

## Joint MU-MCW Master of Engineering Degree in Biomedical Engineering

Biomedical Engineering (BME) is an interdisciplinary field that is based on the application of engineering principles and experimental and analytical techniques to the development of biologics, materials, devices, implants, processes, and systems that advance biology and medicine and improve medical practice and health care.

The Master of Engineering (ME) degree in BME is a non-thesis degree program that includes coursework in existing BME graduate programs of study, upper division undergraduate courses that carry graduate credit, and graduate coursework taken outside of the Department offerings.

### a. Admission Requirements.

#### i. Educational Background.

- The intent of the BME ME degree program is to empower current engineers to increase depth of professional knowledge within a specific specialization area of BME. Given the short duration of the typical ME program of study and the need to demonstrate adequate technical proficiency, students without an undergraduate engineering degree or equivalent are not normally admitted to this degree program.
- Ideally, a 3.0 grade point average or better on a 4.0 scale. Graduate admission is based on several criteria, and applicants may be admitted with a slightly lower GPA if other criteria indicate future success in the program.

#### ii. Application for Admission.

All applicants, regardless of status sought, must submit the following documents with the MU Graduate School.

<https://graduate.admissions.marquette.edu/apply/>

Priority deadlines for completed applications for fall and spring admission are June 1<sup>st</sup> and December 15<sup>th</sup>, respectively. Normally, no application is considered for admission until it is complete. The required documents are:

- Completed graduate school "Application for Admission"
- Three letters of recommendation - at least one from the current employer.
- Official transcripts of undergraduate and graduate records, sent directly to the MU Graduate School by the issued institution. If a transcript or mark sheet is not in English, the applicant must supply a translation.
- A one-page statement of purpose (Why do you want to earn this degree?).
- Results of the Graduate Record Examination (GRE), sent directly to the MU Graduate School by the Educational Testing Service ([www.ets.org](http://www.ets.org)). **Optional for fall 2023 and spring 2024.**
- International students must submit results of the TOEFL examination, sent directly to the MU Graduate School by the Educational Testing Service ([www.ets.org](http://www.ets.org)). International students who are in the process of completing or have completed their undergraduate degree in the United States, United Kingdom, Australia, New Zealand or Canada (excluding Quebec) are not required to take the TOEFL examination.
- Application fee (non-refundable).

Admission is not official until the student is notified of acceptance by the MU Graduate School. Admission cannot be made final until an official transcript has been received indicating the conferral of an undergraduate degree. If a student fails to register for courses within two years after the date of application for admission, the student's file will be discarded.

#### **b. Areas of Specialization.**

Upon enrolling in the joint MU-MCW ME degree program in BME, a student should select one of the following specializations/tracks.

1. *Bioinstrumentation*
2. *Biomechanics*
3. *Biomedical Imaging*
4. *Cellular and Molecular Engineering*
5. *Computational Biology and Bioinformatics*
6. *Rehabilitation Bioengineering*

**The student's Academic Advisor then works with the student to design the appropriate curriculum. This will include courses in engineering, biology, mathematics, and medicine.**

#### **c. Transfer of Graduate Credit.**

A maximum of 6 semester hours of approved graduate coursework in a Graduate Program from other institutions may be transferred into a student's ME degree program in BME with the consent of the MU Graduate School Dean and the BME Department Chairperson. Under special circumstances, when courses from other institutions are directly comparable in content to those at MU, up to 12 semester hours may be transferred. A course will be considered for transfer credit only if the grade is "B" or better and completed for graduate credit at the institution at which it was taken no more than five years before the start of the MU-MCW ME degree program in BME. Students applying for transfer credit must complete the appropriate form available from the MU Graduate School after completion of at least 6 semester hours at Marquette (9 semester hours if on probation).

#### **d. Course Work**

##### **i. Program Requirements:**

- **Option # 1:** 30 credit hours of didactic graduate level courses that include:
  - A minimum of 15 credit hours must be engineering courses, including a minimum of 12 credits of BIEN (Biomedical Engineering) courses.
  - **Biomedical Science** course (3 credits) (e.g., cellular and systems physiology, neurophysiology, intra- and inter-cellular signaling, genetics and developmental biology, pharmacology, cellular pathology, microbiology and immunology, molecular biology, biochemistry, etc.) (e.g., *MU BIEN 5700, MU BIEN 5720, MU BIOL 5102, MU BIOL 5703, MCW IDP 16215, 16216, 16217 and 16218, MCW IDP 16271, MCW NDP 12206, 12210, 12221, and 12237, MCW Physiol 08204*)
  - **One readings course:** A faculty member will determine the title and topic, which should link various areas of BME, e.g., bioinstrumentation, biomechanics, biomedical imaging, rehabilitation bioengineering, computational biology and bioinformatics, cellular and molecular engineering. This requirement can be managed via the existing BIEN 6995 "Independent Readings and Research" course.

- **Option # 2:** “Stackable” certificates. For this option, students complete 2 engineering certificates (12 credits each) plus 6 credits of BIEN graduate courses for a total of 30 credits of didactic graduate level courses.
  - One of the 2 certificates must be a BIEN certificate (Clinical Immersion in Medical Design certificate).
  - One of the two certificates can be from another engineering department. Approved engineering certificates include:
    - Machine Learning for Engineering Applications
    - Systems Engineering
    - Essential skills for Practicing Engineers
  - A minimum of 15 credit hours must be engineering courses, including a minimum of 12 credits of BIEN courses.
  - **Biomedical Science** course (3 credits) (e.g., cellular and systems physiology, neurophysiology, intra- and inter-cellular signaling, genetics and developmental biology, pharmacology, cellular pathology, microbiology and immunology, molecular biology, biochemistry, etc.) (e.g., MU BIEN 5700, MU BIEN 5720, MU BIOL 5102, MU BIOL 5703, MCW IDP 16215, 16216, 16217 and 16218, MCW IDP 16271, MCW NDP 12206, 12210, 12221, and 12237, MCW Physiol 08204).
  - **One readings course:** A faculty member will determine the title and topic, which should link various areas of BME, e.g., bioinstrumentation, biomechanics, biomedical imaging, rehabilitation bioengineering, computational biology and bioinformatics, cellular and molecular engineering. This requirement can be managed via the existing BIEN 6995 “*Independent Readings and Research*” course.
- ME students are required to register for the BME Department seminar series for the duration of their study (**BIEN 6953**, 0 credit). For a given semester, students are expected to attend at least two thirds of the seminars.

## ii. Academic Load.

The maximum load for a semester is 13 credits of coursework. For summer session and inter-session courses, the maximum load is the number of credit hours equal to the number of weeks in the session. The Dean of the MU Graduate School must approve all credit overloads.

## iii. Independent Study Course (BIEN 6995).

Independent study courses (BIEN 6995) are offered for capable and highly motivated students. They are not intended as substitute courses for those offered through the joint BME Department. Rather, they are intended to provide a unique tutorial experience in which topics not covered in the existing curriculum may be explored in detail. Normally only one such course can be used for the MS degree requirements.

A maximum of 3 credits of BIEN 6995 course work can be credited toward the 30 credit hours.

### • Approval and Contract

Students taking a BIEN 6995 course must complete, at registration, both an

“Approval Form for BIEN 6995” and a “BIEN 6995 Course Contract.” Please note that more details on required forms is included on page 7 of this Handbook. The first form must be signed by the Course Director and the BME Department Chairperson. The second form must be signed by the student, the Course Director, and the BME Department Chairperson. Both forms must be turned in to the MU BME office at least two weeks before the start of classes.

- **Summary Report**

The Graduate Committee of the joint BME Department reviews all BIEN 6995 courses. A summary report, including a list of references, must be submitted by the student to the Graduate Committee no later than two weeks after the end of classes in the semester in which the course is taken.

**iv. Grades.**

Satisfactory academic work is not solely determined by course grades. However, grades are an important factor in the evaluation process. A minimum GPA of 3.0 is required to graduate, and students with a GPA under 3.0 are placed on probationary status. An "I" grade will be regarded as a "C" grade in evaluating academic progress in the BME ME Program. Incomplete grades must be cleared by the date specified in the academic calendar or they will automatically become the grade of IP (permanent incomplete).

**e. Academic Progress.**

**i. Application for Degree.**

Prior to the deadline posted in the MU Graduate Bulletin, each student planning to graduate must file an “*Application for Degree*” with the MU Graduate School Office.

When the student prepares for their defense, it must be noted that the academic timeline and terms between the two institutions throughout the school year do not perfectly align. here are a few points in time during the year where Marquette’s calendar may be in one term, while MCW’s calendar is in another. When applying for graduation, the student would apply under (Current Term) Graduation at Marquette while also applying under (Current Term) Graduation at MCW. The student should work with the department administration as well as the graduate school to confirm dates and ensure that the correct applications for graduation have been submitted.

**ii. Time Limitations.**

A student must complete all of the requirements for a ME degree within **6 years**. If courses from other universities are transferred into the BME ME degree program and if those courses were taken prior to work at MU and MCW, the beginning date of the first course will be used to establish the beginning of the student's time period.

**f. Student Classification.**

**1. Full-Time.**

A student who takes seven or more credits in a regular semester or is otherwise pursuing graduate work on a full-time basis is considered to be a full-time student.

2. **Part-Time.**

A student who takes six or fewer credits in a regular semester is considered to be a part-time student.

3. **Degree Student.**

A student is a degree student if enrolled in a program leading to a degree. A student cannot be classified as a degree student unless the department has agreed to accept him or her into a program of study.

a. **Regular.**

A regular status student has been admitted to the Graduate School and is working toward a degree in a particular program of study. Such students are eligible for tuition scholarships, graduate assistantships, and fellowships.

b. **Probationary.**

A student may be admitted to a degree program with probationary status if their academic performance is below Graduate School standards but if there is other evidence that he or she has the potential for successful graduate study. Upon completion of nine semester hours of work with an average grade of "B" (3.0) or better (with no grade lower than "C"), at least one-third of which must be at the 6000 course level, the probationary status is removed. A student who fails to remove their probationary status on completion of nine semester-hours work will not be permitted to remain in the Graduate School. A student on probation is not eligible to receive financial aid.

4. **Non-Degree Student.**

A student who chooses this status does not work toward a degree, but credits earned are graduate credits and may be certified as such to school boards or other authorities. Those students seeking non-degree admission must meet the same admission standards as those seeking admission to a degree program. There is no guarantee that credits earned while a non-degree student will later count toward a degree if the student is admitted to a degree program. A student who completes a master's or doctoral degree at Marquette will, upon application, be automatically classified as a non-degree student. Non-degree students may register for any course for which they have met the prerequisites and for which they have department permission.

a. **Regular.**

A regular student is clearly admissible to the Graduate School but is not seeking a degree.

b. **Probationary.**

A student whose past academic performance falls below Graduate School standards but shows other evidence of potential for successful graduate work may be granted probationary status. This status is identical to the probationary degree status except that this person is not seeking a degree.

c. **Temporary.**

A student who seeks to register for graduate courses and who appears to meet Graduate School admission standards but who has not submitted all necessary documentation to the Graduate School that is required for regular admission. Admission to this status is valid for only one semester. A student admitted as a

temporary student must apply for and be admitted into one of the other classifications before he/she will be allowed to register for courses in another semester.

**Note:** A change from non-degree status to degree status requires a new “Application for Admission” be submitted to the Graduate School.

### **g. Advising System.**

The advising system is designed to assist and guide the graduate student from the first day of admission into graduate school. The process includes an orientation meeting, distribution of the Graduate Student Handbook and assignment of an academic advisor.

#### **1. Orientation Meeting.**

At the beginning of each academic year, all graduate students are required to attend an orientation meeting organized and held by the Department Chairperson. During this meeting, topics including financial aid, general policies, program requirements, special course offerings and areas of research will be presented and discussed.

#### **2. Academic Advisor.**

When a student is admitted to the graduate program in BME, an advisor in their area is assigned by the Director of Graduate Studies to assist with any problems and in course selection. The Academic Advisor will assist the student in preparing a coursework plan.

**It is each student’s responsibility to satisfy all program requirements, ensure that all forms are completed and filed appropriately, and that all deadlines are met. All Graduate Students must notify the BME Department of their intent to graduate at the same time they notify the Graduate School.**

### **h. Program Objectives and Requirements.**

#### **a. Learning Objectives.**

The Learning Objectives of the BME ME training program, and their assessment, provide tools that ensure continuous quality improvement. Graduates earning the ME degree will be able to:

- **Synthesize information in the two fields of engineering and life science.** This outcome will be measured through the required Readings Course.
- **Write an article length paper on interdisciplinary BME topics.** This outcome will be measured by successful completion of the Readings Course requirement.
- **Appropriately communicate technical information to specific audiences.** This outcome will be measured via a high technical quality of the Readings Course.
- **Describe the economic, legal, ethical, and regulatory aspects of healthcare delivery and medical device development.** Feedback from employers of ME program graduates, and evaluation of student performance in the Readings Course will be used to measure this outcome.

#### **i. Example Plans of Study for the ME Degree.**

Students may choose to follow a plan of study that roughly corresponds to one of our existing emphasis areas of graduate study. The sample study plans below reflect the flexibility that is built into the ME degree program. Furthermore, these plans are designed for an academic progress pace that is reasonable for students from industry.

Refer to the following pages for recommended full-time study plans for some of the specializations.

## **Grading, Evaluation of Performance.**

### **a. Grading System.**

The letter grades A, A-, B+, B, B-, C+, C, C-, D+, D, D-, F, W, SC/SNC, UC/UNC, I and X will be assigned for graduate coursework at the end of each semester. Detailed explanations of these grades are given in the MU Graduate School Bulletin.

See link below for MCW grading system:

<https://www.mcw.edu/-/media/MCW/Education/Graduate-School/Forms/Handbook---2020-2021.pdf>

### **b. Appeal of Grades.**

Any student may consult their instructor about the grades received for work done. The exercise of this right neither requires a fixed procedure nor is subject to procedural conditions. Final graduate course grades assigned in the BME Department may be appealed following the procedures given below, provided that this action is initiated before the first day of class of the next regular semester following the issuance of the grade.

1. The student must consult with the instructor to determine the reasons for the grade. When there are special circumstances, the Chairperson of the BME Department may waive the requirement of consultation with an instructor.
2. When the student is not satisfied with the reasons given by the instructor, he/she may present his/her case in writing to the BME Chairperson. The student should present all evidence of his/her performance and may request that all other pertinent material be supplied by the instructor.
3. When the BME Chairperson has examined the appeal and after consultation with the instructor the Chairperson will: (1) Inform the student that no further department action is to be taken; or (2) convene a committee to review the appeal.
4. The BME Chairperson will appoint a committee of three regular faculty members of the BME Department. The Chairperson may sit on the committee.
5. The committee may proceed from written evidence or may consult the instructor and/or the student according to its judgment.
6. The committee shall give one of three decisions: (1) That the grade given will remain; (2) That the instructor will reconsider the grade in light of what the committee discovered and that the instructor's reconsidered grade will stand; or (3) That the committee recommends a change of grade to the Dean of MU Graduate School.
7. The decision of the committee should be the final action inside the BME Department and any appeal beyond the BME Department must be made to the Dean of MU Graduate School.

### **c. Evaluation of Performance.**

The Academic Advisor will submit annual academic progress reports to the BME Department regarding each graduate student. The BME Chairperson evaluates the academic progress of all graduate students at the end of the semester. If a student is not performing satisfactory work, the student and the Dean of MU Graduate School will be notified in writing.

The Student may be counseled to withdraw. The Dean of MU Graduate School may be asked to place the student on probation, register a voluntary withdrawal, or administratively withdraw students so counseled.

**d. Academic Dishonesty and Research Misconduct.**

Upon detection of academic dishonesty, the student involved will automatically receive an "F" grade in the course. Beyond this, additional credit for graduation may be required or expulsion from the school may result depending on the nature of the offense and the MU Graduate School Dean's decision according to the University policy. Refer to the MU Graduate Bulletin for "Definitions of Academic Dishonesty" and its consequences and to the University statement regarding "Research Misconduct".

**e. Registering for Courses at MCW.**

Once you have decided which courses you will be taking at MCW, you must inform the MU BME Department's Administrative Assistant. Take for example the Human Physiology course at MCW – you would first contact the MU BME Department Administrative Assistant and provide her with the course number, professor, and number of credits. This procedure assures that you get MU credit for taking the class. The MU BME Department Administrative Assistant will grant consent for you to register. Next, you must register at MU for **BIEN 6947**. Choose the section that corresponds to the total number of credits you're taking at MCW that semester. Furthermore, you **MUST** register at the MCW Graduate School. Your earned grade will show up on your MU transcript. **NOTE:** the MCW classes may start considerably earlier or later than the MU classes and the weekly meeting schedule may vary. It is your responsibility to register for BIEN 6947.

A non-exhaustive list of existing pertinent graduate courses can be found here: <https://mcw.marquette.edu/biomedical-engineering/documents/graduate-courses-2023.pdf>

**f. Continuous Enrollment.**

You must request continuous enrollment when you are not registering for any specific course work at MU (when finished with coursework and thesis credits, but still doing your research work) or when you are not carrying sufficient course load so as to maintain full-time enrollment status. To request continuous enrollment, you must fill out the "Graduate School Continuous Enrollment Registration Form" and pay the appropriate fee. This completed form must be signed by your advisor and returned to the BME Department office, Olin Room 206. Consent will be provided for you to enroll. You must register for **BIEN 9xxx** according to the nature of your continuous enrollment. The details are explained on the form, which is included at the end of this handbook. The Bursar will bill you the appropriate fee for continuous enrollment.

**g. Restrictions on Financial Assistance.**

No financial assistance (fellowships, research and teaching assistantships) will be provided to students in the non-thesis degree program. It is assumed that employers will fund the education of these students or they will be self-funded. Students who are enrolled in the current thesis-required program and are receiving funding from the Department of BME may neither convert nor apply to the non-thesis program.

Loan assistance is available to assist qualified students who, without such aid, would be unable to attend the University. Students are eligible for student loans if they are attending the University on at least a half-time basis and are in good academic standing. No applicant will be considered for loan assistance until he/she has been formally admitted to the Graduate School. For specific information on loans and other resources available to graduate students attending Marquette, refer to the Marquette University Financial Aid brochure. This brochure is available from the Office of Student Financial Aid, Marquette University, Milwaukee, WI 53233. Telephone: (414) 288-7390.