

BME Program Guidelines

2023-2024 Academic Year

Overview

The purpose of the Biomedical Engineering Graduate Program is to train students to understand the (patho)physiology of human organ systems and develop experimental and/or computational approaches or tools to gather, analyze, manage and present data in both written and oral form, communicate within a team of interdisciplinary learners and collaborators, and develop an understanding of the translation of discovery to application. Our overall goal is to prepare students to learn and perform research at the interface between basic science and medicine, and to create solutions to solve unmet clinical needs.

To complete the requirements for the Doctorate (PhD) degree, graduate students in the Biomedical Engineering Graduate Program must successfully complete required core and elective courses, attend Biomedical Engineering (BME) departmental seminars, pass a qualifying examination, perform research, make sufficient academic progress each term, write a dissertation and pass an Oral Examination. The program requires the completion of at least 135 hours of course and research credits, of which at least 54 hours must be in PhD Dissertation Research (which begins after advancement to candidacy). Students are expected to enroll in 12 credit-hours per term (including summer term).

The following pages outline the Guidelines governing all students electing to pursue a doctorate degree in the Graduate Program of the Department of Biomedical Engineering. All students must complete the requirements described by the Graduate Council of the Oregon Health & Science University (OHSU) School of Medicine.

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Checklist

For all BME students (pre-candidacy):

- Register and attend required core and elective course requirements:
 - At least 6 terms of BME 607 Biomedical Engineering Seminars
 - MGRD 650 The Practice of Ethics of Science
 - Either BMSC 620 Biostatistics or BMI 631 Probability and Statistical Inference Class
 - 4 elective classes (2 or more credits each; letter grade)
- Register and attend BME 605 Readings course for one term (Fall term of first year)
- Register and attend BME 608 Grant Writing/Qualifying Prep course (term in which qualifying exam is taken)
- Pass Qualifying Exam and request Advancement to PhD Candidacy
- Register for BME 601 research credits each term (pre-qualifying students)

For all BME PhD students (post-candidacy):

- Request Appointment and Approval of a Dissertation Advisory Committee
- Formally meet with Dissertation Advisory Committee at least once every 6 months
- Register for BME 603 dissertation credits each term (post-qualifying students); at least 54 credits required
- Successfully complete 135 hours of approved graduate credits for PhD students
- Request Oral Examination
- Defend dissertation and pass Oral Examination for PhD students
- Submit final forms to library and SoM Graduate Studies office and a bound dissertation to the BME department.
- Graduate!

General Timeline

General Timetable for most graduate students (9 credit minimum; 12-16 credit hours recommended each term including summer terms):

Year 1: BME courses requirements

A main goal for the first year is to discuss with your mentor (advisor) and to identify those courses of most relevance to your area of research, and to take as many core courses and electives as practical during the first 9 months in preparation for your proposal development and oral exam. Some electives are offered once every two years and it may be desirable to take these electives during the first year in order to prepare for the qualifying exam at the end of the second year. Students should participate in a journal club and/or discuss with their mentor the critical review of the scientific literature in their area.

Year 2:

Students should enroll in any remaining required and/or elective courses and BME seminars to fulfill requirements for taking the Qualifying Exam. The majority of the student's time and effort should be in

research. A major goal for the second year is to begin to acquire the laboratory skills and conceptual configuration necessary for dissertation. The student should also be spending free moments reading the scientific literature. BME students should prepare for and complete the 2nd-year Qualifying Exam by taking BME 608 in the Fall or Spring term. BME students are recommended to take the qualifying exam during their 8th term and are required to pass it by the end of their 12th term.

BME students are required to form and meet with their Dissertation Advisory Committee (DAC) which must be approved by the BME Graduate Program Director within 6 months of passing the qualifying examination. Students may form the DAC and meet with the committee prior to their qualifying exam.

Year 3 and beyond:

Students should continue educational training and research leading to the Ph.D. dissertation and complete all program elective course requirements. Register for and attend relevant Seminar Series and Journal Clubs. The student must meet with their DAC at least every 6 months to bring them up to date on research progress and to discuss future directions. The student should present a research seminar during the third year. About 6 months prior to anticipated dissertation defense, it is useful to meet with the DAC to establish a consensus on items that need to be completed. It is expected that most PhD graduate students will defend their dissertation sometime in their fifth academic year. It is a SoM requirement that the student be continuously enrolled until the dissertation is submitted. Students may not use a leave of absence to make corrections to the dissertation.

Definitions

Academic Progress. The term academic progress refers to the progress made toward the research objectives and is reviewed by the Dissertation or Thesis Advisory Committees and described in progress reports filed by these Committees with their Graduate Program Director and Graduate Studies. For students without these committees, their Graduate Program Director will annually file a report describing their academic progress. Failure to make satisfactory academic progress can and will result in a loss of good academic standing.

Good Academic Standing. The term good academic standing refers to the progress made toward meeting the minimum degree requirements and professional requirements as defined by the School of Medicine Graduate Studies [Academic Regulations of the Graduate Programs](#). Failure to make maintain good academic standing can and will result in academic warning, academic probation, suspension, or dismissal. A student may be recommended for dismissal from their graduate program without a probationary period.

Graduate Program. Any educational program leading to the Doctor of Philosophy, Master's degree, Graduate Certificate or equivalent graduate degree at OHSU.

Nano Course. A NANO course refers to a short course, offered for 0.5 credits. They are intended to be special topics courses that capitalize on timely subject matter, visiting expertise, and/or highlight new developments in a field. Flexibility in scheduling and course leadership (i.e. not part of the permanent curriculum) will insure these courses are nimble. Nano courses are only offered once. If a course is offering regularly, it will go through the regular course review and approval process.

Program. The word "Program" shall refer to a department, interdepartmental committee or other School of Medicine administrative unit that has received approval from the Faculty Council and has been accredited to offer an educational program leading to the Master's or Ph.D. degree. A Program with a single administrative structure that oversees training for more than one degree (e.g., Master's and Ph.D.) shall be considered to be one program.

Program Director. "Program Director" shall refer to the department chair, chair of the interdepartmental committee, or director of the administrative unit responsible for overseeing the Program. Responsibility for representing the program may be delegated to a member of the program

faculty when deemed appropriate by the Program Director.

Sakai is OHSU's online course management system.

WebAdmit is the admissions platform used by all graduate programs in the School of Medicine.

Abbreviations

BME – Biomedical Engineering

CONJ – Conjunct courses

DAC – Dissertation Advisory Committee

MGRD – Medical Graduate

OHSU – Oregon Health and Science University

QE – Qualifying Exam

QEC – Qualifying Exam Committee

SOC – Scientific Oversight Committee

SoM – School of Medicine

BME Admissions Process

The BME graduate program can admit students at the beginning of each term. However, the majority of applicants apply as part of the main admissions cycle for admission to Fall term. The BME Admissions Committee, a committee comprised of BME and Graduate faculty, reviews applications received for both the main (Dec 10th deadline) and off-cycle terms (March 10th, June 10th, Sept 10th deadlines). Off-cycle applications are reviewed 3 months prior to the start of the admission quarter by at least 3 members of the BME Admissions Committee.

Admissions Committee Composition

The BME Admissions Committee consists of the Department Chair and the Program Director(s) who are permanent members, and a standing committee of BME and graduate faculty members and optional student members (at the discretion of the chair). The Chair, Co-Chair, and members of the standing committee are selected by the Program Director(s). The standing committee serves a term of 3 years with the option of renewal and the student members serve a term of 2 years. Faculty and students serving on the Admissions Committee are required to adhere to OHSU training requirements for Admissions Committees. The Admissions Committee is supported by the Program Coordinator and the Department Administrator.

Admissions Committee Charge

It is the responsibility of the committee to review applications, participate in admissions committee meetings, and make admissions recommendations to the graduate program. All applications are reviewed based on established rubrics: BME Rubric for Graduate Admissions for the initial review of applications, and the BME Interview Rubric for evaluations of candidate interviews. Review of online applications is expected within 2 weeks of assignment and review of interviews is expected within 3 days of the Recruitment Event.

Orientation (Kickoff)

The Admissions Committee meets with the Program Director(s) prior to the deadline of the application. The purpose of the Admissions Committee pre-meeting is to review the expectations of the Admissions Committee, application review and interview best practices, the BME Rubric for Graduate Admissions and give the committee the opportunity to ask questions or clarify any open issues

Admissions Review Meeting

Applications are assigned to individual committee members for review by the Program Director(s) shortly after the submission deadline (Dec 10th). Each committee member reviews the applications assigned to them based on the BME Rubric for Graduate Admissions and enters their scores and evaluations through WebAdmit. The Admissions Committee then meets to review the applications as a group and reach decisions on which applicants will be invited to interview.

Recruitment Event (Interviews)

Applicants who accept the invitation to interview attend the BME recruitment event and are then considered candidates. During the recruitment event, candidates are given an introduction to OHSU and the BME graduate program, meet with members of the BMES student chapter, interview with at least three OHSU faculty members, meet with a BME student representative, and given an opportunity to interact with students and faculty through an open reception forum. This may be held virtually.

Faculty interviewing candidates are required to use the BME Interview Rubric to evaluate candidates. Evaluations, scores and interview comments are entered into WebAdmit for review by the Admissions Committee.

Admissions Decision Meeting

The Admissions Committee meets to reach admissions decisions about each candidate.

Subsequent to the recruitment event, candidates are asked to list their faculty choices. Faculty accepting new students into their labs are also asked for their candidate choices. Based on this information and prior to the admissions decision meeting, the Program Director(s) undertakes candidate/faculty matching and the recommendations are brought to the Admissions Committee. The Admissions Committee carefully considers interview results, candidate applications and Program Director recommendations in making admissions decisions. Candidates receive a decision about admissions decisions shortly thereafter (offer, waitlist or admissions denial).

BME Direct Admission Students Selection of a Faculty Mentor

Students are matched with their faculty mentor during the admissions process. The matching of a student and faculty member is dependent upon agreement between the faculty member and the graduate student as well as the approval of the BME Admissions Committee. The faculty mentor must be a member of SoM Graduate Faculty.

MD/PhD Students

Students enrolled in the MD/PhD dual-degree program select a graduate program for their dissertation research with few exceptions by the end of the Spring term of the second year of the OHSU MD program. Under the guidance of their Scientific Oversight Committee (SOC), MD/PhD students start their research rotations after they have taken the USMLE Step 1 exam the winter term prior. Typically, rotations should be completed and a mentor should be chosen no later than the end of Summer term.

MD/PhD students interested in Biomedical Engineering are required to meet with the MD/PhD Academic Coordinator to communicate their desired graduate program. Additionally, MD/PhD students are encouraged to meet with the BME program director and academic coordinator early on, preferably the summer of the first year of the OHSU MD program or earlier, to begin immediate planning for the research component of their dual-degree program, and to ensure that research rotations meet BME criteria for graduate research. To enroll in the BME program, MD/PhD students need approval from their mentor and BME program directors.

MD/PhD students are fully integrated into the activities of the BME program and are held to the BME degree requirements and program guidelines. Based on prior coursework, the BME director may elect to waive part or all of the core course requirements of the BME curriculum.

Required Core Courses

BME Specific Requirements

- MGRD 650 The Practice of Ethics of Science
- BMSC 620 Introduction to Biostatistics for the Basic Sciences OR BMI 631 Probability and Statistical Inference
- BME 605 Readings in Biomedical Engineering –required during first year
- BME 607 Biomedical Engineering Seminars – registration is required for 6 terms and attendance is required every term
- BME 608 BME Qualifying exam preparation – required for term of qualifying exam (see below)
- Students are expected to take courses related to their dissertation topic, in consultation with their dissertation advisor (and DAC if applicable).

| Requirements | Course Number | Title | Term Offered | Credit Hours |
|---|---------------------------|---|--------------------------|--------------|
| At least 6 terms (every term expected) | BME 607 | Biomedical Engineering Seminars | All terms | 0.5 |
| Core | MGRD 650 | The Practice of Ethics of Science | Fall | 1 |
| Core | BMSC 620 or BMI 631 | Introduction to Biostatistics for the Basic Sciences Probability & Statistics for Scientists and Engineers | Winter Fall | 3 3 |
| Core (first year students) | BME 605 | Readings in Biomedical Engineering | Fall | 1 |
| Core (term of qual exam) | BME 608 | Grant Writing & Qualifier Preparation | Fall/Spring | 1 |
| | BME 601 | Pre-qualifying PhD Research | All terms | |
| At least 54 credits | BME 603 | PhD Dissertation Research | All terms | 54 |
| 4 electives | | | Any term (pre-candidacy) | ≥8 |
| Total requirements | | | | 71 |
| Flexible credits | | | | 64 |
| Graduation requirements | | | | 135 |

Electives

At least four elective graded graduate courses, each of which at least 2 credits, totaling at least 8 credits. Up to four courses may be transferred from graduate courses at accredited institutions in which student earned a graduate-level degree at the discretion of the Program Director. Up to two courses may be transferred from OHSU's undergraduate medical courses (MD didactic courses).

Research Credits

Students who have not advanced to Ph.D. candidacy are required to register for at least 1 research credit each term. If a graduate student fails (i.e. receives a grade of NP – No Pass) a term of research credits (BME 601), the student is immediately placed on academic probation. The student is required to obtain a passing grade in the next term (and subsequent terms) of research credits or the student may be dismissed from the graduate program. The student is required to notify and meet with their dissertation mentor immediately upon receiving a failing grade on research credits in any one term. The dissertation advisor will suggest a course of action that the student must follow in correcting academic performance.

Dissertation Credits

Students who have advanced to Ph.D. candidacy by passing the Qualifying Exam are required to register for at least 1 credit of BME 603 each term. If a graduate student fails (i.e. receives a grade of NP – No Pass) a term of research credits (BME 603), the student is immediately placed on academic probation. The student is required to obtain a passing grade in the next term (and subsequent terms) of research credits or the student may be dismissed from the graduate program. The student (in consultation with their mentor) is to schedule a DAC meeting immediately upon receiving a failing grade on dissertation credits in any one term. The DAC meeting must take place within two weeks of receipt of the failing grade on the dissertation credits. The mentor and DAC will suggest a course of action that the student must follow to correct their research program.

BME 607 Biomedical Engineering Seminars

All students are required to enroll in and attend BME 607 Biomedical Engineering Seminars for at least 6 terms throughout their graduate tenure; continued attendance every term is expected. This seminar course will feature presentations and discussions on topics in biomedical engineering that exemplify the wide range of applications of biomedical engineering to science and medicine. The goals are to provide the students with an overview of the diverse opportunities for research and application, to foster development of critical analysis and thinking, and to stimulate creative problem solving and research planning.

Journal Clubs

Students should participate in a journal club or readings and/or meet with their mentor to critically review the scientific literature in their area. Students are encouraged to take BME 605 Readings in Biomedical Engineering during the fall term of their first year. They are taught to think critically and independently and to review scientific papers.

Course Load

A normal course load is considered to be 12-16 credit hours per term (including credits for courses and research). A minimum of 9 credits are required to be considered a full-time student.

Course Transfer

If a student feels that they have completed an equivalent, graduate-level course to any of the core or elective courses, they may petition to have the course transferred. Transferred courses will not count toward credit hour requirements. To petition, the student should write a memo requesting that the course requirement be transferred and explain why the student feels that the previous course is equivalent to the required course. A course description or syllabus that indicates the subjects covered

by the previous course should be included with the memo. Upon approval by the BME graduate program director, the transfer will be submitted to the School of Medicine Graduate Studies Office for approval by the Associate Dean of the School of Medicine (SoM). [OHSU Policy 02-70-005, Transfer of Course Credits](#)

Course Grading

Students must receive a grade of C or better in all courses and maintain a 3.0 GPA. Students not receiving a C or better in a required course must repeat that course the following year and failure to do so constitutes grounds for termination from the program.

The grade of Incomplete is reserved for circumstances beyond the control of the student, (e.g. illness) preventing completion of the course requirements by the end of the term AND it is possible to complete the requirements within the subsequent term. An Incomplete required approval from the program director, and a written plan for what exactly the student needs to complete to pass the course.

[Academic Regulations for the School of Medicine Graduate Programs.](#)

Students failing a term of research credits (i.e. receive an "NP-No Pass" on research) are immediately placed on academic probation. To return to good standing, the student must obtain a passing grade on the next term of Research (and all subsequent terms). Failure to do so constitutes grounds for termination from the Program.

Pre-qualifier Students: Students are required to notify and meet with their Program Director immediately upon receiving a NP grade on Research. The Program Director will suggest a course of action for correcting research performance. Students on academic probation are not allowed to take the qualifying exam.

Candidate Students: After advancing to candidacy, students receiving an NP grade in Research will schedule a Dissertation Advisory Committee (DAC) meeting to take place within two weeks of receipt of the NP grade in Research. The mentor and DAC will suggest a course of action that the student must follow in correcting research performance. Students on academic probation are not allowed to defend their dissertation.

Required Course Descriptions

CORE

BME 605 Readings in Biomedical Engineering

This course is designed to teach critical evaluation of information in the field of Biomedical Engineering. Students will read articles and papers on timely topics related to the student's area of interest. Students are required to present summaries of the readings and to lead class discussions.

BME 608 Grant Writing and Qualifier Preparation

Students will be instructed in the preparation of a 6-page NRSA-style grant proposal per the BME Program Guidelines for submission to their qualifying exam committee. The topic of the proposal will be determined by each student. In addition to didactic instruction on grant writing skills, the student will serve as reviewers for their fellow students' proposals.

BMSC 620 Introduction to Biostatistics for the Basic Sciences

This course is designed for students enrolled in basic science graduate programs to introduce biostatistics concepts and analysis methods that are required to conduct research in these fields. The course is a combination of lectures (some of which may be online), statistical, computing tutorial sessions and journal clubs. Some homework/projects will require the use of a statistical software package.

BMI 631 Probability & Statistical Inference for Scientists and Engineers

This course will introduce fundamental concepts underlying statistical data display, analysis, inference and statistical decision making. The topics include presentation and description of data, basic concepts of probability, Bayes' theorem, discrete and continuous probability distributions, estimation, sampling distributions, classical tests of hypotheses on means, variances and proportions, maximum likelihood estimation, Bayesian inference and estimation, linear models, examples of nonlinear models and introduction to simple experimental designs. One of the key notions underlying this course is the role of mathematical modeling in science and engineering with a particular focus on the need for an understanding of variability and uncertainty. Examples are chosen from a wide range of engineering, clinical, and social domains.

MGRD 650 The Practice of Ethics of Science

This course is designed to provide students in biomedical research with survival skills and an understanding of ethical conduct. Topics covered include: being a trainee, scientific integrity and misconduct, scientific publication, oral presentations, lab safety, use of laboratory animals, human subjects research, and research funding. Ethical dilemmas and issues are discussed in context of the practice of science.

ELECTIVES

BME requires that students successfully complete at least four elective graduate courses offered by BME or other SoM departments on campus prior to taking their qualifying exam. Below is a listing of some of the more common electives taken by our students:

BME 620 Science Writing for Journals

This course breaks down the components of scientific writing to include the following topics: 1) Starting strategies- Deciding on a journal and the review process; 2) Abstract construction; 3) Introduction- Communicating significance and rationale; 4) Methods- Data recording and transparency; 5) Figure making- Tools and guidelines; 6) Communication of results; 7) Discussion- Summaries, limitations, and the bigger picture; 8) Submission and Response to reviewers; 9) Review articles, letters, short communications and conference abstracts; 10) Navigating collaborations and mentorship.

BME 640 Fluid Mechanics and Biotransport

This course introduces basic concepts of fluid mechanics and convective mass transport. It will start with a derivation of mass, momentum and energy conservation equations for fluid flows. The importance of non-dimensional parameters such as Reynolds number and the Womersley parameter will be extensively discussed, and non-dimensional equations will be derived. Other topics to be covered include Bernoulli's equation, low and high Reynolds number flows, oscillatory flows, interactions of fluid flows with tissue and boundary layers. The final part of the course will cover the derivation and use of mass transport equations in fluid flows. Examples from different areas of biomechanics will be discussed throughout the course.

BME 645 - Biocompatibility: Host - Implant Interactions

This course provides the student with a firm understanding of how the body reacts to implanted biomaterials at the cell, tissue, organ, and systemic levels. In addition, specific characteristics that hinder or improve the biocompatibility of materials will be addressed. The concepts of biocompatibility with regards to biomaterials in experimental and clinical situations are presented. The influences of the molecular interactions between materials with different bulk and/or surface chemistry will be discussed. Issues related to the consequences of degradation products, inflammation and infection are discussed at the cellular and molecular level. Techniques to characterize biomaterials in vitro, as well as the in vivo / ex vivo analysis of implanted and explanted biomaterials are presented.

BME 669: The Physics of Medical Imaging

This course will provide a comprehensive introduction to all major aspects of standard medical imaging systems used in the clinic today. Topics will include radiation, radiation-interaction with matter, dosimetry, radiation damage and risk, x-ray imaging, computed tomography, image reconstruction and analysis nuclear medicine, MRI, ultrasound and imaging applications.

BME 673: Cancer Systems Biology

Cancer systems biology is an integrative approach to understanding cancer as a complex biological system that is made up of more than the sum of its parts. Interactions between components are a primary focus, as is the behavior of subsystems made up of several components. This course is designed to provide an understanding of the rationale and approaches used in cancer systems biology. The class will transition through discussions of the biological basis for cancer, experimental methods, experimental model systems, large-scale data resources, analytical methods, and will provide practical experience with analyzing data from a systems perspective.

BME 674: Foundations of Measurement Science

This course is intended for first- and second-year graduate students in the BME program or quantitative students in other programs who are interested in quantitative biosystems approaches to biomedical research and seek a deeper understanding of the technologies used in their research. The course will examine the physical principles underlying the instrument design and function and discuss analysis of their output and their practical use in actual research settings.

BME 675: Analysis in Quantitative Bioscience

This introductory computational biology course is geared toward students comfortable with quantitative methods, but extensive programming experience is not necessary. The course introduces and employs python notebooks for analyses of genomic and related 'big' biological data. Key statistical concepts are introduced and used throughout the course in the discussion of algorithms for the analysis and simulation of biological data. Topics covered typically included sequence alignments, analysis of RNA sequence data, pathway analysis, Markov modeling, and machine learning.

BME 680 (EE682 cross-listed) Signals and Linear Systems

This course will teach students the core principals of digital signal processing. We will survey a variety of topics in class lecture/discussion based on assigned readings while exploring specific topics/applications in depth through lab assignments and a final project. Specifically, we will cover the core topic areas in digital signal processing including an overview of discrete-time signals and systems, the discrete-time Fourier transform, the z-Transform and transform analysis, the discrete Fourier Series, the discrete Fourier transform, circular convolution, network structures for FIR systems, design of IIR and FIR filters, multi-rate processing, and linear prediction. If time permits, we will also provide an introductory lecture on the Kalman filter and the extended Kalman filter.

BME 683 Physiologic modeling and model predictive control

This course will teach students the core principals of modeling of physiologic processes and then teach how to use these models within a model-predictive control configuration. Models of physiology can be used to improve our understanding of a system and for educational purposes and as a means to support clinical processes. Model predictive control (MPC) is a method for controlling systems based on prior knowledge about the process being controlled and using a horizon of predicted responses of the process to determine optimal input control parameters. This class will introduce modeling of physiologic processes.

BME 690 Topics in Nanomedicine

Nanomedicine involves the development and application of materials and devices to study biological processes and to treat disease at the level of single molecules and atoms. Through the study and

treatment of disease at the molecular cell level, this exciting new field of nanotechnology and medicine is offering unique capabilities in disease diagnosis and management. This course offers a survey of timely concepts in the rapidly emerging nanomedicine. We will introduce basic principles underlying nanomedicine and review how nanomedicine is redefining clinical research in areas such as diagnostic imaging agents, nanomaterial-based drug delivery, and nanoscale proteomics. Specific attention will be directed to disease processes including: cancer, kidney, and neurodegenerative diseases.

Academic Performance

Academic performance is evaluated based on the fulfillment of the Student Learning Outcomes through the completion of the BME graduate program degree requirements while upholding good academic standing as established in [Academic Regulations of the School of Medicine Graduate Program](#).

Student Learning Outcomes

As students' progress through the PhD program, their academic performance is evaluated based on their academic progress and the fulfillment of the Student Learning Outcomes established by the BME graduate program. The Student Learning Outcomes for our PhD program are as follows and fulfilled through the successful completion of the program requirements:

- A. Demonstrate a strong foundational knowledge of central concepts in biomedical engineering.
- B. Demonstrate advanced knowledge in a research area of concentration within biomedical engineering.
- C. Formulate hypothesis-driven or data-driven projects based on current concepts in the student's specialized field within biomedical engineering.
- D. Design, conduct, and interpret their own research.
- E. Demonstrate doctoral-level competence in written and verbal communication.
- F. Interpret and critique scientific literature in biomedical engineering.
- G. Understand and apply Ethics in research and professional environments.
- H. Develop interpersonal skills necessary to obtain professional positions.
- I. Work effectively within collaborative or team-based diverse interprofessional environments.
- J. Contribute to advanced biomedical research with societal impact.

Good Academic Standing

The BME graduate program abides by the [Academic Regulations of the Graduation Programs](#) from the School of Medicine Graduate Studies. Failure to uphold these regulations could result in academic probation or dismissal.

Training in the Responsible Conduct of Research

The National Institutes of Health requires continued ethics training for all trainees, fellows, participants, and scholars receiving support through any NIH training, career development, research education, and dissertation research grant ([NOT-OD-10-019](#)). To meet this requirement, all graduate students are required to complete MGRD 650 The Practice of Ethics of Science.

Dissertation Advisory Committee (DAC)

DAC Formation

A DAC should be assembled and begin meeting, between a student's 7th term and 12th term. The rationale for this is to give the student advice earlier in their graduate careers concerning research, courses, and preparing for the Ph.D. qualifying exam. Students should assemble their DACs, keeping in mind that the committee should be composed of four faculty members (including their mentor), and should include as diverse a faculty membership as possible, so as to get advice from a multidisciplinary committee. Specific OHSU rules for the composition of DACs are listed below.

DAC membership requires approval from the Graduate Program Director and Associate Dean of Graduate Studies, and will include:

- At least four faculty members (including the student's advisor) with expertise in one or more aspects of the student's project and who are familiar with the requirements of the graduate program for completion of a PhD. Students (in consultation with their faculty advisor and program director) may request specific faculty to serve on their DAC.
- A majority of DAC members must be members of the Graduate Faculty. OHSU faculty from outside the Graduate Faculty may be included.
- One member may be from outside the university, but these require approval by the Associate Dean for Graduate Studies (the Program Director should include a brief CV and short explanation of non-OHSU-faculty expertise on the committee to the Associate Dean)
- No more than two DAC members may lack any DAC experience and at least one member must have been on a DAC for a graduated student.
- DAC Chair: One DAC member, not the mentor, with significant experience in mentoring graduate students, and having served on a DAC before.
- DAC members may be added or removed with the approval of the Program Director and Associate Dean of Graduate Studies. Following the change, the DAC composition will still adhere to the above requirements.
- DACs are approved at the discretion of the Program Director

Typically, DAC members will be invited to serve as part of the student's Oral Exam Committee.

Student Responsibilities

The student must meet every six months with their Dissertation Advisory Committee ([Academic Regulations of the Graduate Programs, School of Medicine Graduate Studies](#)). Following completion of the third year, the student may meet more frequently on the recommendation of his/her committee.

- It is the responsibility of the student to schedule and coordinate the meetings.
- The student must prepare a written report of progress, on the appropriate form, to be submitted a week before the meeting to committee members. Electronic submission is acceptable.
- The student is expected to provide a PowerPoint presentation summarizing goals, progress, and future plans.
- The student is expected to write a summary of the meeting and the plans for future training and research, following discussion with the dissertation advisor. This report should be sent to the DAC and upon their approval sent to the BME Graduate Program Director and BME Graduate Studies Coordinator. A copy will be deposited in the student's file in the BME Department and in the SoM OnBase system.

Committee Responsibilities

The Chair of the Committee may not be the advisor. With the approval of the Program Director, the committee may place a student on academic probation if it is determined that progress has not been adequate. The Program Director shall notify the student and the Associate Dean for Graduate Studies in writing of the probationary status and specify in what way(s) the student is failing to meet standards and specify time limits for correcting the deficiencies. If the student fails to correct the deficiencies within the specified time limits, the Program Director may recommend dismissal of the student.

[\(Academic Regulations of the Graduate Programs, School of Medicine Graduate Studies\)](#)

Qualifying Exam

Overview

The goal of the BME Qualifying Examination (QE) is for students to develop the skills to propose a research project. Specifically, the students will formulate their own hypotheses, develop the background to justify the proposal and develop the experimental approach to test the proposed hypotheses. Students should be thoroughly familiar with key historical and background publications that provide the foundation for their proposal, as well as any current literature that directly pertains to their specific aims.

Eligibility

To be eligible to take the BME Qualifying Examination (QE), students must have successfully completed all courses required in the first two years of the BME curriculum. Students may not take the qualifying examination if they are on academic probation or if an incomplete grade remains on their transcript. In the event that a course is not offered before the end of the student's second year, but the student is otherwise prepared to take the QE, the examination may proceed with approval from the Graduate Program Director. To take the QE, students are required to enroll in BME 608 for the same quarter.

Timeline and Description

Specific dates for the exam may vary slightly from year to year, usually at the end of the fall and spring quarters. The following are general guidelines for stages of the QE. Students are expected to take the qualifying exam by the end of their 8th term of graduate study. Extension of this deadline for any reason will only be considered by written request to the BME Graduate Program director. Students may request permission to take the QE earlier than the 8th term. The request must be made in writing to the BME Graduate Program Director at least two months prior to the proposed exam date. The request must be pre-approved by the student's advisor. If the student fails to complete the QE by the end of the 12th term of graduate study, they will be recommended for dismissal for failure to progress academically.

1. Students take the course BME 608 Grant Writing and Qualifier Preparation.
2. The Qualifying Exam Committee (QEC), responsible for conducting the student's qualifying examination, is appointed by the program. The student is notified of the names of the panel members and the date and time of the exam.
3. The Program Director schedules a date for the oral examination in consultation with the QEC and reserves a room.
4. At least one week prior to the Oral Exam – Student submits final written proposal to the QEC

Qualifying Exam Committee

The QEC, responsible for conducting the student's qualifying examination, is appointed by the department and the student is notified of the names of the panel members. The student's advisor/mentor may NOT be appointed to the panel. The QEC will be responsible for evaluating the written and oral components of the examination, for determining the outcome, and for identifying any

requirements that a student must complete in the case of a conditional pass. Each student will have their own QEC, though BME and SoM faculty may serve on multiple panels. The student is responsible for ensuring all members have a copy of their grant proposal.

Role of Advisor/Mentor

To facilitate an objective examination, the student's dissertation advisor is not permitted to edit or comment on the written proposal. Neither is the dissertation advisor permitted to coach the student in a rehearsal of their oral presentation.

Format

The QE consists of a written and oral component. The candidate must pass both the written and oral portions of the examination in order to advance to candidacy. The written component will resemble a National Institutes of Health (NIH)-style National Research Service Award (NRSA) grant proposal on any topic chosen by the student, including the student's proposed dissertation research (highly recommended). The oral component will consist of a closed 20-30 minute presentation by the student on the topic of the written proposal. Members of the student's Qualifying Exam Committee (QEC) will ask the student a series of questions on the proposal and related science.

Format of Written Proposal

The proposal shall be written following current general guidelines of a NRSA-style application. It is the student's responsibility to check on the current guidelines, which are available on the NIH website. The proposal shall be no shorter than 6 pages, and no longer than 8 pages (single-spaced), excluding references. Students are encouraged to discuss topics and proposed experiments with all sources (fellow students, post-doctoral fellows, faculty, and visiting scientists). Students may also seek general assistance in scientific writing and proofreading. However, it must be remembered that the written proposal is an examination and must represent the student's ideas and development of the research topic. Students are expected to adhere to established guidelines for professional ethical conduct in the preparation of their QE proposal topics.

Format of Oral Exam

The oral examination will probe the sufficiency of the student's preparedness to conduct the proposed research and also the depth of the student's understanding of his/her research proposal. Students are expected to begin the oral examination by giving a short (20-30 minute) formal presentation summarizing the written proposal. Audio-visual aids, such as PowerPoint slides, may be used during the summary of the proposal. Slides and figures from the oral summary may be referred to if they are the subject of a question from the exam panel. Questions from the QEC should focus primarily on issues pertaining to the proposal; however, the student is responsible for all areas that have been covered during the first two years of graduate courses. Therefore, students also should expect questions on general knowledge in addition to questions relating to the scientific background pertinent to their areas of specialization, as well as more general issues related to the proposed experiments. Students may be asked about the choice of methodologies, their relative advantages and disadvantages, and potential alternative strategies (when appropriate). Students will be expected to understand and be ready to explain the scientific basis of technical methods they intend to employ. The student should be prepared to discuss the rationale for the proposed study, the strengths and limitations of the proposed experimental strategies, and potential pitfalls and alternatives.

Preparation for Oral Exam

Students should be thoroughly familiar with key historical and background publications that provide the foundation for their proposal, as well as any current literature that directly pertains to their specific aims. In addition, students are encouraged to review the more general areas that provide the conceptual configuration for their proposal. Students are encouraged to use all resources outside of their mentor. They may contact panel members for guidance in preparing their oral exam presentation.

Preparatory course enrollment in BME 608 Grant Writing & Qualifier Preparation is required. This 1-credit course is generally offered in the spring and fall terms.

Outcomes

The outcome will be recommended by majority vote of the QEC and be recorded on the BME Qualifying Examination form. The form shall be signed by the chair of the QEC and returned promptly to the BME Graduate Program Director. The Program Director will then present and discuss the QEC forms and outcomes with the Graduate Education Committee, which will review all QEC outcomes. In case that the Graduate Education Committee does not agree with the QEC outcome, the Committee will consult with the QEC to reach a final decision. The Program Director will then inform students of the outcome of the exam. Possible outcomes include:

Pass – The student passes both the written and oral examination. In certain circumstances, the QEC may identify specific areas of weakness that the student needs to address during subsequent dissertation. This information will be communicated in writing to the student, advisor, and BME program director by the chair of the examination panel.

Conditional Pass – A conditional pass may be given for either the written or oral components of the examination if significant deficits are identified. In this case, the student will be provided with specific requirements that must be met within a prescribed time frame. A variety of requirements may be assigned at the discretion of the QEC to correct a perceived deficit, including (but not limited to) additional courses; revision of some or the entire written proposal; assignment of additional directed reading; preparation of a written review of a particular topic; or oral presentation on specific topics. In the case of assigned additional courses, the student must complete the assigned course(s) with a grade of “B” or better.

The chair of the student’s QEC will be responsible for notifying the BME Graduate Program Director when the student has successfully completed the requirements of the conditional pass. Failure on the part of the student to complete the requirements within the prescribed time frame will be considered unsatisfactory progress, and the student may be subject to dismissal from the BME Program. The Program Director will notify the student and the student’s advisor of the final outcome.

Fail – If the student fails either portion of the examination, the student fails the qualifying exam. Within one week of the examination, the Program Director will provide a written statement to the student, and the advisor, describing the deficiencies that led to failing the qualifying examination. The student may petition the Program Director to retake the qualifying examination (written and oral) again. The petition needs to be submitted within 2 weeks after the student was notified of the Fail. The reexamination must be completed within the three months of the exam date (unless a longer time frame is specifically requested in the petition), or alternatively the student may resign from the graduate program. The Program Director may also elect to offer the student the option to complete a Master’s Degree, rather than re-taking the Qualifying Examination. In such a case, students will be obligated to complete all the requirements for a Master’s Degree in BME. The Program Director and QEC will counsel the student with respect to the most prudent course of action. If the student decides to re-take the qualifying examination, then he/she must submit a revised or new proposal as summarized above.

Timeline for re-examination. The re-examination procedure should be completed within three months of the original examination.

Outcome for re-examination. Students will be assigned a “pass,” “conditional pass,” or “fail” by the same criteria as summarized above. Failure to pass the QE after two attempts will result in recommendation to the School of Medicine for dismissal from the graduate program.

Advancement to Ph.D. Candidacy

Admission to the Biomedical Engineering Ph.D. program does not automatically identify a student as a degree candidate. Advancement is granted only after successful completion of the qualifying examination. The BME graduate program abides by the [Academic Regulations of the Graduate Programs of the School of Medicine Graduate Studies](#).

Formation of Oral Examination Committee

All instructions and guidelines adopted by the Graduate Council By-Laws shall be carefully followed.

According to the Graduate Council By-Laws, the Oral Examination Committee for a dissertation defense:

- Must include no fewer than four (4) members of the Graduate Faculty who do not all have primary appointments in the same department or institute.
- Must include at least one (1) member who is not a member of the student's Dissertation Advisory Committee.
- Must be chaired by a member of the Graduate Faculty.
- The student's dissertation advisor should serve on the committee but may not serve as Chair.
- Programs may request permission to replace one of the committee members by a recognized scholar who is not a member of the Graduate Faculty.
 - 1) This individual may not serve as Chairperson of the exam committee.
 - 2) Requests to appoint an outside member to the exam committee must be supported by a letter from the Program Director and a copy of the scholar's curriculum vitae.
 - 3) Appointment of an outside member may be used to meet the requirement that not all members have primary appointments in the same department or institute, and/or that the committee includes at least one member who was not a member of the student's Advisory Committee.

The Oral Exam Committee is approved by the Associate Dean for Graduate Studies based upon the recommendation of the BME Graduate Program Director in the term prior to the student's defense.

Preparation and Submission

Distribution of Dissertation to Oral Examination Committee.

- a) All members of the Examination Committee must receive the following at least two weeks prior to the oral examination:
 - An unbound copy of the dissertation from the student.
 - A copy of the approved REQUEST FOR ORAL EXAMINATION form from the oral exam chair.
 - A copy of the "Instructions for Members of the Oral Examination Committee" from the oral exam chair.
- b) Upon approval of the Request for Oral Examination form, the Office of Graduate Studies will prepare the ORAL EXAMINATION CERTIFICATION form for and forward to the Chairperson of the Examination Committee with the "Instructions for the Chair of the Oral Examination Committee."
- c) The ORAL EXAMINATION CERTIFICATION form includes student's name, dissertation title, degree sought and names of committee members.

Dissertation Seminar

The exam must be held on campus and be open to the public. The BME Program in conjunction with the student and oral exam committee set the date, time and place of the exam and post notices on campus.

Finalizing Ph.D. Requirements

OHSU awards diplomas each term, based on the completion of final forms and dissertation binding. The following requirements must be completed within six months following the completion of the Oral Examination Corrections to Dissertation. If necessary, make corrections to the dissertation.

- All members of the Examination Committee who recorded a satisfactory vote for the oral examination must sign the CERTIFICATE OF APPROVAL page. Signing of the approval page indicates that all required corrections have been completed.
 - All required corrections must be completed and approved by the Examination Committee within 6 months after the oral exam. Programs may impose a stricter deadline. Graduate Studies will defer to program.
 - Failure to submit an approved dissertation within this time limit will void the oral exam and the oral examination will need to be retaken.
- a) Electronic Submission of Dissertation. The Library requires OHSU students to submit an electronic copy of their doctoral dissertation. Additionally, students are required to submit an electronic copy to the BME graduate program coordinator for program records.
- Students should email their electronic copy in PDF format along with required forms to ethesis@ohsu.edu at least two weeks before signed forms are due in the Graduate Office.
 - The page containing your committee members' signatures should not be filled out for the copy you submit to the library.
 - Workstations in the library are set up with all necessary applications. Limited support can be arranged prior to submission.
 - Review Theses, Dissertations, Capstones, & Portfolios on the [OHSU library website](#) for required forms, more detail on submission requirements and options for electronic publishing.
 - The OHSU LIBRARY DOCUMENT SUBMISSION FORM & RECEIPT and the CERTIFICATE OF APPROVAL page are required by the Graduate Studies Office. The Library will copy the Graduate Studies Office when they email their signature acknowledging receipt to you for your dissertation. In addition, you may forward the signed librarian receipt to somgrad@ohsu.edu. If you receive a hard copy receipt, please deliver the original receipt to the Graduate Studies Office. A copy of the credit card or payment receipt is not required.
- b) Application for Degree. The Office of the Registrar requires that the APPLICATION FOR DEGREE form be completed and is required in the Registrar's Office one term prior to completing degree requirements. Exit contact information will be collected on the 'Application for Degree' form.
- c) Survey of Earned Doctorates. The required Survey of Earned Doctorates can be found at <https://sed-ncses.org/>. Student responses are confidential, except for the postgraduate placement information (institution and job title), which may be shared with the programs.
- d) After all of the preceding requirements have been completed, the Associate Dean for Graduate Studies will review all forms and sign the Oral Exam Certification form.
- The original form will be forwarded to the Registrar as final approval of the dissertation and acceptance for graduation.

Graduation. Information regarding graduation will be posted to the Graduate Studies website at www.ohsu.edu/som/graduate

School of Medicine Commencement Ceremony. This is a special event when graduate degrees are formally conferred for those who received a degree from the School of Medicine during the prior academic year. Family and friends are encouraged to attend and no ticket is required. Degrees will not be awarded until all academic requirements have been met and the student pays all debts and discharges all other obligations he or she has to the University, including the Registrar's graduation fee.

Ethical and Professional Behavior

In compliance with federal regulation and OHSU institutional policy, all investigators, research staff, and other relevant personnel (those reasonably involved in the design and/or conduct of human, animal, applied and/or basic science research) must complete OHSU's Responsible Conduct of Research (RCR) education.

All Doctoral students are required to successfully complete at least one course in ethics and professional conduct or be exposed to equivalent content.

Refer to [Graduate Studies Policies and Guidelines](#) for more on behavior and conduct policies.

Time Limit for Completing Degree Requirements

For the Ph.D. degree, 135 approved graduate credit hours are required. Graduate credit toward Ph.D. degree requirements shall be granted only for courses completed during the 7 calendar years (28 terms) prior to completing all degree requirements. [OHSU Policy 02-70-035, Degree and Certificate Standards](#)

Exceptions

In matters related to courses, exceptions must first be approved by the Course Director and the BME Graduate Program Director. Other exceptions must first be approved by the BME Graduate Program Director.

Completion of a Master's Degree

If a student is unable to successfully complete the Qualifying Exam or make sufficient academic progress toward their dissertation research, with the support of the Program Director a student can elect to terminate their training with the completion of a Master's Degree. A degree conversion must be requested by the Program Director and approved by the Associate Dean of Graduate Studies. The student will be held to the degree requirements of a Master's degree as described in the [Academic Regulation of the Graduate Programs, School of Medicine Graduate Studies](#).

For all BME MS students:

- Request Appointment for a Thesis Advisory Committee
- Formally meet with Thesis Advisory Committee at least once every 6 months
- Register for BME 503 thesis credits each term; at least 24 credits required
- Successfully complete 45 hours of approved graduate credits for MS students
- Request Oral Examination
- Present Thesis and pass Oral Examination for MS students
- Submit final forms to library and SoM Graduate Studies office and a bound thesis to the BME department
- Graduate!

MS Student Learning Outcomes

The Student Learning Outcomes for our MS program are as follows and fulfilled through the successful completion of the program requirements:

- A. Demonstrate a basic knowledge of central concepts in biomedical engineering.
- B. Demonstrate advanced knowledge in one specialized research area within biomedical engineering.
- C. Design, conduct, and interpret their own research.
- D. Demonstrate master's-level competence in written and verbal communication.
- E. Interpret and critique basic scientific literature in biomedical engineering.
- F. Apply fundamental knowledge of Ethics in research.
- G. Work effectively within a collaborative team.
- H. Contribute to biomedical research with societal impact.

Additional Policies

BME follows all academic and student policies laid out in the [Graduate Studies Student Handbook](#), which include but are not limited to the following:

- Vacation sick leave policy
- Academic adjustment policy for new parents
- Continuous enrollment policy
- Mentor-Student Discussion policy
- School of Medicine technical standards

The Student Handbook will be emailed to incoming students during the onboarding process, and can always be found on the SOM [Graduate Studies Forms and Policies](#) page.

Approved by BME Education Committee on: September 25, 2023