



THE UNIVERSITY OF VERMONT
**ENGINEERING AND
MATHEMATICAL SCIENCES**

Graduate Student Handbook for the University of Vermont Biomedical Engineering Graduate Degree Program

The guidelines in this handbook are applicable for all students beginning their graduate studies on or after June 1, 2018. Students who started their degree program before this date are encouraged to transition to the requirements in this handbook, in consultation with their advisor and the Graduate Program Coordinator.

Contents

1	Introduction	1
2	Biomedical Engineering Graduate Program Faculty	2
3	Graduate Student General Requirements and Classifications	3
3.1	Graduate seminar	3
3.2	M.Sc. Program Admission	3
3.3	M.Sc. Candidacy	3
4	Requirements for the M.Sc. Degree in Biomedical Engineering	5
4.1	M.Sc. Thesis Option	5
4.2	M.Sc. Project Option	6
4.3	M.Sc. Coursework Option	7
4.4	Accelerated Master’s Program	8
5	General information for graduate students	10
5.1	Graduate Program Applications	10
5.1.1	Deadline for Application and Financial Aid	10
5.1.2	Test Scores Requirement for GRE and English Proficiency Examinations	11
5.2	Funding Policies	11
5.3	Duration of GTA Funding	12
5.4	Graduate Student Grants and Travel Funds	12
5.5	Information Available Online	12

Graduate Student Handbook for the University of
Vermont Biomedical Engineering Graduate Degree
Program

August 24, 2020

Chapter 1

Introduction

The Biomedical Engineering (BME) program at the University of Vermont (UVM) offers programs of study leading to a M.Sc. degree in Biomedical Engineering. In addition the BME program partners with other academic units to offer a Ph.D. degree in bioengineering. Areas of research expertise in biomedical engineering include tissue engineering, biomaterials, biomechanics, biomedical instrumentation, biosensing and signal processing, and computational modeling.

This guide to the graduate program in BME at the University of Vermont is designed to help each student plan a program of graduate study leading to the M.Sc. in BME. As such, it is devoted to the policies, rules, and procedures of our graduate program in BME with the intention of providing a general framework for your graduate studies. Any unanswered questions should be addressed to your faculty advisor, the BME graduate program coordinator, or the Graduate College. Notice that the program requirements for the M.Sc. degree subsumes the Graduate College requirements that are described in the Graduate Catalogue. It is the Graduate College that awards each graduate degree so that their rules must either be satisfied or subsumed by program rules. For general information regarding graduate studies at the University of Vermont, see the Graduate College website <http://www.uvm.edu/~gradcoll/>.

Chapter 2

Biomedical Engineering Graduate Program Faculty

The following full-time faculty members advise students pursuing the M.Sc. degree in Biomedical Engineering:

- Professor Jason Bates (Ph.D., Otago, NZ). Systems Modeling, Lung Mechanics.
- Professor Bruce Beynnon (Ph.D., University of Vermont). Orthopaedics.
- Professor Peter Spector (M.D., Albert Einstein College of Medicine). Cardiology modeling and Instrumentation.
- Associate Professor Rachael Oldinski (Ph.D., Colorado State University). Tissue Engineering.
- Assistant Professor Amber Doiron (Ph.D., University of Texas at Austin). Biomaterials and Nanoparticles.
- Assistant Professor Niccolo Fiorentino (Ph.D., University of Virginia). Musculoskeletal Biomechanics and Imaging.
- Assistant Professor David Jangraw (Ph.D., Columbia University). Naturalistic neuro-engineering, brain-computer interfaces.
- Assistant Professor Ryan McGinnis (Ph.D., University of Michigan). Digital Health.

Chapter 3

Graduate Student General Requirements and Classifications

Graduate students in biomedical engineering are classified as either Master of Science (M.Sc.) Program Students or Master of Science (M.Sc.) Candidates. Each of these classifications is defined below along with general requirements that are common to all graduate students.

3.1 Graduate seminar

All BME graduate students are required to regularly attend the EBE graduate seminar course (BME393, 0 - 1 credit) each semester. Graduate students should register for 1 credit at least once prior to graduation. Thesis/Dissertation students should register for this credit in association with the presentation of their thesis proposal during the graduate seminar time slot.

3.2 M.Sc. Program Admission

Admission into the BME graduate degree program requires an accredited bachelors' degree in engineering, physics, mathematics, computer science, or a similarly appropriate field. Admission into the M.Sc. Program requires that the applicant have an undergraduate grade point average above 3.0 (based on a 4.0 scale), that their BME course grades are strong (B average or better), and that their letters of recommendation are positive. In borderline cases, specific scholastic requirements may need to be set by the BME Graduate Program Committee. Admitted students without biomedical backgrounds may be required to take additional foundational course work which may not necessarily count towards the MSBME degree.

3.3 M.Sc. Candidacy

Advancing to candidacy in the UVM BME graduate degree program requires that students demonstrate mastery of core biomedical engineering material. The core BME material in-

cludes engineering, mathematics (including differential equations and linear algebra), and science (including physics, chemistry, and anatomy/physiology). Students may demonstrate mastery in these areas in one of the four following ways:

1. Holding a bachelors' degree in biomedical engineering from an accredited institution,
2. Completing relevant coursework at an accredited institution with a grade of B or better,
3. Completing a higher-level course that requires the core courses as a prerequisite with a grade of B or better, or
4. Auditing relevant courses and completing the requisite exams with a grade of B or better.

Each student admitted to the BME graduate degree program who does not have an existing BME degree should obtain approval of their plan for completing the BME core requirement from the graduate program coordinator before the end of their first semester of study.

In addition to the undergraduate core above, ME 312 (Advanced Bioengineering Systems) and CS 302/CSYS 302 (Modeling Complex Systems) are considered core graduate courses. M.Sc. students are expected to complete at least one of these courses with a grade of B or better. Graduate students should be prepared to address questions related to the core BME material, as defined above, in their M.Sc. comprehensive exam.

To advance to candidacy, students must demonstrate a mastery of core biomedical engineering material, and complete the M.Sc. Comprehensive Exam.

Chapter 4

Requirements for the M.Sc. Degree in Biomedical Engineering

The M.Sc. degree in biomedical engineering requires, at a minimum, 30 credit hours at the 200 level or higher, including the BME M.Sc. core requirement consisting of either ME 312 (Advanced Bioengineering Systems) or CS 302/CSYS 302 (Modeling Complex Systems), and the completion of a comprehensive examination. All courses should be selected in consultation with the student's graduate advisor in order to best prepare the student for their research and/or career objectives. To bolster his/her background in a particular area and with pre-approval from the graduate college and the student's advisor, a student may apply up to three credits of 1XX-level or higher engineering coursework to their M.Sc. degree requirements.

Students can choose, in consultation with their graduate advisor, between a thesis option, a project option, and a coursework option. Students who are funded with a GTA or a GRA are required to choose between the thesis or project options. Students are highly encouraged to check frequently with the graduate college for UVM M.Sc. degree requirements and deadlines, which all graduate students are required to meet.

4.1 M.Sc. Thesis Option

The table below summarizes the requirements for the thesis option M.Sc. degree in BME.

Total credits	≥ 30 credits, selected with guidance from a graduate faculty advisor. At least 6 credits must have a BME designation and at least 6 credits must be at the 3XX level.
BME coursework	≥ 15 credits of engineering coursework at the 2XX-level and above, selected with guidance from a graduate faculty advisor, including ME 312, CSYS 302, or equivalent
Elective coursework	≥ 9 credits selected from BME or related graduate courses in science, technology, engineering and math, or thesis credits (BME 391), selected with guidance from a graduate faculty advisor.
Thesis research credits	≥ 6 credits (BME 391) under supervision of a BME graduate program faculty member
Thesis committee & Comprehensive exam	The student must orally present a proposal for their thesis research at least 3 months prior to graduation. After this presentation the student's thesis committee will orally examine the student based on the student's coursework and research focus, including the BME core and ME 312 or CS/CSYS 302. Successful completion of this step will meet the requirements for a comprehensive exam.
Thesis	A thesis must be completed, under the supervision of a BME graduate program faculty member. The written thesis must meet Graduate College requirements and be defended orally in public forum. See the Graduate College requirements for additional information.

4.2 M.Sc. Project Option

The table below summarizes the requirements for the project option M.Sc. degree in BME. Note that within the project option students are limited to 3 credits of BME 392.

Total credits	≥ 30 credits, selected with guidance from a graduate faculty advisor. At least 9 credits must have a BME designation and at least 6 credits must be at the 3XX level.
BME coursework	≥ 15 credits of engineering coursework at the 2XX-level and above, selected with guidance from a graduate faculty advisor, including ME 312, CSYS 302, or equivalent
Elective coursework	≥ 12 credits selected from BME or related graduate courses in science, technology, engineering and math, or thesis credits (BME 391), selected with guidance from a graduate faculty advisor.
Project research credits	3 credits (BME 392) under supervision of a BME graduate program faculty member.
Project committee	The student should work with their graduate advisor to choose a project committee by their second semester consisting of two to three regular faculty members, with not less than two from the BME graduate program faculty who approve the project.
Comprehensive exam	The student must orally present a proposal for their project research at least 3 months prior to graduation. The student's project committee will orally examine the student based on the student's project proposal as well as material from the BME core.
Project	The project topic is selected after consultation with a BME graduate faculty member and must not be the same as any project performed as part of a paid position. A written project report must be completed under the supervision of a BME graduate faculty member. The project should be orally presented in a public forum and approved by a committee of at least three faculty members, with not less than two from the BME graduate program faculty.

4.3 M.Sc. Coursework Option

The table below describes the requirements for the coursework option M.Sc. degree in BME.

Total credits	≥ 30 credits, selected with guidance from a graduate faculty advisor. At least 6 credits must have a BME designation and at least 6 credits must be at the 3XX level.
BME coursework	15 credits of engineering coursework at the 2XX-level and above, selected with guidance from a graduate faculty advisor, including ME 312, CSYS 302, or equivalent
Elective coursework	15 credits selected from BME or related graduate courses in science, technology, engineering and math, with guidance from the student's advisor.
Exam committee	As needed to meet the requirements below, the student should work with their graduate advisor to choose a comprehensive exam committee consisting of two to three regular faculty members, with not less than two from the BME graduate faculty.
Comprehensive exam	Any student who demonstrates mastery in the BME core and completes their BME coursework requirements with a grade of B+ or better in all of the courses that meet this requirement, meets the requirements for a comprehensive exam. If the student does not meet this threshold, the graduate program coordinator and the student's advisor will jointly select two or more courses at the level of BME 200 or above and will provide the student with an oral exam on this course material. The student must complete this exam at the B+ level or better.

4.4 Accelerated Master's Program

Qualified UVM undergraduate students who would like to earn a master's degree in Biomedical engineering may apply for the program's Accelerated M.Sc. Degree Program (AMP). This program enables the student to begin working on a master's degree while still an undergraduate student. The basic requirements for admission to and completion of this program are as follows:

- Interested students may apply to the Accelerated M.Sc. Program beginning in the first semester of their junior year and must do so no later than the second semester of their junior year. Applications are typically due on April 15th.
- In order to be admitted to the Accelerated M.Sc. Program, the student must have a cumulative grade point average of at least 3.2 at the time of application, and they must submit a letter of application to the BME Graduate Program Coordinator naming a BME graduate program faculty member who has agreed to serve as their graduate advisor.
- Upon being admitted into the Accelerated M.Sc. Program, the student may take up to 9 credit hours of courses for graduate credit while still an undergraduate. Of these, up to 6 credit hours of 200-level or higher courses can be counted toward both the B.Sc. and M.Sc. degrees, subject to the approval of the student's graduate advisor.

- Students who pursue the AMP on the project or thesis track typically begin work toward their master's thesis or project starting in the summer following their junior year.
- All other requirements for the M.Sc. degree apply.

Chapter 5

General information for graduate students

5.1 Graduate Program Applications

In order to be considered for admission to Biomedical engineering M.S. program, you will need to complete the UVM graduate admissions application process. In addition, if you are interested in financial support in the form of a Graduate Research Assistantship or a Graduate Teaching Assistantship you may wish to write to one of the program faculty members whose research interests align with yours. However, please note that offers of financial support can only be made after a student has completed the application process described below.

Checklist of Required Application Materials:

1. Application (online) <https://www.applyweb.com/uvmg/>
2. Resume
3. Statement of Purpose
4. Three Letters of Recommendation
5. Transcripts: One official Transcript from each institution attended
6. Test Scores: TOEFL/IELTS (can be waived for the student who has received a college degree from a University in North America).
7. Application fee: paid with submission of online application

5.1.1 Deadline for Application and Financial Aid

Fall Semester Enrollment: The official deadline is April 1. However the Department of Electrical and Biomedical Engineering will start the graduate application reviews and assistantship position (GRA/GTA) allocations starting from January 1, and will continue

until all positions have been filled. Applicants are highly encouraged to complete their complete application packages submitted on or before January 1.

Spring Semester Enrollment: The official deadline is November 15. However the Department of Electrical and Biomedical Engineering typically starts graduate application review and assistantship (GRA/GTA) allocation starting on October 1. Applicants are highly encouraged to complete their application packages before October 1.

5.1.2 Test Scores Requirement for GRE and English Proficiency Examinations

- **Graduate Record Examination (GRE):** The GRE is not required.
- **TOEFL or IELTS score:** TOEFL or IELTS scores are required for an international student who does not have a college degree from an accredited university in North America. The minimum acceptable TOEFL scores for admission is 90 for the Internet-based test, and 577 for the paper-based test.
Minimum acceptable TOEFL scores for Graduate Teaching Assistant (GTA) funding:
Internet based: 100
Paper Based: 600
Minimum acceptable IELTS (academic version) scores for admission: 6.5
Minimum acceptable IELTS (academic version) scores for GTA funding: 7.0

5.2 Funding Policies

In order to maintain a healthy level of activity in our graduate program, a proper balance must be maintained between the University supported GTA positions and externally supported Research Assistantships (GRA positions). In recruiting students, special attention must be given to diversity and excellence and capability of performing well as Graduate Teaching Fellows in the operation of our teaching laboratories and courses.

Only students pursuing the M.Sc. thesis option are eligible for funding (GTA or GRA). Priority for GTA funding is given to full-time Ph.D. students.

In order to assist in the effort to locate qualified individuals and to help maintain a healthy stream of potential GRAs to our research programs, each faculty member will be encouraged to recruit (on average) at least one new graduate student annually. It will be the responsibility of each faculty member to both seek an individual that meets the goals stated above, and to initially welcome and advise that student once arriving at UVM. Once at UVM the student may elect to take any member of the BME Graduate Program Faculty as their advisor (with that faculty members concurrence) without affecting their original graduate teaching assistantship.

The BME Graduate Program Faculty will discuss the awards of GTA positions in a meeting chaired by the BME Graduate Program Coordinator. All the operational duties of the Graduate Program, such as organizing applications and assisting committees in administering comprehensive examinations, will be performed by the BME Graduate Program

Coordinator. Awards made during the summer will be coordinated with two members of the Graduate Program Faculty, if possible.

If a student wishes to change to an advisor who is not a member of the BME Graduate Program Faculty, they will forfeit their GTA position.

5.3 Duration of GTA Funding

A M.Sc. thesis option student may receive GTA funding for no more than two years. If the student then continues on to the Ph.D. program, this two years of funding is then counted in the same manner as any other Ph.D. student (i.e., flexibility in funding is allowed).

Maintaining GTA funding requires that a student maintain good academic standing as evidenced by an overall GPA of 3.0 or higher, the completion of appropriate coursework, and acceptance as a thesis student by one of the BME Graduate Program Faculty, and adequately meeting all GTA responsibilities.

The performance of GTA-funded students will be reviewed midway through each semester in order to determine whether or not funding will be continued in the following semester.

5.4 Graduate Student Grants and Travel Funds

UVM's Graduate College provides information for graduate students seeking specific funding for academic, research, and travel endeavors. The Funding Manual for Graduate Students, which includes a list of graduate student fellowship competitions sponsored by such organizations as the National Science Foundation, the American Association of University Women, and the Ford Foundation, is updated each year and published in the Spring. This manual is available in the Graduate College and in the UVM Libraries. In order to assist graduate students in attending national meetings to present papers or poster, the Graduate College, through the Graduate Student Advisory Committee (GSAC), can provide some funds on a department matching-fund basis. Application forms are available in the Graduate College Office.

The Department of Electrical and Biomedical Engineering may provide a 1:1 match for funds obtained from the Graduate College to support student travel. Requests for these funds must be made in written to the Department Chair.

5.5 Information Available Online

The best place for updated information about graduate studies at UVM is the graduate college web site: <http://www.uvm.edu/~gradcoll/>.

The following links may also be helpful.

Graduate Student Costs at UVM:

- Tuition and fees: <http://www.uvm.edu/~stdfinsv>
- Living and housing: <http://www.uvm.edu/studentlife> and <http://reslife.uvm.edu>

Application Procedure & General Information:

- Admissions web site with application deadlines: https://www.uvm.edu/graduate/prospective_student_resources
- UVM catalog: <http://www.uvm.edu/academics/catalogue>
- Graduate college: <http://www.uvm.edu/~gradcoll/>