

WORCESTER POLYTECHNIC INSTITUTE

Department of Biomedical Engineering

Ph.D. in Biomedical Engineering

Master of Science in Biomedical Engineering

Master of Engineering in Biomedical Engineering

Graduate Student Handbook
Version 1 Fall 2018

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Program Mission and Goals

WPI's Biomedical Engineering Department never stops on its search to uncover the next advance in therapies, devices, and products to help people live longer, healthier lives. Our department is leading diverse, cutting-edge research and product and thought innovation to develop new breakthroughs in this rapidly changing field.

We work on advances as diverse as wound-healing sutures, blood vessel engineering, vital sign monitoring for firefighters, and braces for joint stabilization. We seek to understand how physicians and patients will use devices, making these devices more user friendly and useful.

Our students and faculty collaborate on ambitious research projects to push the boundaries at the intersection of engineering, biology, and medicine, often making groundbreaking discoveries and industry-changing developments to move the field forward.

We identify emerging technologies and help launch them through development and commercialization. Students work on teams here to help advance new developments and connect theory and practice of the university.

BME graduate programs are designed to be flexible, student-centered, and customizable to each individual student's academic background, professional experience, and career goals. Courses may be taken on campus or online (as available). Depending on the specific degree program, coursework, thesis and dissertation research, and project work may be integrated with industry co-ops and internships, full-time employment in a related industry, or an international research experience.

BME Graduate Program Faculty and Staff

Department Head: Kristen L. Billiar – kbilliar@wpi.edu
Graduate Coordinator: Karen L. Troy – ktroy@wpi.edu
Graduate Student Admissions Coordinator: Songbai Ji – sji@wpi.edu

Administrative contacts:

Lynda Hammett – lhammet@wpi.edu
Ina Gjencaj – igjencaj@wpi.edu

Graduate Program Email: BMEGradProgram@wpi.edu

A list of current BME Primary faculty can be found in the WPI Graduate Catalog
A list of current BME Program Faculty can be found on the [BME Faculty page](#). They are designated as “Collaborative Faculty”

WPI Graduate Program Resources and Links

[Office of Graduate Admissions](#)
[Office of Graduate Studies](#)
[Graduate Student Government \(GSG\)](#)
[Committee on Graduate Studies and Research \(CGSR\)](#)
[Registrar](#)
[Gordon Library](#)
[Career Development Center](#)
[Office of Financial Aid](#)
[International House](#)
[Transportation](#)

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Chapter 1. Introduction

1.1 Overview and Scope of Handbook

The purpose of this Handbook is to provide students, faculty, and staff with an up-to-date source of information on the different Biomedical Engineering (BME) graduate degree programs at Worcester Polytechnic Institute (WPI).

It is divided into the following sections:

Chapter 1: This chapter is primarily intended for prospective students seeking guidance and insights prior to submitting a full application. General information covered includes:

- Descriptions of each BME Graduate Program offered at WPI
- BME Graduate Program application and admissions procedures
- General information on financial aid and transfer credit
- Internship and co-op opportunities (including international internships)
- General guidance for course selection and academic planning

Detailed information, including course descriptions, and institutional policies and requirements for all WPI degrees, can be found in the WPI Graduate Catalog or online at the appropriate administrative office's website (Registrar, Financial Aid, Graduate Admissions, etc).

Chapters 2-5: Detailed information about each degree program is provided. These chapters are intended for both prospective students seeking more information about a particular degree program, and current graduate students seeking information about degree requirements and procedures specific to a particular degree program. Each chapter covers a single degree program in detail. "Program-at-a-Glance" schematics at the end of each chapter serve as a quick reference guide to degree requirements and expected timelines.

Chapter 6: Description of general WPI degree requirements and procedures, primarily intended for current graduate students. A complete description of institutional policies and requirements for all advanced degrees can be found in the WPI Graduate Catalog.

Appendices: Program administrative forms (including Degree Program Plans of Study, Application for Qualifying Examination, and Tracking Documents) are no longer included as appendices. Instead, current versions of these documents are located at: <https://wp.wpi.edu/bme/grad> (the BME Grad Studies Website).

1.2 Programs of Study in Biomedical Engineering (BME)

The goal of the BME graduate program is to apply engineering principles and technologies as solutions to significant biological and medical problems. Students trained in these programs have found rewarding careers in major medical and biomedical research centers, academia, medical care industries, and entrepreneurial enterprises.

1.2.1. Doctor of Philosophy (PhD) Degree Programs

The degree of Doctor of Philosophy (PhD) is conferred on candidates in recognition of high attainments and the ability to conduct original independent research. Graduates will be prepared to affiliate with academic institutions and the growing medical device and biotechnology industry, which have become major economic factors in the Commonwealth of Massachusetts and the United States.

PhD students must complete a minimum of 90 credit hours of graduate work beyond the bachelor's degree, or a minimum of 60 credit hours of graduate work beyond the Master's degree, including in either case at least 30 credit hours of research. All PhD students must pass a Qualifying Exam to advance to PhD candidacy. The student must prepare a doctoral dissertation and defend it before a Dissertation Committee, the makeup of which is specified in this document.

1.2.2. Master's Degree Programs

There are two master's options in BME: the Master of Science (MS) in Biomedical Engineering and the Master of Engineering (MEng) in Biomedical Engineering. While the expected levels of student academic performance are the same for all options, they are oriented toward different career goals. The Master of Science option in BME is oriented toward the student who wants to focus on a particular facet of biomedical engineering practice or research. The Master of Science requires a thesis or project and can serve as a terminal degree for students interested in an in-depth specialization. The Master of Engineering in Biomedical Engineering is a non-thesis graduate degree generally oriented towards students interested in gaining an in-depth knowledge of BME and applying it in industry. It is normally considered to be a terminal professional degree.

1.2.3. Combined Bachelor of Science (BS) / Master's Degree Programs

The goal of the Combined BS/Master's Degree Program is to allow qualified WPI undergraduate students to obtain a cost-effective and time-efficient advanced degree in BME, while at the same time enhancing the quality of the graduate program by attracting WPI's most talented undergraduates. It affords an opportunity for outstanding WPI undergraduate students to earn both a Bachelor's degree and a Master's degree in BME from WPI concurrently and in less time than would typically be required to earn each degree separately. The principal advantage of this program is that it allows for certain courses to be counted towards both degree requirements, thereby reducing total class time. With careful planning and motivation, this program typically allows a student to complete the requirements for both degrees with only one additional year of study (5 years total). However, because a student must still satisfy all graduate degree requirements, the actual time spent in the program may be longer than 5 years. There are two degree options for students: a thesis-based Master of Science (BS/MS) option and a non-thesis Master of Engineering (BS/MEng) option.

1.2.4. Advanced Study for Non-Degree Students

Courses in biomedical engineering are available for students who do not wish to commit themselves to any degree or certificate program but who wish to enroll in a single course or a limited number of courses in a specialized field. Up to three courses in biomedical engineering can be taken as a non-matriculated graduate student and subsequently applied to a graduate degree program at WPI.

1.3 Admission Requirements

Applicants to BME graduate programs are *expected to have an undergraduate degree and a strong background in engineering and mathematics* and to achieve basic and advanced knowledge in engineering, life sciences, and biomedical engineering. Admission normally requires a minimum GPA of 3.2 (out of 4.0). Successful applicants typically have a minimum TOEFL score of 100.

1.4 Application Procedure

Applications to WPI must be submitted online through the WPI Office of Graduate Admissions: <http://www.grad.wpi.edu>

Requirements for admission:

- A completed Application for Admission to Graduate Study at WPI, **DUE JANUARY 1**.
- A nonrefundable application fee (waived for WPI alumni).
- Official college transcripts from all accredited degree-granting institutions attended.
- Three letters of recommendation from individuals who can comment on the qualifications relevant to the applicant's admission, particularly with respect to advanced coursework and independent research. These references should ideally be from faculty and technical/research supervisors.
- TOEFL scores must be submitted by all foreign applicants (waived for foreign students presently attending a U.S. school).
- Statement of Purpose. This is a brief essay discussing academic background, research and engineering experience and interests, academic and career intent, and the reasons the applicant feels they would benefit from the degree program in biomedical engineering to which they are applying.

For full consideration for admission and financial aid, applications must be submitted on or before **January 1**. *Applications are considered for Fall Admission only*. New applications for admission to BME Graduate Programs are reviewed in January and February each year. Applications to Master's degree programs will be considered on a rolling basis through April. The online system will close to new applications on May 1. No new applications will be considered and incomplete applications will not be reviewed after May 15.

1.5 Financial Aid

Fellowships, research assistantships (RAs), teaching assistantships (TAs), and Graduate

Assistantships (GAs) are available on a competitive basis to outstanding graduate students. All PhD students in good standing are provided financial support (stipend and tuition). Exceptional Master's students may be awarded RA, GA, or TA support on a competitive basis as available. RAs and GAs are awarded to graduate students by individual faculty members. TAs may be awarded on a competitive basis to support undergraduate teaching in the BME Department at WPI. Fellowships are awarded by WPI, national organizations, and corporate sponsors. A more detailed description of these roles is located in the [Financial Assistance section of the WPI Graduate Catalog](#).

Additional support may be available to qualified graduate students through the Department or University in the form of fellowships and Peer Learning Assistant (PLA) hourly positions.

More information on individual fellowships, student loans, tuition incentive programs, and other forms of financial aid can be found on the WPI Financial Aid Office website.

1.6 Transfer Credit

Students may apply for transfer credit for graduate level courses that they have taken at other Universities. Transfer credit policies follow those outlined in the Graduate Catalog and require departmental approval and a completed form, available from the Registrar's website. In general, credit for specific WPI courses will only be given if the syllabus from the course taken indicates substantial overlap in the material covered by the equivalent WPI course. Non-equivalent courses that qualify for transfer credit will be assigned a Special Topics/elective course designator.

1.7 Career Preparation and Professional Development

The Graduate Studies office offers a series of programs and activities aimed at professional development for graduate students. These include the Student Training and Readiness Series (STARS) and the Graduate Research Innovation and Entrepreneurship (GRIE) research fair. Additional information about these and other professional development programs can be found on the [Office of Graduate Studies](#) website.

1.7.1 Co-ops and Internships

Co-ops, internships, and scientific exchanges for graduate students are encouraged. The project-based MS degree includes the option to pair a project with an industry or clinical experience. Other co-ops and internships at both the Master's and PhD levels may be arranged by the student in collaboration with their advisor and with assistance from the Career Development Center. Generally, students are paid by their industry host during these experiences, and the student is not charged tuition during the period they are away from the University. International exchanges may be funded through external fellowships. Interested students should discuss options for funding with their advisor.

1.7.2 Course Selection, Academic Planning and Advising

Students are each assigned an academic advisor when they enter the program. To select courses, students should consult with their advisor, the information available on the BME Graduate Program website (<https://wp.wpi.edu/BME/grad/>), and the information provided to students during BME Graduate Student Orientation. Students should discuss their career goals and focus with their advisor to guide their course selections.

1.7.3 Selecting a Research Mentor

Students who are pursuing research-based degrees (PhD, MS with thesis option) should contact potential research mentors before or during their first semester in the program. Students may rotate through several laboratories before deciding on a research mentor, but laboratory rotations are not required. Typically, a laboratory rotation includes the student completing 1-3 credit hours of BME 598 Directed Research. Students should identify their mentor by the end of their first year in the program. Once a research mentor has been selected, they also become the student's academic advisor.

1.7.4 Plans of Study

All students should fill out a Plan of Study form in consultation with their faculty advisor. Select the appropriate form based on your degree. These forms are found on the BME Graduate Website. They outline the requirements for each degree and are designed to help students track their progress towards meeting those requirements.

1.7.5 Petitions to Request BME Credit or Competency

The BME Graduate Programs are designed to be flexible and allow students to meet the degree requirements through many different mechanisms. However, sometimes situations arise in which students require additional flexibility. To request that a course to count for BME credit, or for a course or experience to fulfil a competency, students may submit a petition with this request to the Graduate Studies Committee. A blank petition may be found in the BME Graduate Website.

1.8 Graduation Paperwork and Procedures

The semester that the student is expected to complete all graduation requirements, they must fulfil various requirements and complete several forms and other items. All of the necessary University forms may be found on the Registrar's website:

<https://www.wpi.edu/offices/registrar/forms>

1. The student must be registered at least one (1) credit of coursework or research during the semester they will graduate.
2. Complete an Application for Graduation and return it to the registrar by the required date.
3. Complete a Plan of Study form that documents all of their coursework and research hours, to demonstrate that they have met the degree requirements. This form may be found on the BME Graduate Website.
4. Assemble any petitions or waivers that they have obtained to document that they have met the degree requirements (e.g. competencies).
5. Complete a Master's and PhD Completion Form. This form must be signed by the

student's advisor (first) and by the BME Graduate Coordinator (second).

- a. To obtain a signature from the Graduate Coordinator, send an email to the Graduate Coordinator and Cc BMEGradProgram@wpi.edu. To it, please attach:
 - i. the plan of study
 - ii. any relevant waivers
 - iii. the form, which has already been signed by the advisor.
 - b. The signed form will be returned to the student. It is the student's responsibility to ensure that the form is submitted to the registrar.
6. Complete the degree requirements.
- For a PhD or MS degree, this includes:
- a. Public presentation of the dissertation, thesis, or project, followed by an examination.
 - b. Approval of the committee. Approval is documented in the following ways:
 - i. For **PhD** and **Thesis-based MS** degrees, a signed cover page and completed eCDR, which includes an uploaded final document.
 - ii. For **Project-based MS** degree, an email from the Committee Chair sent to BMEGradProgram@wpi.edu and copied to all committee members and the student, documenting successful completion of the project requirements. Additionally, the student must submit their final approved document to the same email address.

For a MEng degree, this includes completion of coursework, which should be documented with a completed Plan of Study.

7.

Chapter 2. PhD Degree Program

2.1. Summary of the BME Program Requirements for the PhD Degree

While a complete description of the BME Program's requirements for the PhD degree are provided later in this chapter, the following is a summary of these requirements. All students in the PhD Program must satisfy the following:

- Pass the course requirement.
- Pass the PhD Qualifying Examination.
- Fulfill the seminar requirement.
- Fulfill the residency requirement.
- Fulfill the publication requirement.
- Write a PhD Dissertation on the student's original research.
- Pass the final PhD Dissertation Examination.

2.2. WPI's General Requirements for the PhD Degree

All students in the PhD program must satisfy the following:

- The student must demonstrate to the faculty high academic attainment and the ability to conduct original independent research.
- The student must complete a minimum of 90 credit hours of graduate work beyond the bachelor's degree, or a minimum of 60 credit hours of graduate work beyond the master's degree, including in either case at least 30 credit hours of thesis research.
- The student must establish residency by being a full time graduate student for at least one continuous academic year.
- The student must attain status as a PhD candidate by satisfying the BME Program's Specific Requirements for the PhD Degree.
- The student must prepare a PhD dissertation, and defend it before a Dissertation Committee (the PhD Dissertation Examination), at least two of whose members must be BME Program Faculty, and at least one of whose members must be from outside the PhD Program in BME. After a successful defense, determined by a majority vote in the affirmative by the Dissertation Committee, the dissertation must be endorsed by those members of the Dissertation Committee who voted to approve it. The completed dissertation must follow in format the instructions published by the WPI library.
- Once the student has satisfied the BME Program's candidacy requirements (see below), the student will be permitted to enroll for dissertation credits. Prior to the completion of all candidacy requirements, a student may enroll for no more than 18 credits of directed research.

2.3. BME PhD Committees and Advising

2.3.1. Overview

Various committees and advisors are charged with monitoring and directing the progress of students in the PhD program. These committees and advisors are summarized below:

- Academic Advisor – Provides the student with counsel and information from entry into the Program until a Research Advisor has been selected.
- Research Advisor - The student selects a Research Advisor (or Dissertation Mentor) generally upon completion of (optional) laboratory rotations. The Research Advisor must be an approved BME Program Faculty Member and must agree to mentor the student. The Research Advisor must demonstrate a reasonable ability to provide adequate financial support for conducting the research project and supporting the student.
- Qualifying Examination Committee (QEC) – An *ad hoc* committee formed to administer the PhD Qualifying Examination to the student.
- Dissertation Committee – An *ad hoc* committee formed after the student passes their Qualifying Examination. This committee advises the student and evaluates the Dissertation Proposal, the completed dissertation, and administers the PhD Dissertation Examination to the student.

In the sections that follow on the various committees, the following definition holds:

- **BME Program Faculty Member** - a faculty member with a collaborative appointment in the Biomedical Engineering graduate program formally approved by the BME Graduate Studies Committee. Only a BME Program Faculty Member may serve as Research Advisor (Dissertation Mentor). A current list of BME Program Faculty Members is available on the [BME Faculty Home Page](#).

2.3.2. Standards for All Committees

The Chair for each committee shall keep records of all meetings and send copies of the records to other committee members and, after their approval, to the BME Graduate Studies Committee. The BME Graduate Studies Committee shall distribute the records, after checking them for compliance with the rules and regulations, to the student and a copy shall be kept in the student's file(s).

2.3.3. Program Organization, Administration, and Committees

The BME Graduate Studies Committee is responsible for administering all BME Graduate Degree Programs at WPI. It acts as a liaison between the faculty and students in the program and the administrative structures at WPI.

Duties of the BME Graduate Studies Committee:

- Oversees and administers all BME Graduate Programs.
- Recommends appointments of WPI and non-WPI faculty as BME Program Faculty Members.
- Appoints a student's Academic Advisor based on the student's background and research interests.
- Appoints faculty to a PhD student's QEC based on the student's academic background and research interests.
- Based upon the recommendations of the student and their Research Advisor, appoints

members to a student's Dissertation Committee.

- Appoints BME Program Faculty Members to different sub-committees, including the Admissions Committee and PhD Qualifying Examination Committees.
- Monitors the progress of students in BME Graduate Programs.
- Acts on admission of students in the BME Graduate Programs, including PhD Program to degree candidacy.
- Acts on student and faculty petitions on academic matters.

2.3.4. Qualifying Examination Committee

Upon recommendation by the Academic Advisor and based on the student's background and research interests, a Qualifying Examination Committee (QEC) shall be appointed to administer the PhD Qualifying Examination (QE).

2.3.4.1. Duties of the Qualifying Examination Committee

- Review the academic record of the candidate.
- Advise the student on preparation for the PhD Qualifying Examination.
- Conduct the examination. The student passes the qualifying examination if a majority of committee members vote approval.

2.3.4.2. Structure and Formation of the Committee

At or near the completion of course work and laboratory rotations, the student's Academic Advisor shall recommend to the BME Graduate Studies Committee that the student take the PhD Qualifying Examination. The BME Graduate Studies Committee shall then appoint a QEC of one Chair and three additional members, taking into account the recommendations of the Academic Advisor. The composition of this committee shall meet the following minimum criteria:

- The Chair and one member must hold a primary faculty appointment in the Department of Biomedical Engineering at WPI. The other two members must be WPI BME program faculty members.
- The student's prospective Research Advisor shall not be a member of this committee. They may not be present at the examination.

2.3.5. Dissertation Committee

This committee shall advise the student from the time that student passes their Qualifying Exam until the student has completed their dissertation examination. The committee shall meet at least once per year and whenever requested by the chair, the student, the Research Advisor, or the BME Graduate Studies Committee.

2.3.5.1. Duties of the Dissertation Committee

- Serves in an advisory capacity to the student.
- Reviews and advises on research progress.
- Monitors the progress of writing the dissertation.
- Serves in an advisory capacity to the student and Research Advisor if any conflicts arise between the Research Advisor and the student, in which case the mentor excuses him/herself from the committee proceedings.
- Evaluates and approves a written dissertation proposal presented by the student.
- Conducts the dissertation examination. The student passes the dissertation examination if a majority of the committee members vote approval. After a

successful defense, those members who voted to approve it must endorse the dissertation.

2.3.5.2. Structure and Formation of the Committee

Based upon the recommendations of the student and their Research Advisor, the BME Graduate Studies Committee will appoint a Dissertation Committee. This committee will consist of a Chair and at least four additional members. The composition of this committee shall meet the following minimum criteria:

1. The Chair must hold a primary faculty appointment in the Department of Biomedical Engineering at WPI
2. The Research Advisor is a member of the committee but may not be the Chair
3. At least one other member shall be BME Program Faculty
4. At least one member shall hold a primary faculty appointment at WPI that is *not* in the Department of Biomedical Engineering.
5. At least one member shall be from an institution other than WPI.
 - This member may be appointed at a later date than the internal committee members.
 - This member is not required to attend the dissertation proposal defense. However, we suggest that this member be present if possible, to provide feedback and suggestions to the student.
 - This member normally attends the examination; in unusual circumstances, exemption of attendance by the outside examiner must be approved by the BME Graduate Studies Committee prior to exam.

Typically, Dissertation Committee members with faculty appointments are Tenured/Tenure-Track (that is, they are able to advise doctoral students themselves). The external member typically holds a terminal degree in their given field. However, exceptions may be made in some cases. The student and their Research Advisor should create a Committee that can best advise the student on their project.

When the student and their advisor suggest Dissertation Committee members for approval, they should briefly explain, in 1-2 sentences, the rationale for including each Committee member. Students should contact potential dissertation committee members to secure a tentative willingness to serve, prior to proposing the committee. If students are unsure of whether a potential committee member will be approved, they may contact the Graduate Studies committee to ask.

Dissertation Committee membership may be changed or updated at any point prior to the Dissertation Examination with approval of the Graduate Studies Committee. It is highly recommended that all five committee members be appointed before the Dissertation Proposal occurs. A partial committee may operate at earlier points in the student's trajectory.

2.4. Course Requirement

The 90-credit PhD program has no formal course requirements. However, because research in the field of biomedical engineering requires a solid working knowledge of a broad range of subjects in the life sciences, engineering, and mathematics, course credits must be distributed across the following categories with the noted minimums:

- Biomedical Engineering (12 credits)
- Life Sciences (3 credits)
- Advanced Engineering Mathematics (3 credits)
- Life Sciences or Advanced Engineering Mathematics (3 credits)
- Laboratory Rotations (optional; 6 credits)
- Responsible Conduct of Science (1 credit)
- Advanced Courses and Electives (9 credits)
- Dissertation Research (30 credits)

The student's Academic advisor may require additional course work to address specific deficiencies in the student's background. Up to 6 credits at the advanced undergraduate level (4000-level) may be used to satisfy these course requirements. Graduate courses may also be taken from the Graduate School of Biomedical Sciences, located within the University of Massachusetts Medical School. Instructions on how to cross-register at UMASS Medical School are [located here](#).

The 60-credit PhD program (for students entering with a Master's degree) has no formal course requirements. However, students and their advisors should carefully evaluate their prior coursework in comparison with the requirements for the 90-credit PhD, paying particular attention to how the student's coursework aligns with the topics that are covered in the Qualifying Exam. If the student's Master's degree is from a different discipline, or if the prior coursework does not include sufficient technical rigor, we strongly recommend that they take a distribution of courses similar to the list outlined above. Students are expected to pass the Departmental Qualifying Exam, which includes these topics.

2.4.1. Seminar Requirement

The PhD Program requires that all students attend BME seminars. To facilitate this process, students must enroll in the class *BME 591 – Graduate Seminar*. All PhD students are required to pass BME 591 four times. This graduate course is graded pass/fail for zero credits.

2.5. PhD Qualifying Examination

2.5.1 Timeline for the Qualifying Exam

- The student must take the qualifying exam before the end of their fifth semester in the PhD program. Students may begin the qualifying exam earlier than this, particularly if they entered the program with a previous graduate degree. A student must complete at least 18 credit hours of coursework and/or directed research at WPI before they apply for the QE. Any incomplete grades must be resolved prior to application. Typically, students complete their formal coursework before taking the Qualifying Exam.
- The student will be notified by the QEC committee chair (appointed by the BME Graduate Studies Committee) that the qualifying exam period has begun. At this stage, they will be notified that a Specific Aims review meeting will occur in one calendar week. The student must produce and distribute the specific aims page to the QEC at least 24 hours in advance of the Specific Aims meeting. The Qualifying Exam should follow the formatting and content sections included in the BME QE Template. This template may be downloaded from the BME Graduate

Program Website.

- The Aims meeting is to serve as an opportunity for the student to obtain feedback from the QEC on the style, structure and approach of their proposed Specific Aims. Students should plan a brief (~15 minute) oral presentation to provide the QEC with an overview. The remaining time is meant for discussion. The Aims meeting is scheduled for one hour.
- Three weeks from the Specific Aims meeting, the full proposal is due and is to be distributed to each member of the QEC.
- The Qualifying Exam, which includes a brief (approximately 30 minutes) presentation of the proposed project by the student to the QEC, will be scheduled within two weeks of the proposal due date. The Qualifying Exam is scheduled for two hours.

2.5.2 Applying for and Scheduling the Qualifying Exam

To schedule their exam, students submit the Qualifying Exam Application to the Graduate Studies committee. This application may be found on the BME Graduate Studies website (<https://wp.wpi.edu/bme/grad/>). Prior to scheduling their exam, students should discuss timing with their advisor to ensure that conflicts (e.g. fellowship or grant applications that heavily involve the student, and end-of-term TA responsibilities) are minimized, to the extent possible. Once the student receives their exam dates, they have one week to request any adjustments to resolve conflicts. After the Specific Aims review meeting, exam dates can only be changed for exceptional circumstances. Such changes will be considered only with reasonable advance notice (as much as the circumstances allow).

Failure to meet any of the exam deadlines will be considered a fail of the QE. Assuming the student has an additional attempt left, they may re-apply for, and re-take their QE within 6 months.

2.5.3 Rules for Student/Faculty Interaction during the Qualifying Exam

The student is expected to complete the Qualifying Exam independently. Students may not consult their Academic advisor on matters related to the Qualifying Exam from the time that the Specific Aims page is submitted until the Qualifying Exam is complete. Students may contact QEC members to clarify any discussion points that came up during the Specific Aims review meeting, but may not ask for assistance with the written Exam document.

2.5.4 Rules for Student Preparation for the Qualifying Exam

Students may record their Specific Aims meeting, and may refer back to this recording as they work on their QE proposal. Students may prepare a limited number of extra/ supplemental slides to assist them in demonstrating their content knowledge. However, students should remember that the purpose of the QE is to test their knowledge of biomedical engineering concepts and scientific method. Simply showing a slide that was prepared ahead of time will likely not be sufficient to demonstrate this knowledge, although it may be helpful in explaining how to apply a particular concept. Students may not record the Qualifying Exam.

2.5.5 Parameters assessed during the Qualifying Exam

- The successful student is expected to scientifically defend their proposed experimental rationale as well as relate their project into the broader aspects of the chosen field.
- The successful candidate will demonstrate a core competence in general aspects

- of physiology, engineering, and mathematics (see below).
- The successful candidate will demonstrate his/her ability to formulate a testable hypothesis and design an appropriate experimental plan.
 - Furthermore, the successful candidate will demonstrate an advanced (state of the art) level of competence in a subset of fields encompassing biomedical engineering according to the following scheme:

One area of biological science expertise chosen from:

1. Physiology
2. Molecular Biology
3. Cell Biology

Two (2) areas of engineering expertise chosen from:

1. Tissue engineering
2. Biomaterials
3. Biomechanics
4. Instrumentation
5. Signal processing
6. Imaging

One area of mathematical sciences expertise chosen from:

1. Statistics
2. Advanced engineering mathematics

Members of the QEC will ask the candidate questions related to the candidate's chosen topics in each category listed above. The candidate will provide their chosen area of advanced expertise in writing to the QEC at the time of the specific aims meeting.

2.5.6 Possible outcomes of the BME department Qualifying Exam

1. **Unconditional Pass** – The candidate satisfied a majority of the QE according to all criteria.
2. **Conditional Pass with specific course work to address a specific deficiency** – The candidate satisfied a majority of the QEC with the exception of a particular weakness in a limited number of the areas of specialization. The QEC is confident that the weakness can be corrected by the candidate taking particular course(s) specific to the area(s) of weakness.
3. **Fail with an opportunity to retake within 6 months** - The QEC determined that the candidate lacks fundamental knowledge, had several weaknesses or was not able to scientifically defend their proposed experimental rationale. Or, the student failed to produce a complete QE document by the deadline. However, the majority of the QEC determined that the student has the potential to be a successful PhD candidate and could address the weaknesses. In this case, the student will have an opportunity to repeat the exam which must be accomplished with 6 months of the original exam. The second exam only has two possible outcomes; unconditional pass, or fail without opportunity to retake the exam. The research advisor may elect to suspend funding pending successful completion of the QE by the student.

2.6. Admission to Candidacy

Formal admission to candidacy in the PhD Program is conferred upon students who have completed their core course work (exclusive of thesis research) and passed the PhD Qualifying Examination. With candidacy, the student will be permitted to enroll for dissertation credits (BME 699). Prior to completion of the candidacy requirements, a student may enroll for no more than 18 credits of directed research (BME 598). All BME 598 credits will be automatically counted as Dissertation (BME 699) credits when the student advances to candidacy.

2.7. PhD Dissertation Proposal

The PhD Dissertation Proposal is a written document prepared and defended before the student's Dissertation Committee. Formal acceptance of student's dissertation research program follows the approval of this proposal. The proposal should not be thought of as an examination. Rather, it serves two very important functions:

- An accepted proposal provides a guarantee to the student that the Dissertation Examination Committee found the proposed research program acceptable.
- It provides the student with important feedback on their proposed research. Although the Research Advisor will certainly provide the student with the most valuable advice, the Dissertation Examination Committee can also provide additional insights and feedback.

2.7.1. Standards for the PhD Dissertation Proposal

- The proposal should be presented within one calendar year of taking the PhD QE or as soon as a line of research has been defined and there is evidence that the experimental protocols can be carried out.
- The proposal must be formally approved by the Dissertation Examination Committee before the student can formally begin writing the actual PhD Dissertation Document.
- The proposal is approved if a majority of the Dissertation Examination Committee members vote approval. Generally, most proposals are approved. If the line of research proposed is too distant from what the Dissertation Examination Committee considers "Biomedical Engineering" or, more often, if the hypotheses to be tested are not stated clearly enough, the student will be asked to resubmit the proposal.
- The Dissertation Proposal may be presented to a partially formed Dissertation Committee (at least three members). However, we recommend that all members be present if possible, to provide the best feedback to the student.

2.7.2. Format and Timetable for the Proposal

- The written proposal should be in the general form of an NIH grant proposal and should be cast in the form of hypothesis-testing, not fact gathering. The proposal should include the Specific Aims and other research strategy sections outlined in the BME PhD Dissertation Proposal Template. The Template may be downloaded from the BME Graduate Program Website.
- The student presents the proposal orally at a scheduled Dissertation Committee meeting. The written PhD Dissertation Proposal shall be given to the Dissertation Committee at least 10 days before this meeting. The student will be expected to speak for no longer than 30 minutes and the Committee will probably spend 30-

60 minutes asking questions. The committee then decides in a closed session whether the student has successfully defended his/her proposal. The entire proposal defense takes two hours.

2.7.3 Proposal follow-up (Committee Chair duties)

The successful proposal defense should be documented by the Committee Chair sending an email to: BMEGradProgram@wpi.edu with the student's name and an indication that the student has completed this step of their dissertation. Generally, committee members and the student are Cced on this email.

Within one week of the successful proposal defense, the committee chair should summarize key points of the committee discussion in a letter or email to the student, Ccing the other committee members. The purpose of this summary is to document any suggested or required changes to the proposed project, and to emphasize key aspects of the project that must be completed prior to the defense.

2.8. PhD Dissertation Document and Defense

All PhD students must prepare a dissertation document and defend it before a Dissertation Committee. For this requirement, PhD program students must:

- Present a one-hour public seminar (PhD Dissertation Seminar or Oral Defense) on the results of the completed dissertation project.
- On the same day, successfully pass the PhD Dissertation Examination
- Present an acceptable and appropriately signed dissertation to the Dissertation Committee. Administrative approval by this committee constitutes acceptance of the dissertation.

2.8.1. PhD Dissertation Seminar (Oral Defense)

The BME Departmental Office at WPI shall appropriately publicize the dissertation seminar at least 14 days prior to the examination date. At least 14 days prior to the examination date, the PhD student is responsible to provide the BME graduate studies administrative assistant with a title, abstract, committee members, time and location of the defense. The seminar shall be of the standard research seminar format and shall be limited to approximately one hour; it forms an integral part of the examination.

2.8.2. PhD Dissertation Examination

Following the PhD Dissertation Seminar, the student must defend the dissertation before the Dissertation Committee. The student successfully passes the examination if a majority of the committee members vote approval. If the student does not pass the examination, the Committee shall make a recommendation to the BME Graduate Studies Committee. This recommendation may include:

- Rewriting the dissertation or part of it.
- Doing additional experimental or theoretical work on the dissertation subject.
- Studying background material pertaining to the field of specialization.
- Presenting another seminar.
- Being awarded a Master of Science (MS) degree or Master of Engineering (ME) degree from WPI for coursework and research completed.

2.8.3. PhD Dissertation Document

A copy of the dissertation, which must be given to all Dissertation Committee members,

shall:

- Be a finished product and approved by the Research Advisor.
- Conform to the dissertation standards of WPI

The dissertation must contain:

- A concise, but comprehensive, *Introduction*.
- A concise, but comprehensive, *Discussion* relating the results presented to the current and future state of the field.
- Intervening pages consisting of either: (i) *Materials and Methods*, and *Results* section or, (ii) the text of a series of articles in manuscript form published in or ready to be submitted to peer-review Journals with the candidate as first author. Work conducted by someone other than the student must be clearly identified and referenced as such in the dissertation.
- A comprehensive *Bibliography*.
- An Abstract.
- Figures of a quality suitable for publication.

After successful completion of the PhD Dissertation Examination, the PhD dissertation document shall be:

- Revised and corrected according to the decisions of the examination committee.
- Signed by all committee members who voted approval of the document and the Research Advisor.
- Submitted in a format suitable for archiving and storage. Students must follow the regulations for preparation of dissertations published by the library at WPI.
- Please note that PhD students must be registered at WPI for 1 semester credit hour in the semester that the degree requirements are completed.

2.8.4 Rules and Responsibilities for the PhD Dissertation Committee

- In consultation with the student and the Research Advisor, the Chair sets the date of the examination and oversees the examination and all meetings of the committee.
- Committee members shall receive a copy of the Dissertation after the Research Advisor has approved it. This copy must be essentially in its final form, pending any changes required by the committee.
- Committee members must receive the dissertation at least 14 days before the date of the scheduled examination.
- Committee members must report to the Chair at least 48 hours before the examination if they find the dissertation to be in an inadequate form to proceed with the oral dissertation examination.
- The Chair reports at least 24 hours before the examination to the other committee members, the student, and the BME Graduate Studies Committee if a committee member finds the dissertation to be in an inadequate form to proceed with the oral dissertation examination.
- Committee members approve and sign the final copy of the dissertation. The Chair designates one committee member to supervise that any alterations of the dissertation be completed before submission to the Dissertation Database maintained by the WPI Library. They shall not sign the Dissertation until all of these corrections/alterations are completed.
- The Chair reports in writing to the BME Graduate Studies Committee the results of the examination and the decision of the committee.

2.9 Residency Requirement

The PhD program requires the equivalent of at least 3 years of full-time effort. An explicit and detailed definition of “full-time” status is given in the WPI Graduate Catalog.

2.10 Publication Requirement

The department requires acceptance of at least one full-length, first-author publication, representing original research and based on the student’s dissertation work, in a peer-reviewed venue approved by the student’s PhD Dissertation Committee. Students have an opportunity to petition the BME Graduate Studies Committee in cases of extenuating circumstances.

2.11. Combined Master of Engineering (MEng) / PhD Degree

Most PhD students that do not start with a master’s degree in biomedical engineering will, within 2-3 years of study, satisfy all the requirements for the Master of Engineering (MEng) degree in BME. Students who wish may apply for an MEng Degree by filling out the Intent to Graduate form and subsequent Degree Completion Form that can be found on the Registrar’s website. This form should be submitted at the beginning of the semester the student completes their MEng degree requirements. Earning this degree will not change any of the PhD requirements. Students should note that PhD dissertation credits do not count towards this degree. The required credits for the MEng degree may be based on directed research credits (BME 598).

Students should note that courses can be double counted towards two degrees and/or graduate certificates. However, courses may not be triple-counted.

Chapter 3.

Master of Science (MS) Degree Program

3.1. Summary of the BME Program Requirements for the MS Degree

Students in the MS program must simultaneously satisfy the following degree requirements:

- WPI's General Requirements for All Advanced Degrees.
- WPI's General Requirements for the Master of Science and Master of Engineering Degrees.
- The BME Program's Specific Requirements for the Master of Science Degree.

The first two institutional degree requirements are summarized below and detailed in the WPI's Graduate Catalog. The BME Program's specific degree requirements are explained fully in this chapter of the Handbook. These program requirements have been structured to incorporate all institutional degree requirements, so that satisfying the BME Program's degree requirements for the MS will also satisfy the institutional degree requirements. All degree requirements must be satisfied before the degree is awarded.

3.2. Institutional Degree Requirements

3.2.1. WPI's General Requirements for all Advanced Degrees

All students in the MS program must satisfy the following:

- At the time the degree is awarded, the student must have been admitted to the MS program in Biomedical Engineering.
- A minimum of two-thirds of the required graduate credit for an advanced degree must have been earned at WPI.
- The student must have a program GPA of 3.0 or greater.

The student must satisfy the graduate rules in effect at a single date between their matriculation date and their graduation date. In applying for graduation (the WPI Graduate Student *Application for Graduation*), the student must specify, by year, which WPI Graduate Catalog contains the rules being satisfied. After the *Application for Graduation* is submitted, all advanced degrees are subject to the final approval of the Committee on Graduate Studies and Research (CGSR), which determines if the student has satisfied the letter of intent of the requirements for the MS Degree. The CGSR makes its recommendations for the approval of the MS to the WPI faculty, which in turn recommends to the President and Trustees for their final approval the names of students who should be awarded the Master of Science Degree in Biomedical Engineering. Specific instructions regarding the process for filing various forms can be found in section 1.8. **Graduation Paperwork and Procedures.**

3.2.1.1. WPI's General Requirements for the Master of Science Degree

All students in the MS program must satisfy the following:

- The student must obtain a minimum of 30 credit hours of acceptable course, thesis, or project work. At least 6 credit hours must be thesis research or project work.

- A 1/3 unit WPI undergraduate course taken for graduate credit is assigned 2 credit hours of graduate credit.
- Students pursuing a thesis option must prepare a MS thesis document and defend it before a Thesis Committee (the MS Thesis Examination).
- Students pursuing a project option must prepare a MS project report and present it before a Project Committee (the MS Project Presentation).

3.2.2. Summary of the BME Program Requirements for the MS Degree

While a complete description of the BME Program's Requirements for the MS Degree are provided later in this chapter, the following is a summary of these requirements. All students must satisfy the following:

- Pass the course requirement.
- Fulfill the seminar requirement.
- Write a MS Thesis or Project Report on the student's original research/project.
- Pass the final MS Thesis Examination/Project Presentation.

3.3. Course Requirement

A minimum of 30 credit hours is required for the Master of Science degree, which may be met by satisfying the requirements for a Thesis-Based or Project-Based program of study. BME courses include BME 500-level or 4000-level courses (except BME 4300. MQP Capstone Design). Electives may include any WPI graduate-level engineering, physics, math, biomedical engineering, or equivalent course (500- or 4000-level), subject to the approval of the department Graduate Studies Committee. A maximum of 8 credits of coursework at the 4000-level may be applied to meet the requirements for the Master of Science degree.

| | |
|-----------------------------|-------------------|
| M.S. (Thesis-Based) | 30 credits |
| BME courses | 12 credits |
| BME 599 (M.S. Thesis) | 6 credits minimum |
| Electives | 12 credits |
| | |
| M.S. (Project-Based) | 30 credits |
| BME courses | 12 credits |
| BME 597 (M.S. Project) | 6 credits |
| Electives | 12 credits |

BME courses: BME courses are defined as any course with a BME designator.

Thesis (6 credits, Thesis-Based M.S.)

The Thesis-Based M.S. program requires a minimum of 6 credits of **BME 599. Master's Thesis** and completion of an independent research project under the supervision of a Biomedical Engineering Program Faculty advisor. This option is well-suited for the student seeking to engage in deeper, open-ended inquiry into a research area, in preparation for advanced research training (e.g., Ph.D. degree) or research-focused career opportunities in a medical, academic, government, or industry laboratory setting.

Project (6 credits, Project-Based M.S.)

The Project-Based M.S. program enables students to engage in a focused, credit-based independent project experience that builds on their individual professional and academic experience. The program will facilitate development of experience, skillset, and mindset to

contribute and lead in industry as engineers in a variety of biomedical engineering roles. The Project-Based M.S. program requires completion of 6 credits of **BME 597. Professional Project**, and completion of a capstone deliverable representative of their integrated project experience (e.g., poster or platform presentation, department seminar, final presentation, online portfolio). The Project may include one or more integrated project-based experiences:

- 1) **BME 5900. Internship or Co-op.** Students may apply for an industry-based co-op or internship, and earn academic credit while using elements of the co-op or internship as the basis for satisfying the project requirement.
- 2) **BME 5910. Master's Design Project.** Students may work with a faculty advisor to design a device or prototype, or perform other work in the laboratory that meets a specific set of technical objectives.
- 3) **BME 5920. Clinical Preceptorship.** Students may work with faculty advisors in collaboration with clinicians (including medical, dental, veterinary) to design a device, system, or other product that creates value with positive impact on clinical practice.

In addition, the following requirements must be met for both Master of Science degree programs:

- **Technical Depth Requirement (15 credits minimum).** Thematically-related advanced engineering and science coursework in an area of technical focus within a Biomedical Engineering specialization. No more than one life sciences or regulatory course may be applied towards this requirement, and the course must be relevant to the depth area. Up to 3 credit-hours of a Thesis or Project may be designated as technical depth.
- **Seminar Requirement.** Students must take BME 591. Graduate Seminar (0 credits) and pass it twice.
- **BME Core Competencies.** In addition to meeting the specified minimum credit requirements for the degree program, all Master of Science candidates must satisfy five (5) BME Core Competencies.
 - 1) **Mathematics.** Understanding and ability to apply fundamental principles of mathematics (e.g., statistics, numerical methods, or computational modeling).
 - 2) **Life science.** Understanding and ability to apply fundamental principles of life science (e.g., cell and molecular biology, physiology).
 - 3) **Clinical needs analysis and design.** Ability to communicate effectively with clinical stakeholders, understanding of healthcare systems, exposure to clinical environments and practice, understanding clinical needs and recognizing opportunities to improve healthcare delivery and practice.
 - 4) **Regulation and controls.** Understanding of regulations and standards applied to biomedical engineering design, manufacturing, and research (e.g., medical device design regulations, FDA regulations, engineering standards, QC/QA, GMP/GLP).
 - 5) **Value creation, innovation, technology commercialization.** Development and practice of innovation mindset and skillset to create value and recognize opportunities for innovation in the design and development of medical technologies; commercial and clinical translation of medical innovations that impact healthcare delivery and practice.

Core Competencies. To aid students in developing a Plan of Study, the following example courses that can fulfill each of the five (5) BME Core Competencies are provided. Alternative courses may be applied to fulfill competency requirements. Students need only take one (1) course to fulfill a given competency. Alternatively, waivers may be considered based on documented work experience, advanced degrees, majors, or minors that demonstrate advanced mastery in the core competency area. Course substitutions and waivers must be approved by the department Graduate Studies Committee. If approved, a Thesis or Project may be used to fulfill up to two (2) Competencies. A waiver application may be downloaded from the BME Graduate Web Site. A waiver is not eligible for course credit, but does fulfill a competency.

Mathematics:

MA 511. Applied Statistics for Engineers and Scientists
MA 501. Engineering Mathematics
MA 543. Statistical Methods for Data Science
MA 542. Regression Analysis
MA 546. Design and Analysis of Experiments

Life Science:

BME 560. Physiology for Engineers
BME 562. Laboratory Animal Surgery
BME 564. Cell and Molecular Biology for Engineers
Classes from Biology/Biotechnology may also fulfill this competency

Regulations and Controls:

BME 532. Medical Device Regulation
BME 535. Medical Device Design Controls

Clinical Needs Analysis and Design:

BME 592. Healthcare Systems and Clinical Practice
OR

Documented attendance of at least 7 hours of clinical “Grand Rounds” or similar clinically focused lectures/seminars, submitted with a waiver*.

Value Creation, Innovation, Technology Commercialization.

BME 595V. Value Creation and Innovation in BME Thesis Research
BME/ID 511 Research and Projects That Create Value
ETR 500. Entrepreneurship and Innovation
ETR 593. Technology Commercialization: Theory, Strategy and Practice
SYS 501. Concepts of Systems Engineering
SYS 502. Business Practice

*Grand Rounds may be in person, via zoom/webinar, or accessed through publicly available recordings. The original presentation must have been recorded within the last two years. Documentation must include the following information: URL linking to the recording or announcement (if live), date of original presentation, date of student viewing/attendance, organization presenting the seminar, title, speaker name, and a 1-paragraph summary of the key points covered in the seminar.

Technical Depth Specializations and Example Courses. To aid students in developing a Plan of Study that fulfills the Technical Depth requirement, we provide the following examples. These lists are not exhaustive. Students may propose alternative courses and specializations, including thematically-related courses double-counted toward a WPI Graduate Certificate, to fulfill the Technical Depth requirement (subject to review and approval by the department Graduate Studies Committee).

Biomaterials and Tissue Engineering:

BME 531. Biomaterials in the Design of Medical Devices
BME/ME 550. Tissue Engineering
BME/ME 552. Tissue Mechanics
BME 555. BioMEMS and Tissue Microengineering
BME 583. Biomedical Microscopy and Quantitative Imaging
BME/ME 4814. Biomaterials
BME 4828. Biomaterials-Tissue Interactions
BME 4831. Drug Delivery
BME 4701. Cell and Molecular Bioengineering
CHE 521. Biochemical Engineering
MTE 509. Electron Microscopy
MTE 558. Plastics
MTE 511. Structure and Properties of Engineering Materials
MTE 512. Properties and Performance of Engineering Materials
MTE/MFE 5841. Surface Metrology
PH 561. Atomic Force Microscopy

Biomechanics and Medical Robotics:

BME 552. Tissue Mechanics
BME 553. Biomechanics of Orthopaedic Devices
RBE 500. Foundations of Robotics
ME/RBE 501. Robot Dynamics
RBE 520. Biomechanics and Robotics
RBE 580/ME 5205. Biomedical Robotics
BME/ME 4504. Biomechanics
BME/ME 4606. Biofluids
BME 450X. Computational Biomechanics

Additional Technical Depth Courses:

BME 523/BME 4023. Biomedical Instrumentation
BME 581. Medical Imaging
BME 4011. Biomedical Signal Analysis
BME 4201. Biomedical Imaging
ECE 503. Digital Signal Processing
ECE 5106. Modeling of Electromagnetic Fields in Electrical & Biological Systems
CS 583/BCB 503. Biological and Biomedical Database Mining
CS 534. Artificial Intelligence
CS 539. Machine Learning
CS 545/ECE 545. Digital Image Processing

Graduate courses may also be taken from the Graduate School of Biomedical Sciences, located within the University of Massachusetts Medical School. Instructions on how to cross-register at UMASS Medical School are [located here](#).

3.3.1. Seminar Requirement

The MS Program requires that all students attend BME seminars. To facilitate this process, students must enroll in *BME 591 – Graduate Seminar*. All MS students are required to pass BME 591 twice. This graduate course is graded pass/fail for zero credits.

3.4. Committees and Advising

3.4.1. Overview

Various advisors and committees are charged with monitoring and directing the progress of students in the MS program. These advisors and committees are summarized below:

- Academic Advisor – A core BME faculty member at WPI designated to provide the student with counsel and information during the initial time in the Program. They advise the student from entry into the Program until a Research Advisor has been selected.
- Research Advisor (Thesis Mentor or Project Mentor) – A BME Program Faculty Member charged with mentoring and supporting the thesis research or project.
- Thesis/Project Committee – An *ad hoc* committee formed to advise the student after a Research Advisor has been selected and to administer the MS Thesis/Project Examination to the student.
- BME Graduate Studies Committee- A committee responsible for administering the MS Program. In the sections that follow on the various advisors and committees, the following definitions hold:
 - BME Program Faculty Member- a faculty member with an appointment in the Biomedical Engineering graduate program formally approved by the BME Graduate Studies Committee. Only a BME Program Faculty Member may serve as Research Advisor (Thesis Mentor).

3.4.2. Standards for All Advisors and Committees

Advisors and the Chair for the Thesis/Project Committee shall keep records of all meetings with the student and send copies of these records to the BME Graduate Studies Committee. The BME Graduate Studies Committee shall distribute the records, after checking them for compliance with the rules and regulations, to the student and a copy shall be kept in the student's file in the Department of Biomedical Engineering at WPI.

3.4.3. Academic Advisor

Each student entering the MS Program is advised by an Academic Advisor. This advisor meets with the student at least twice yearly, normally just before each academic semester.

3.4.3.1. Duties of the Academic Advisor

- Meet with the incoming MS student during the orientation period to go over *this Handbook* in detail, making sure that everyone understands his/her responsibilities.
- Provide the student with counsel and information.

- Assist the student in selecting a sequence of coursework.
- Advise the student in the selection of a Research Advisor.
- Assess progress and approve alterations in proposed course work.
- Provide a written report of the student's status to the BME Graduate Studies Committee following each meeting.

The BME Graduate Studies Committee shall distribute the records, after checking them for compliance with the rules and regulations, to the student and a copy shall be kept in the student's file in the Department of Biomedical Engineering at WPI.

3.4.3.2. Selection of the Academic Advisor

The BME Graduate Studies Committee shall appoint the Academic Advisor. This selection shall be based on common research interests and a potential for that individual to become the student's Research Advisor. The Academic Advisor must be a core BME Faculty Member at WPI. The student may, at any later time, request a new Academic Advisor.

3.4.4. Research/Project Advisor

The student selects a Research/Project Advisor (or Thesis Mentor) no later than the end of the second semester, and preferably before the end of the first semester, in the MS Program. The Research/Project Advisor must be an approved BME Program Faculty Member and must agree to mentor the student.

3.4.4.1. Duties of the Research/Project Advisor

- A Research Advisor must demonstrate a reasonable ability to provide adequate financial support for conducting the research project.
- A Project Advisor must ensure that the student fulfills departmental requirements for the project, in collaboration with the student and project host (for example, an industry sponsor).

3.4.5. Thesis/Project Committee

This committee shall advise the student after a Research or Project Advisor has been selected and, as a terminal act, administer the MS Thesis/Project Examination. The committee shall meet with the student at least once per semester and whenever requested by the chair, the student, or the BME Graduate Studies Committee.

3.4.5.1. Duties of the Thesis/Project Committee

- Serves in an advisory capacity to the student prior to the MS Thesis/Project Examination.
- Evaluates and approves a written thesis proposal presented to it by the student.
- Reviews and advises on research progress.
- Determines when the student is ready to begin writing the thesis.
- Monitors the progress of writing the thesis
- Serves in an advisory capacity to the student and Research Advisor if any conflicts arise between the Research Advisor and the student, in which case the mentor excuses him/herself from the committee proceedings.
- Conduct the MS Thesis/Project Examination. The student passes the thesis examination if a majority of the committee members vote approval.

3.4.5.2. Structure and Formation of the Thesis/Project Committee

The committee shall be appointed by the BME Graduate Studies Committee upon the recommendations of the Research Advisor and the student and shall consist of a Chair and two or more additional members who can best judge the research. It shall be formed no later than six months following the approval of the Research/Project Advisor. The composition of this committee shall meet the following minimum criteria:

- The Chair and at least one other member shall be BME Program Faculty.
- At least one member must hold a primary faculty appointment in the Department of Biomedical Engineering at WPI.
- The Research/Project Advisor may not be the Chair.
- For Master's Projects occurring in collaboration with an external site, one committee member shall be a member of the Graduate Studies Committee.

3.4.5.3. Rules and Responsibilities for the MS Thesis/Project Examination

- In consultation with the student and the Research/Project Advisor, the Chair sets the date of the examination and oversees the examination and all meetings of the committee.
- Committee members shall receive a copy of the thesis/project report after the Research/Project Advisor has approved it. This copy must be essentially in its final form and signed by the Research/Project Advisor.
- Committee members must receive the thesis/project at least 10 days before the date of the scheduled examination.
- Committee members must report to the Chair at least 48 hours before the examination if they find the thesis/project to be in an inadequate form to proceed with the oral thesis examination.
- The Chair reports at least 24 hours before the examination to the other committee members, the student, and the BME Graduate Studies Committee if a committee member finds the thesis/project to be in an inadequate form to proceed with the oral examination.
- Committee members approve and sign the final copy of the thesis/project. The Chair designates one committee member to supervise that any alterations of the thesis be completed before submission to the BME Graduate Studies Committee. They shall not sign the thesis or project completion form until all of these corrections/alterations are completed.
- The Chair reports in writing to the BME Graduate Studies Committee the results of the examination and the decision of the committee.

3.4.6. BME Graduate Studies Committee

The BME Graduate Studies Committee is responsible for administering the MS Program in BME. It acts as a liaison between the faculty and students in the program and the administrative structures at WPI.

3.4.6.1. Duties of the BME Graduate Studies Committee

- Oversees and administers the MS Program.
- Appoints faculty as BME Program Faculty Members.
- Appoints Academic Advisors for new graduate students. An Academic Advisor must be a core BME Faculty Member at WPI.

- Based upon the recommendations of the student's Research Advisor, appoints faculty to a student's Thesis/Project Committee.
- Appoints BME Program Faculty Members to different sub-committees, including the Admissions Committee.
- Monitors the progress of students in the BME Graduate Programs.
- Acts on student and faculty petitions on academic matters.

3.5. MS Thesis Proposal

The MS Thesis Proposal is a written document prepared and submitted to the student's Thesis Committee. Formal acceptance of student's thesis research program follows the approval of this proposal. An accepted proposal provides reasonable assurance that, when the proposed work is completed and the thesis is written, it will be accepted as a thesis.

3.5.1. Standards for the MS Thesis Proposal

The proposal should be submitted to the Thesis Committee no later than six months after selecting a Research Advisor or as soon as a line of research has been defined and there is evidence that the experimental protocols can be carried out.

The Thesis Committee must formally approve the proposal before the student can formally begin writing the actual MS Thesis Document. The proposal is approved if a majority of the Thesis Committee members vote approval. Generally, most proposals are approved. If the line of research proposed is too distant from what the Thesis Committee considers "Biomedical Engineering" or, more often, if the hypotheses to be tested are not stated clearly enough, the student will be asked to resubmit the proposal.

3.5.2. Format of the Proposal

The formal written proposal shall be prepared by the student and submitted to the Thesis Committee. It should describe the research to be undertaken and will typically contain the following sections:

- **Specific Aims / Introduction** – Statement of the problem, why it is important, what is the proposed approach, why is it potentially better than alternative approaches.
- **Literature Review** – A substantive review of the relevant literature; this does not have to be exhaustive, but should be of sufficient depth to convince the reader that the student is aware of other work in the proposed area of study and to provide a working background of information for the implementation of the proposed work.
- **Proposed Approach** – How is the problem to be attacked? What are the expected problem areas together with their expected, relative difficulties? This section may be speculative but should indicate that the student has considered the problem in depth.

While there is no prescribed length, the proposal should contain sufficient detail and clarity to allow its review by individuals not familiar with the area of study. The student's Thesis Committee must accept the proposal before substantial work begins on the research.

The student presents the proposal orally at a scheduled Thesis Committee meeting. The written Master's Thesis Proposal shall be given to the Committee at least 10 days before this meeting. The student will be expected to speak for no longer than 30 minutes and the Committee will probably spend 30-60 minutes asking questions. The committee then decides in

a closed session whether the student has successfully defended his/her proposal. The entire proposal defense takes 90 minutes.

The successful proposal should be documented by the Advisor or Committee Chair sending an email to: BMEGradProgram@wpi.edu with the student's name and an indication that the student has completed this step of their dissertation. Generally, committee members and the student are Cced on this email.

3.6. MS Thesis Document and Defense

All MS students pursuing the Thesis option must prepare a thesis document and defend it before a Thesis Committee. For this requirement, MS program students must:

- Present a public seminar (MS Thesis Seminar or Oral Defense) on the results of the completed thesis project. During this seminar, the student should plan to present their work for approximately 30 minutes. Additional time (up to 15 minutes) should be allowed for public questions/answers and discussion.
- On the same day, successfully pass the MS Thesis Examination.
- Present an acceptable and appropriately signed thesis to the BME Graduate Studies Committee. Administrative approval by this committee constitutes acceptance of the thesis.

3.6.1. MS Thesis Seminar (Oral Defense)

The BME Departmental Office at WPI shall appropriately publicize the thesis seminar at least 14 days prior to the examination date. At least 14 days prior to the examination date, the student is responsible to provide the BME graduate studies administrative assistant with a title, abstract, committee members, time and location of the defense. The seminar shall be of the standard research seminar format and shall be limited to approximately one hour including questions and answers; it forms an integral part of the examination. Typically, the presentation portion of the seminar lasts around 30 minutes, with an additional 15 minutes for public questions and discussion.

3.6.2. MS Thesis Examination

Following the MS Thesis Seminar, the student must defend the thesis before the Thesis Committee. The student successfully passes the examination if a majority of the committee members vote approval. If the student does not pass the examination, the Committee shall make a recommendation to the BME Graduate Studies Committee. This recommendation may include:

- Rewriting the thesis or part of it.
- Doing additional experimental or theoretical work on the thesis subject.
- Studying background material pertaining to the field of specialization.
- Presenting another seminar.

3.6.3. MS Thesis Document

The MS Thesis must be given to all Thesis Committee members for review at least 10 days prior to the MS Thesis Examination. The thesis shall:

- Be a finished product and approved by the Research Advisor.
- Conform to the thesis standards of WPI.

The thesis must contain:

- A concise, but comprehensive, *Introduction*. This should include a literature review, which may be an updated/more focused version of the thesis proposal

literature review.

- A concise, but comprehensive, *Discussion* relating the results presented to the current and future state of the field.
- Intervening pages consisting of either: (i) *Materials and Methods*, and *Results* section or, (ii) the text of a series of articles in manuscript form published in or ready to be submitted to peer-review Journals with the candidate as first author. Work conducted by someone other than the student must be clearly identified and referenced as such in the thesis.
- A comprehensive *Bibliography*.
- An *Abstract*.
- Figures of a quality suitable for publication.

After successful completion of the MS Thesis Examination, the MS thesis document shall be:

- Revised and corrected according to the decisions of the examination committee.
- Signed by all committee members who voted approval of the document and the Research Advisor.
- Submitted to the BME Graduate Studies Committee for administrative approval.
- Submitted in a format suitable for archiving and storage. Students must follow the regulations for preparation of theses published by the library at WPI.

3.7. MS Project

3.7.1 Definition of a Master's Project:

A Master's Project is an open-ended project related to the field of Biomedical Engineering. It may be completed within a laboratory setting at WPI, or in collaboration with an outside sponsor (e.g. industry partner or clinical partner). All projects must include the following components:

- Goals statement and a defined Sponsor / client
- Deliverable. Examples include a report, prototype, patent, or other product.
- Written documentation (may be part of the deliverable), including a literature review and defined methods and analysis. Examples include engineering processes, designs, plans, or computational modeling.

The project must

- include data collection/generation/analysis
- include statistical analysis/testing in some context
- represent novel work by the student(s)

Finally, the project must be presented publically in some format.

The MS Project Declaration Form must be completed by the student and submitted to the BME Department before the student may register for BME 597 (MS Project) credits. The form is available on the [BME Graduate Website](#). The form must be signed by the student's Faculty Advisor.

Specific details about the MS Project Requirements may be found in the BME 597 (MS Project) Syllabus, which is available on the [BME Graduate Website](#).

3.7.2 MS Project Presentation (Oral Defense)

The BME Departmental Office at WPI shall appropriately publicize the Project Presentation at least 14 days prior to the completion date. Some projects may be presented off-campus at the Project Sponsor's place of business. The student must submit a Project Presentation Form no later than 14 days before the final presentation date. This form is available on the [BME Graduate Website](#).

MS Projects are typically presented orally during a (approximately) 20 minute presentation. In some cases, projects may be presented in a poster session. In all cases, the audience should have an opportunity to interact with the presenter and ask questions.

3.7.3 MS Project Report (written document)

A final written report must be produced to fulfil the requirements for the MS Project, according to the Syllabus. The MS Project Report must be given to all Project Committee members for review at least 10 days prior to the MS Project Examination.

If the written report contains confidential information and will not be made publicly available, the student must submit an IEEE-format abstract to the Department, which will serve as a public record of the project. A template for the abstract may be downloaded from the BME Graduate Website.

The final approved MS Project Report (if not confidential) or IEEE Abstract (if confidential) must be submitted to the Department by the last day of the semester, prior to graduation.

3.7.4. MS Project Examination

Following the MS Project Presentation, the student must defend the written project before the Project Committee. Students should schedule 30 minutes with their committee for this examination. The student successfully passes the examination if a majority of the committee members vote approval. If the student does not pass the examination, the Committee shall make a recommendation to the BME Graduate Studies Committee. This recommendation may include:

- Rewriting the project report/deliverable, or part of it.
- Doing additional work on the project.

Chapter 4. Master of Engineering (MEng) Degree Program

4.1. Summary of the BME Program Requirements for the MEng Degree

Students in the MEng program must simultaneously satisfy the following degree requirements:

- WPI's General Requirements for All Advanced Degrees.
- WPI's General Requirements for the Master of Science and Master of Engineering Degrees.
- The BME Program's Specific Requirements for the Master of Engineering Degree.

The first two institutional degree requirements are summarized below and detailed in WPI's Graduate Catalog. The BME Program's specific degree requirements are explained fully in this chapter of the Handbook. These program requirements have been structured to incorporate all institutional degree requirements, so that satisfying the BME Program's degree requirements for the ME will also satisfy the institutional degree requirements. All degree requirements must be satisfied before the degree is awarded.

4.2.1. Institutional Degree Requirements

All students in the MEng program must satisfy the following:

- At the time the degree is awarded, the student must have been admitted to one of the ME programs in Biomedical Engineering.
- The student must have a program GPA of 3.0 or greater.
- The student must satisfy the graduate rules in effect at a single date between their matriculation date and their graduation date. In applying for graduation (the WPI Graduate Student *Application for Graduation*), the student must specify, by year, which WPI Graduate Catalog contains the rules being satisfied.

After the *Application for Graduation* is submitted, all advanced degrees are subject to the final approval of the CGSR, which determines if the student has satisfied the letter of intent of the requirements for the MEng Degree. The CGSR makes its recommendations for the approval of the ME to the WPI faculty, which in turn recommends to the President and Trustees for their final approval the names of students who should be awarded the Master of Engineering Degree in Biomedical Engineering (MEng Program).

4.2.1.2. WPI's General Requirements for the Master of Engineering Degree

All students in either MEng program must satisfy the following:

- The student must obtain a minimum of 30 credit hours of acceptable course or project work. A thesis is not required for the ME degree. (Note: The BME Program's Specific Requirements for the ME Degree requires 33 credit hours of acceptable course or project work).
- A 1/3 unit WPI undergraduate course taken for graduate credit is assigned 2 credit hours of graduate credit.

4.2.2. Summary of the BME Program Requirements for the MEng Degree

While a complete description of the BME Program's Requirements for the MEng Degree are provided later in this chapter, the following is a summary of these requirements. All students must satisfy the following:

- Pass the course requirement, which may include directed research credits.
- Fulfill the seminar requirement.

4.2.3. Exceptions and Petitions for Change

Exceptions to general and specific degree requirements or to other rules may be made, but only by written petition to the Committee on Graduate Studies and Research (CGSR) at WPI. A petition to CGSR should be initiated by the student, but normally should be written on behalf of the student by the BME Graduate Studies Committee.

4.3. Course Requirement

The MEng program has no formal course requirements. Course credits in the MEng Program must be distributed across the following categories with the noted minimums:

- Biomedical Engineering (12 credits)
- Life Sciences (3 credits)
- Advanced Engineering Mathematics (3 credits)
- Life Sciences or Advanced Engineering Mathematics (3 credits)
- Advanced Courses and Electives (12 credits)

Students may substitute 3 to 6 credits of directed research for 3 credits of biomedical engineering and/or 3 credits of electives. Any WPI graduate-level engineering, physics, math, BME, business or equivalent course, subject to the approval of the BME Graduate Studies Committee, may be used for Advanced Courses and Electives. The student must obtain a minimum of 24 credit hours of graduate-level courses. Other courses (to make up the minimum total of 33 credit hours) may include advanced undergraduate courses approved by the BME Graduate Studies Committee. Such courses are normally considered to be at the 4000-level. The BME Graduate Studies Committee must approve the use of advanced undergraduate courses for the satisfaction of MEng degree requirements. The student's Academic Advisor may require additional course work to address specific deficiencies in the student's background.

4.3.2. Seminar Requirement

The MEng Program requires that all students attend BME seminars and, in addition, present a seminar once a year. To facilitate this process, students must enroll in *BME 591 – Graduate Seminar*. All MEng students are required to pass BME 591 twice. This graduate course is graded pass/fail for zero credits.

4.4. Committees and Advising

4.4.1. Overview

Various advisors and committees are charged with monitoring and directing the progress of students in the MEng program. These advisors and committees are summarized below:

- Academic Advisor – A core BME faculty member at WPI designated to provide the student with counsel and information in the Program.
- BME Graduate Studies Committee – A committee responsible for administering

the MEng Program. In the sections that follow on the various advisors and committees, the following definitions hold:

- BME Program Faculty Member – a faculty member with an appointment in the Biomedical Engineering graduate program formally approved by the BME Graduate Studies Committee. Only a BME Program Faculty Member may serve as a Directed Research Advisor.

4.4.2. Academic Advisor

An Academic Advisor advises each student in the MEng Program. This advisor meets with the student at least twice yearly, normally just before each academic semester.

4.4.2.1. Duties of the Academic Advisor

- Meet with the incoming MEng student during the orientation period to go over *this* Handbook in detail, making sure that everyone understands his/her responsibilities.
- Provide the student with counsel and information.
- Assist the student in selecting a sequence of coursework.
- Advise the student in the selection of any directed research projects.
- Assess progress and approve alterations in proposed course work.
- Provide a written report of the student's status to the BME Graduate Studies Committee following each meeting. The BME Graduate Studies Committee shall distribute the records, after checking them for compliance with the rules and regulations, to the student and a copy shall be kept in the student's file in the Department of Biomedical Engineering at WPI.

4.4.2.2. Selection of the Academic Advisor

The BME Graduate Studies Committee shall appoint the Academic Advisor based on the student's background and research interests. The Academic Advisor must be a core BME Faculty Member at WPI. The student may, at any later time, request a new Academic Advisor.

4.4.3. Directed Research Advisor

A Directed Research Advisor supports a directed research project (BME 598). The Directed Research Advisor must be an approved BME Program Faculty Member.

4.4.3.1. Duties of the Directed Research Advisor

- Must demonstrate a reasonable ability to provide adequate financial support for conducting the directed research project.

4.4.4. BME Graduate Studies Committee

The BME Graduate Studies Committee is responsible for administering the MEng Programs in BME. It acts as a liaison between the faculty and students in the program and the administrative structures at WPI.

4.4.4.1. Duties of the BME Graduate Studies Committee

- Oversees and administers the MEng Program.
- Appoints faculty as BME Program Faculty Members.
- Selects Academic Advisors for new MEng students.
- Appoints BME Program Faculty Members to different sub-committees, including

the Admissions Committee.

- Monitors the progress of students in the MEng Program.
- Acts on student and faculty petitions on academic matters.

4.5. Directed Research

Students in the MEng Program may elect to participate in an ongoing research project of a BME Program Faculty Member and receive credit towards their MEng degree. After an agreement between the student and the Directed Research Advisor is reached, the student registers for BME 598 (Directed Research) and begins a period of research in the Directed Research Advisor's laboratory.

Chapter 5.

Combined Bachelor of Science / Master's Degree Programs

There are two combined BS / Master's degree programs in BME: The BS/MS Program in Biomedical Engineering and the BS/MEng Combined Program in Biomedical Engineering. This chapter describes these two programs, hereafter referred to as the Combined Program, in detail.

5.1. Admission Requirements and the Application Process

5.1.1. Admission Requirements

To take advantage of the Combined Program, a student must:

- Be a currently registered WPI undergraduate.
- Successfully participate in and complete a two-step application process, consisting of a course approval process followed by a separate, full application for admission into one of the BME Master's Programs. Completion of the course approval process does not imply or guarantee admittance to the Combined Program.
- Have an equivalent GPA of 3.2 (out of 4.0) in all coursework and a minimum GPA of 3.5 (out of 4.0) in BME coursework at the time of the full application. Because the Combined Program is an accelerated program, only students demonstrating very strong academic skills and potential will be admitted.

5.1.2. Application Procedure

Application to the Combined Program is a two-step process: submission of a signed *Course Designation Form* listing the courses that will count toward both degree requirements and a Full Application to one of the BME Master's Programs.

5.1.2.1. Course Approval Process

On the *Course Designation Form* (available from the Registrar's Office), the student lists the courses that they plan to count towards both degrees. A maximum of four courses are allowed, with a maximum of three courses at the 4000-level (the 4th course must be a graduate course). These courses must meet the degree requirements for both the Bachelor's and Master's degree and courses designated for graduate students only cannot be listed. This form must bear the signature of each course instructor and be submitted to the Chair of the BME Graduate Studies Committee for signature no later than the last day of registration for any undergraduate or graduate course to be used for graduate credit. This form will then be forwarded to the Graduate Admissions Office for distribution to course instructors and administrators. A grade of B or better is required for any course to be counted towards both degrees and additional work may be required for undergraduate courses taken for graduate credit. For students in the Combined Program, approved undergraduate courses are assigned graduate credit with a conversion rate of 1/3 WPI undergraduate unit = 2 credit hours, while graduate courses applied toward the undergraduate degree are awarded undergraduate credit with a conversion rate of 3 credit hour = 1/2 undergraduate unit.

The *Course Designation Form* serves two purposes. First, it assures the student that if they are admitted into the Combined Program, the courses listed will count towards both degrees. Second, the instructor in each course listed will be formally notified that the course was approved for the Combined Program. The instructor then has a right (but not an obligation) to require additional work of the student. It is important to understand that the approval of this *Course Designation Form* does not guarantee admission to the graduate program, nor does it obligate the student to complete the full application process or enter the program. Students who fail to submit a *Course Designation Form* to the Chairman of the BME Graduate Studies Committee on time may not be eligible for the Combined Program, but may still apply for one of the regular graduate programs in BME.

5.1.2.2. Formal Application

The Full Application for the Combined Program follows the same process required of all undergraduate students interested in the BME graduate programs at WPI, with the following modifications:

- GRE scores are not required. However, because acceptance into the Combined Program is competitive and not guaranteed, an interested student should still consider taking the GRE and applying to other graduate programs where the GRE may be required. If desired, GRE scores may be submitted to strengthen an application to the Combined Program.
- The application and transcript fees are waived.

Typically, the application should not be submitted before the student is actively involved in their MQP project. Except for in exceptional circumstances, a Full Application submitted earlier than this will not be considered. The Full Application will be evaluated by the BME Departmental Admissions Committee in exactly the same manner as any application from an undergraduate at another university. A student should not assume that they will be admitted to the Combined Program based on approval of the *Course Designation Form* or submission of the Full Application and should consider and plan for other career options. A student admitted into the Combined Program is considered a graduate student only after the successful completion of the Bachelor's degree.

5.1.3. Financial Aid

All Financial Aid mechanisms discussed in Chapter 1 and in the Graduate Catalog are potentially available to support students. A very limited number of fellowships, research assistantships (RAs), graduate assistantships (GAs), and teaching assistantships (TAs) are available to outstanding graduate students in the Combined Program. Fellowships are awarded by WPI, national organizations, and corporate sponsors. RAs and GAs are awarded to graduate students by individual faculty members. A student requiring financial aid is urged to discuss the possibility of obtaining a fellowship or other support first with their MQP advisor(s), and then with any faculty member with whom they might be interested in working. Teaching assistantships (TAs) and Peer Learning Assistantships (PLAs) are awarded on a competitive basis to support undergraduate teaching in the BME Department. Decisions regarding departmental TAs and PLAs are made during the spring semester for the following academic year. However, because TAs and PLAs are required to commit time during the academic year to teaching support, a student with TA or PLA support will find it more difficult to finish the Combined Program in 5 years. Students should consider this possibility before accepting a teaching related position.

5.2. Additional Information

Because students in the Combined Program must independently meet the degree requirements for both the Bachelor's and Master's degrees, a Combined Program student should consult the appropriate chapter of this Handbook (either MS or MEng Degree Program) for more detailed information on the specific BME Graduate Degree Program being sought.

5.3. Summary

A student interested in the Combined Program should complete the following steps:

1. At the start of a 4000 level course, complete and submit a *Course Designation Form* on which the courses to count towards both degrees are listed. This form must bear the necessary signatures.
2. For the BS/MS Combined Program it may be helpful to choose an MQP that can be extended into an MS thesis or project. Discuss this possibility with your prospective MQP advisor before you sign up. The earlier you start looking, the better your chances of finding the right MQP. There is little likelihood that the Combined Program can be completed in 5 years without the MQP as a preliminary effort.
3. For the BS/MEng Combined Program it is still important to complete an excellent MQP project. However, the MEng degree does not require completion of a project or thesis.
4. Work hard on your MQP. A strong performance will increase the likelihood that you will be able to complete the BS/MS program in 5 years. As with all decisions regarding your educational objectives and career, you should discuss the appropriateness of the Combined Program with your academic advisor and knowledgeable colleagues. While there are many advantages to the Combined Program, there are situations where it may not be appropriate. For example, a student who plans to pursue a PhD degree at another institution and has a strong academic record (GPA well above 3.2, GRE scores in the 70th percentile or better) may be better served by skipping the Master's degree at WPI.
5. Consider taking the GRE general test. While not a requirement for the Combined Program, it may be necessary for other graduate programs.
6. In the fall of your final (senior) year, submit a Full Application for admission to a BME master's program. Remember that you must meet the minimum GPA requirement (3.2 in all coursework and 3.5 in BME coursework).

Chapter 6.

WPI Graduate Degree Requirements and Policies

6.1. WPI's General Requirements for all Advanced Degrees

Students in the BME graduate programs must simultaneously satisfy WPI's General Requirements for All Advanced Degrees and the BME Graduate Program's specific degree requirements.

WPI degree requirements are summarized below and detailed in the WPI Graduate Catalog. The BME Program's specific degree requirements are explained fully in subsequent chapters of this Handbook. BME program requirements have been structured to incorporate all institutional degree requirements, so that satisfying the BME Graduate Program's degree requirements will also satisfy WPI's institutional degree requirements. All degree requirements must be satisfied before the degree is awarded.

All graduate students must satisfy the following:

- At the time the degree is awarded, the student must have been admitted to the graduate program in Biomedical Engineering.
- A minimum of two-thirds of the required graduate credit for an advanced degree must have been earned at WPI.
- The student must have a program GPA of 3.0 or greater for courses taken at WPI.
- The student must satisfy the graduate rules in effect at a specific date between their matriculation date and their graduation date. In applying for graduation (the WPI Graduate Student *Application for Graduation*), the student must specify, by year, which WPI Graduate Catalog contains the rules being satisfied.

6.2. Standards for Course Grades

- Students must maintain a GPA of at least 3.0 on a scale of 4.0, where A = 4.0, B = 3.0, C = 2.0, D = 1.0, and F = 0.0. A grade of Pass does not count toward the GPA.
- Students may have a C grade in at most two courses for credit to count towards the ME Degree; no D or F grades are allowed.

6.3. Application for Graduation

After the WPI *Application for Graduation* is submitted, all advanced degrees are subject to the final approval of the Committee on Graduate Studies and Research (CGSR) at WPI, which determines if the student has satisfied the letter of intent of the requirements for the PhD. The CGSR makes its recommendations for the approval of the PhD to the WPI faculty, which in turn recommends to the President and Trustees for their final approval the names of students who should be awarded the doctorate in biomedical engineering.

6.4. Exceptions and Petitions for Change

Exceptions to general and specific degree requirements or to other rules may be made, but only by written petition to the CGSR at WPI. A petition to the CGSR should be initiated by the student and may be supported by the BME Graduate Studies Committee.