 701		2
9 credits of engineering courses in design, prototyping and manufacturing¹		9
B M E 601	Special Topics in Biomedical Engineering	
B M E 601	Special Topics in Biomedical Engineering (Design for Rehabilitation)	
B M E 602	Special Topics in Biomedical Engineering	
B M E 602	Special Topics in Biomedical Engineering (Microfluidics and Rapid Prototyping)	
B M E/M E 603	Topics in Bio-Medical Engineering	
B M E/I SY E 662	Design and Human Disability and Aging	
M E 449	Redesign and Prototype Fabrication	
M E 514	Polymer Additive Manufacturing	
M E 549	Product Design	

M E 601	Special Topics in Mechanical Engineering	B M E 511	Tissue Engineering Laboratory
M E/I SY E 641	Design and Analysis of Manufacturing Systems	B M E 520	Stem Cell Bioengineering
M E 748	Optimum Design of Mechanical Elements and Systems	B M E/ MED PHYS 530	Medical Imaging Systems
I SY E 415	Introduction to Manufacturing Systems, Design and Analysis	B M E/ MED PHYS 535	Introduction to Energy-Tissue Interactions
I SY E 515	Engineering Management of Continuous Process Improvement	B M E 545	Engineering Extracellular Matrices
I SY E 517	Decision Making in Health Care	B M E 550	Introduction to Biological and Medical Microsystems
I SY E 552	Human Factors Engineering Design and Evaluation	B M E 556	Systems Biology: Mammalian Signaling Networks
I SY E 557	Human Factors Engineering for Healthcare Systems	B M E/CBE 560	Biochemical Engineering
I SY E 601	Special Topics in Industrial Engineering	B M E/ MED PHYS 573	Mathematical Methods in Medical Physics
I SY E 602	Special Topics in Human Factors	B M E/ MED PHYS 574	Data Science in Medical Physics
I SY E 603	Special Topics in Engineering Analytics and Operations Research	B M E/ MED PHYS 578	Non-Ionizing Diagnostic Imaging
I SY E 604	Special Topics in Manufacturing and Supply Chain Management	B M E/M E 615	Tissue Mechanics
I SY E 606	Special Topics in Healthcare Systems Engineering	B M E/ MED PHYS/ PHM COL- M/PHYSICS/ RADIOL 619	Microscopy of Life
INTEREGR 477	Tools for Prototyping and Manufacturing	B M E/CHEM/ MED PHYS 750	Biological Optical Microscopy
INTEREGR 601	Topics in Interdisciplinary Engineering	B M E/E C E/ MED PHYS 778	Machine Learning in Ultrasound Imaging
6 credits of general business, entrepreneurship and strategic innovation courses	6	CBE 540	Polymer Science and Technology
<i>Must include at least one of the following two BME courses:</i>			
B M E 640	Medical Devices Ecosystem: The Path to Product	E C E/ COMP SCI 533	Image Processing
B M E 740	Biomanufacturing Entrepreneurship	E C E/COMP SCI/ M E 539	Introduction to Artificial Neural Networks
GEN BUS 310	Fundamentals of Accounting and Finance for Non-Business Majors	M E 563	Intermediate Fluid Dynamics
GEN BUS 311	Fundamentals of Management and Marketing for Non-Business Majors	M E/E M A 570	Experimental Mechanics
M H R/A A E 540	Intellectual Property Rights, Innovation and Technology	M E 573	Computational Fluid Dynamics
M H R 715	Strategic Management of Innovation	M S & E 521	Advanced Polymeric Materials
M H R 722	Entrepreneurial Management	MED PHYS/ PEDIAT 705	Women and Leadership: Science, Health and Engineering
M H R 734	Venture Creation	3-6 credits of advanced design or research project	3-6
M H R 738	Weinert Applied Ventures in Entrepreneurship (WAVE)	B M E 799	Advanced Independent Study
R M I 650	Sustainability, Environmental and Social Risk Management	Additional credits taken from the list above, in consultation with advisor	0-6
0-6 credits of other technical elective engineering courses¹	0-6	Total Credits	30
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 510	Introduction to Tissue Engineering		

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At least 6 credits in "Engineering courses in design, prototyping, manufacturing" and/or "Technical elective engineering courses" need to be from B M E courses.

Students in this program may not take courses outside the prescribed curriculum without faculty advisor and program director approval. Students in this program cannot enroll concurrently in other undergraduate, graduate or certificate programs.

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

This program follows the Graduate School's policy for Satisfying Requirements with Prior Graduate Coursework from Other Institutions. (<https://policy.wisc.edu/library/UW-1216/>) Reach out to the BME Graduate Coordinator for more information.

UW–Madison Undergraduate

A student who has completed their bachelor's degree at UW–Madison may transfer 6 credits of coursework with program approval. These courses must be engineering or advanced biological sciences coursework numbered 400 or above. Coursework earned five or more years prior to admission to a M.S. degree is not allowed to satisfy requirements. These courses may not be used toward the Graduate School's Minimum Graduate Residence Credit.

UW–Madison University Special

This program follows the Graduate School's policy for Transfer from UW–Madison University Special Student Career at UW–Madison. (<https://policy.wisc.edu/library/UW-1216/>) Reach out to the BME Graduate Coordinator for more information.

PROBATION

This program follows the Graduate School's Probation policy (<https://policy.wisc.edu/library/UW-1217/>).

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 LIMITS

The MS BIDE program is typically completed in less than 18 months.

This program follows the Graduate School's Time Limits policy (<https://policy.wisc.edu/library/UW-1221/>).

GRIEVANCES AND APPEALS

These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (<https://doso.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/hib/>)
 - Office of the Provost for Faculty and Staff Affairs (<https://facstaff.provost.wisc.edu/>)
- Dean of Students Office (<https://doso.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://employee disabilities.wisc.edu/>) (for qualified employees or applicants with disabilities to have equal employment opportunities)
- Graduate School (<https://grad.wisc.edu/>) (for informal advice at any level of review and for official appeals of program/departmental or school/college grievance decisions)
- Office of Compliance (<https://compliance.wisc.edu/>) (for class harassment and discrimination, including sexual harassment and sexual violence)
- Office of Student Conduct and Community Standards (<https://conduct.students.wisc.edu/>) (for conflicts involving students)
- 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.

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. Students are also encouraged to talk with their faculty advisors regarding concerns or difficulties, or reach out to the Graduate Student Services Coordinator or Associate Chair of BME Graduate Advising for additional assistance. These activities do not rise to the level of a formal grievance; however, the student is encouraged to keep documentation of these interactions as they may be useful if a formal grievance is pursued.

Step 2

Should a satisfactory resolution not be achieved, a formal grievance can be filed with the BME Grievance Committee. To do so, the student contacts the Department Administrator, who will provide the student with the name of the current chair of the Grievance Committee. The student will then contact the Chair of the Grievance Committee, who will reply within seven calendar days. If the grievance is with the current Chair of the Grievance Committee, please let the Department Administrator know and they will identify an alternate committee member to contact. It is advised that grievances are filed within 60 calendar days of the alleged unfair treatment to enable a thorough investigation.

Step 3

If the student does not feel comfortable working through the departmental process, they are encouraged to seek out other campus resources including:

- The Assistant Dean for Graduate Affairs in the College of Engineering
- The Graduate School
- UW Division of Diversity, Equity & Educational Achievement (DDEEA)
- McBurney Disability Resource Center
- Employee Assistance Office
- Ombuds Office
- University Health Services

Step 4

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 ten working days to file a written appeal to the School/College. For more information, students should consult the College of Engineering Academic Advising Policies and Procedures.

Step 5

Documentation of the grievance will be stored for at least seven 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 are strongly discouraged to pursue positions as Project Assistants, Teaching Assistants or Research Assistants during their time in this program, as the rigor and accelerated nature of this program may not accommodate those work time commitments. Students in this program will not receive the tuition remission that is typically part of the compensation package for a graduate assistantship.

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.

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
 Darilis Suarez-Gonzalez
 Aaron Suminski

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