

**BIOMEDICAL ENGINEERING**  
**GRADUATE PROGRAM POLICY DOCUMENT**  
*(Revised November 2023)*

## **OVERVIEW**

Through the Department of Biomedical Engineering (BME) at the University of Delaware (UD), graduate students can obtain a PhD and/or a MS degree. Students are not admitted directly into the MS program. The MS and PhD programs are built on a common first year core curriculum with advanced curricula that are based on the research the student will perform for their PhD dissertation (or MS thesis, if electing that option). Due to the interdisciplinary nature of Biomedical Engineering, faculty that are affiliated with the BME graduate program come from multiple colleges and departments at UD. PhD and MS students will generally identify a Faculty Advisor from among our program's primary and joint faculty, who will be responsible for defining the student's research responsibilities and for evaluating the student's performance. The PhD and MS degrees will be administered by the BME Program and will be awarded by the College of Engineering.

This multi-disciplinary graduate program builds upon the established biomedical research strength at the University of Delaware, largely within the College of Engineering. It offers academic rigor, as well as flexibility, to meet the needs and interests of students from different backgrounds and of their faculty advisors from different research areas.

## **ADMISSION REQUIREMENTS**

Admission to the BME graduate program is competitive. Those who meet stated requirements are not guaranteed admission, and those who do not meet all the requirements are not necessarily precluded from admission if they offer other appropriate strengths. Applicants to the PhD program in BME should meet the following criteria:

- A bachelor's degree or higher in engineering, physical, or biological sciences from an accredited 4-year college or university with a minimum cumulative GPA of 3.2 on a 4.0 scale.
- Engineering, science, and math courses from the following list, while not required for admission, are highly recommended: Calculus, Differential Equations, Calculus-based Physics, Biology, Physiology, Chemistry, Organic Chemistry, Signal Processing, Statics and Dynamics, Probability and Statistics, and Computer Programming. It is understood that very few applicants will have completed all of these courses, but all provide a foundation that will help with the required courses in the Biomedical Engineering graduate program.
- For international applicants, a TOEFL exam taken within the last 2 years with a minimum score of 550 for the paper-based test and of 79 for the iBT (internet-based test) with a 18 for the iBT speaking component, or degree from a primary English-speaking University, consistent with policies from the UD Graduate College.  
<https://www.udel.edu/apply/undergraduate-admissions/requirements/internationalstudents>

- Three letters of recommendation from individuals acquainted with the student and their academic work or from employers or others who have had a supervisory relationship with the applicant and are able to assess the applicant's potential for success in graduate studies.
- A personal statement (1-2 page) that indicates:
  - The reason for the student's interest in graduate study
  - A discussion of previous research experience and/or industrial experience
  - The student's area(s) of research interest and a list of faculty with whom they would like to work
  - The student's ultimate career objectives.

We encourage applications from students from all backgrounds.

## PhD PROGRAM

The PhD program in Biomedical Engineering consists of 39 credits of graduate level course work, inclusive of 9 credits of Doctoral Dissertation research. The program allows for considerable flexibility in course selection. The PhD program also requires completion of a Teaching Aid requirement, the Qualifying Exam, the Candidacy (Proposal) Defense, and the Doctoral Dissertation and Defense.

## PhD DEGREE REQUIREMENTS

The table below lists the credit requirements for a PhD degree in BME.

<b>PhD requirements in Biomedical Engineering: 39 credits total</b>	
4 Core courses	
Physiology	3 credits
Advanced Math	3 credits
Statistics	3 credits
Communication	3 credits
5 Technical electives (minimum), of which at least 1 must be a 600-level or higher BMEG elective	15 credits
Research	3 credits minimum
Doctoral Dissertation	9 credits maximum
Seminar series (3 semesters)	0 credits

## COURSE REQUIREMENTS

<b>Core Courses (12 credits)</b>
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Physiology (3 credits)	BMEG 804 Quantitative Human Physiology
Advanced Math (3 credits)	BMEG 671 Mathematical Physiology
Statistics (3 credits)	BMEG 802 Advanced Biomedical Experiment Design & Analysis
Communication (3 credits)	BMEG 801 Communication in Biomedical Engineering

Other classes may be substituted for the approved core courses at the recommendation of the student's Faculty Advisor with the approval of the Graduate Director and Graduate Committee.

### TECHNICAL ELECTIVES

<b>Technical Elective Courses (15 credits minimum) (Choose 5 courses minimum, of which at least one must be a 600-level or higher BMEG Technical Elective)</b>	
BISC 602	Molecular Biology of Animal Cells
BISC 609	Molecular Biology of the Cell
BISC 612	Advanced Cell Biology
BISC 615	Developmental Biology
BISC 625	Cancer Biology
BISC 639	Developmental Neurobiology
BISC 654	Biochemical Genetics
BISC 682	Bacterial Pathogens: Molecular Mechanisms
BISC 690	Fundamentals of Pharmacology
BMEG 640	Structural Attachments in Biology
BMEG 641	Biomechatronics
BMEG 643	Magnetic Resonance Imaging
BMEG 644	Microscale Biofluid Mechanics
BMEG 645	Material-Human Body Interfaces
BMEG 646	Neuromechanics of Human Motion
BMEG 661	Cell Engineering
BMEG 662	Engineering Biomedical Nanostructures
BMEG 663	Mechanotransduction
BMEG 665	Tissue Biomechanics and Modeling
BMEG 679	Introduction to Medical Imaging Systems

CHEG 604	Probability and Statistics for Engineering Problem Solving
CHEG 608	Introduction to Particle Technology
CHEG 617	Colloid Science and Engineering
CHEG 621	Metabolic Engineering
CHEG 624	Bio-Based Materials
CHEG 648	Biomaterials for Drug and Gene Delivery
CHEG 649	Molecular Biophysics
CHEG 660	Systems Biology
CHEG 825	Chemical Engineering Thermodynamics
CHEG 827	Chemical Engineering Problems
CHEG 828	Statistical Thermodynamics
CHEG 842	Selected Topics in Biochemical Engineering
CHEG 845	Advanced Transport Phenomena
CHEM 641	Biochemistry
CHEM 642	Biochemistry
CHEM 643	Intermediary Metabolism
CHEM 645	Protein Structure and Function
CHEM 646	DNA-Protein Interactions
CHEM 649	Molecular Biophysics
CHEM 684	Biochemistry of Nucleic Acids
CIEG 601	Introduction to the Finite Element Method
CIEG 605	Intermediate Topics in Finite Element Analysis
CISC 636	Computational Biology and Bioinformatics
CISC 642	Introduction to Computer Vision
CISC 681	Artificial Intelligence
CISC 842	Introduction to Machine Learning
CISC 689	Topics: Artificial Intelligence
CISC 844	Computational Biomedicine
CISC 849	Advanced Topics in Computer Applications
CISC 852	Computer Network Performance
ELEG 602	Advanced Machine Learning
ELEG 604	Digital Imaging and Photography
ELEG 630	Information Theory
ELEG 631	Digital Signal Processing
ELEG 634	Signals and Systems
ELEG 679	Introduction to Medical Imaging Systems
ELEG 815	Analytics I: Statistical Learning

KAAP 617	Biomechanical Lab Instrumentation
KAAP 620	Advanced Human Anatomy
KAAP 651	Neurophysiological Basis of Human Movement
MEEG 613	Nanomaterials and Nanotechnology
MEEG 621	Linear Systems
MEEG 628	Multiscale Modeling of Materials
MEEG 651	Introduction to Microsystems
MEEG 671	Introduction to Robotics
MEEG 677	Introduction to State Estimation
MEEG 682	Clinical Biomechanics
MEEG 683	Orthopedic Biomechanics
MEEG 684	Biomaterials and Tissue Engineering Applications
MEEG 698	Stochastic Optimal Control
MEEG 829	Applied Nonlinear Control
MEEG 833	Mesosopic CFD Method
MEEG 837	Multiphase Flow and Transport
MEEG 841	Microscale Thermal Transport
MEEG 877	Sensing and Estimation in Robotics
MEEG 890	Nonlinear Programming
MEEG 894	Linear Feedback Control Design
MEEG 895	Game Theory & Mechanism Design
MSEG 630	Introduction to Science and Engineering of Polymer Systems
MSEG 803	Equilibria in Material Systems
MSEG 804	Kinetics in Material Systems
MSEG 817	Composite Materials
MSEG 832	Principles of Polymerization
NSCI 626	Advanced Neuroanatomy
NSCI 627	Advanced Neurophysiology
NSCI 628	Advanced Neuropharmacology
NSCI 629	Integrative Neuroscience I
NSCI 630	Integrative Neuroscience II
NSCI 632	Developmental Behavioral Neuroscience
NSCI 633	Neuroplasticity
NSCI 634	Stress and the Brain
NSCI 635	Neuroplasticity
NSCI 636	Seminar in Spatial Cognition
NSCI 637	Behavioral Epigenetics
NSCI 638	Clinical Neuropsychology
NSCI 639	The Emotional Brain
NSCI 640	The Immune System and Behavior

NSCI 641	Hormones and Behavior
NSCI 642	Social Neuroscience
NSCI 643	Body and Space
PSYC 626	Advanced Neuroanatomy
PSYC 627	Advanced Neurophysiology
PSYC 628	Advanced Neuropharmacology
PSYC 642	Mental Representation and Memory
PSYC 653	Introduction to Functional Magnetic Resonance Imaging
PSYC 829	Advanced Psychopathology
PSYC 845	Childhood Psychopathology
PSYC 878	Hierarchical Linear Modeling
PSYC 879	Structural Equation Modeling
STAT 609	Regression and Experimental Design

Courses not on the above Technical Elective list can be substituted with permission of the Faculty Advisor and approval by the Graduate Director. Check for updated lists periodically. For descriptions of technical electives, please refer to the [UD Course Catalog](#).

## **OTHER COURSE REQUIREMENTS**

### **Seminar Series**

Biomedical engineering is an emerging and rapidly expanding field where engineering and biological disciplines converge. To keep up to date with the wide variety of research encompassed by this field, students are required to sign up for and successfully complete 3 semesters of the zero (0) credit BME Seminar Series (BMEG890) during semesters in which the course is offered. Students enrolled in the BME Seminar Series must attend at least 75% of the regularly scheduled departmental seminars in that semester to achieve a passing grade. Attendance will be taken at all regularly scheduled departmental seminars for those students enrolled in the Seminar Series course. Students are encouraged to attend the BME Department's Seminar Series, whether or not they are officially enrolled in the course or not.

### **Research and Doctoral Dissertation Research Credits**

PhD students must complete 27 credit hours of course work (described above), plus at least 3 credit hours of Research (BMEG 868) and 9 credit hours of Doctoral Dissertation research (BMEG 969). Please see the section on Sustaining Status (described below) regarding the policy on BMEG964 Pre-Candidacy Study and BMEG969 Doctoral Dissertation research credits.

### **Students with Previous Graduate Work**

The BME program may waive up to 12 credit hours of required course work for students entering with a master's degree or transfer up to 9 credits for graduate course work performed at another recognized graduate school not leading to degree conferral. Waivers and transfers will only be

granted for courses that cover subjects eligible for credit toward a PhD in Biomedical Engineering from the University of Delaware. Requests for credit waiver or course transfers must be initiated by the student before the beginning of their third semester at UD. Waivers and transfer credits must be approved by the Faculty Advisor and the BME Graduate Director and will be contingent on the student's demonstration of satisfactory performance in course work taken at UD.

## **ADDITIONAL PhD PROGRAM REQUIREMENTS**

### **TEACHING AID REQUIREMENT**

The ability to communicate ideas, concepts, and factual information is an essential skill for all PhD graduates, even those who have no interest in an academic career. In recognition of this, all PhD students are required to fulfill a Teaching Aid Requirement for 1 semester that consists of serving as a Teaching Aid. Note that this is different from the Teaching Assistantships offered as financial aid (described in *Financial Aid* section). While fulfilling this Teaching Aid Requirement, students are expected to continue being actively involved in their research.

The responsibilities of the Teaching Aid Requirement will be defined by the course instructor and should not exceed 20 hours per week. In general, PhD students should not merely be assigned grading responsibilities. They could have an opportunity to plan and deliver lectures, lead discussion sections, and lead laboratory exercises. Direct interaction with course students is highly encouraged.

The University requires that all first time Teaching Aids take a TA orientation class offered by the Center for Teaching and Learning (typically scheduled for prior to the start of their first semester classes). International students must also enroll in the ELIITA ([English Language Institute International Teaching Assistant](#)) program before performing their teaching requirement.

Although the exact timing of these Teaching Aid appointments is flexible, it is highly desirable to complete all teaching responsibilities by the end of the 2nd year, although they can be extended to the 3rd year or later under certain circumstances. The BME Graduate Committee assigns these positions in late Fall (for the upcoming spring semester) and in late Spring or Summer (for the following fall semester). Students are encouraged to submit their preferences for specific positions early to facilitate the process. Although every effort will be made to satisfy these requests, students should recognize that this is not always possible.

### **CHOOSING A FACULTY ADVISOR**

All PhD students must have a Faculty Advisor overseeing doctoral studies and research. The Faculty Advisor will be a member of the Biomedical Engineering department faculty (Primary, Joint, or Affiliated).

During the first four months following fall matriculation (September through December), students will be advised by the Graduate Director (unless a direct match to an advisor is made during the

admission process). Unless a direct match to an advisor has been made during admissions, each student will participate in a minimum of two five-week lab rotations during their first semester. Rotations within specific labs will be assigned by the Graduate Committee based upon matriculating student interests and prospective advisor needs and availability. Upon the completion of rotations, the BME Graduate Academic Advisor will request that students provide, by the Monday before Thanksgiving, a confidential and ranked preference of at least two potential research advisors they consent to matching with. Similarly, advisors will submit their confidential ranked preference of rotated students to the Graduate Academic Advisor. The Graduate Committee will then work to match all students to Faculty Advisors within approximately two weeks of the end of rotations.

After matching, the Faculty Advisor will be the primary contact of the student for questions and advice regarding their training and dissertation research throughout the remainder of their program. Each student will develop a plan of study for the program with their Faculty Advisor by the end of the second semester of their first year. Any changes to a student's program of study must be approved by the Faculty Advisor and the BME Graduate Director.

### **DISSERTATION COMMITTEE**

The student must establish a Dissertation Committee by the end of their third semester after matriculation (typically the Fall semester of their second year of study). The Dissertation Committee plays a significant role in the student's PhD studies, including administering and approving the Qualifying Exam, Dissertation Proposal, and Dissertation Exam, as well as annual progress evaluation, and advisement of both student and faculty advisor alike. The committee upholds the standards of the department for research conduct and can act as advocates for both student and faculty advisor in resolving conflicts.

The Dissertation Committee is selected by the Faculty Advisor and the student and must have a minimum of four members including the advisor and at least three additional faculty. Three members must have an appointment in BME (Primary, Joint, or Affiliated), at least one member (other than the advisor) must hold a Voting appointment in BME, and one must be from outside of the primary research area of the dissertation topic. Three members must be from the University of Delaware. One external member must be from outside of the Biomedical Engineering department, and may be from outside of the university. Faculty who have Joint or Affiliated appointments in BME may serve as an external member, as long as their primary appointment is in a different department. Using the [Form to Establish Dissertation Committee](#) document, the student must submit their proposed Dissertation Committee and a short paragraph justifying the committee composition. The Graduate Director must approve the committee and committee chair. Disagreements between student and advisor over committee composition will be resolved by the Graduate Director. Once the committee has been established, students must complete the **Dissertation Committee Confirmation** form and submit it to the Graduate College.

If a student is unable to form their dissertation committee by the end of their third semester after matriculation, they must petition the Graduate Director, in writing, for an extension of this deadline, else they risk being designated a Student Not in Academic Compliance (see description below). Any subsequent changes in committee members must be approved by the Graduate



Director, and the student must complete the [Request to Change Dissertation or Education Leadership Portfolio Committee](#) form and submit it to the Graduate College.

## THE QUALIFYING EXAM

The Qualifying Exam must be taken after the student forms the Dissertation Committee. This qualifying exam comprises both written and oral components. The oral component is expected to be completed within the first month after the end of the student's third semester (i.e., during Winter term for Fall matriculating students). The written component will be prepared leading up to the oral component, and is expected to be finished approximately one week before the oral component. The student must also have successfully completed at least 5 approved courses with a cumulative GPA of 3.00 or better. For students with non-fall matriculation or part-time study, the timing of this exam will be set based on course completion and approval by the Graduate Director.

The purpose of the Qualifying Exam is to establish and maintain a common standard of preparation and progress for dissertation research by students in the PhD program. The role of the committee in this process is to uphold that standard on behalf of the department, and to provide necessary feedback guidance to students to maximize their success in their dissertation research. The written and oral components of the Qualifying Exam mechanism are collectively used to evaluate and provide feedback regarding the preparation of the student in the areas of i) background knowledge, and methodologies and techniques needed to complete their research; ii) critical thinking, including the ability to identify gaps in knowledge in their area of research and to describe potential directions of future research to address such gaps, as well as potential pitfalls or limitations ; iii) current research progress made to date; and iv) oral and written scientific communication.

The Qualifying Exam will be administered by the student's Dissertation Committee. The outcome of this exam will be either 'satisfactory' or 'unsatisfactory' (see below) and will help develop a training and mentoring plan to address any shortcomings identified in the Qualifying Exam and student preparation and progress to date, and provide the student important feedback for successfully completing their PhD.

### Written Component

Students will prepare a 4-6 page research plan to be presented to their Dissertation Committee. The format of the document should adhere to standard NIH or NSF grant formats, and include the following:

1. background and significance of their proposed area of research, including major gaps in current knowledge to be addressed
2. proposed directions of research, i.e. preliminary aims of the student's dissertation, including important methodologies and foundational knowledge necessary to complete aims
3. description of current research and accomplishments to date (recommended to be approximately 1 page)
4. self-assessment of progress and preparation, and areas where feedback or guidance from the committee is needed
5. separate references section (no page limit), formatted as standard in the field of research

Students may initiate work on this examination document anytime they wish. However, primary work on this exam document is expected to occur after forming the Dissertation Committee and before the oral component of the qualifying exam is held, where the student will be expected to dedicate significant time to its completion. Students must submit the exam document to the Graduate Director in PDF format one week before their scheduled oral component of the qualifying exam. Students are expected to continue to participate in their research activities during the time they are working on their qualifying exams.

Students may consult their advisor, other faculty members, and other students regarding scientific questions during the preparation of this work. However, the written exam must be the student's original and independent work.

Any text or figures used from published sources (including previously published works by the student and/or grant submissions) must be properly cited. Failure to do so constitutes plagiarism.

### **Oral Component**

After the written component has been completed, an oral component of the Qualifying Exam will be scheduled with the student's Dissertation Committee. The oral component will be scheduled for 60 minutes by the student with the committee. To make scheduling easier, students are suggested to schedule this meeting in advance at the time the Dissertation Committee is formed, and the Graduate Program Advisor can assist with resolving scheduling conflicts.

For the oral component, the student should prepare an approximately 20-minute presentation based on the written component, covering the same key topics. Following the presentation, there will be approximately 40 minutes for discussion of the exam material by the committee. This will predominantly include questioning of the student to understand their knowledge base, research progress, and readiness to move forward in the PhD program. The student is also expected to facilitate discussion to receive feedback and guidance on research directions and approaches, as well as potential research hurdles and means to address them.

At the conclusion of the oral component, the committee will provide both verbal and written feedback to the student regarding both the written and oral components of the examination and submitted to the Graduate Director.

### **Possible Examination Outcomes**

The Qualifying Exam Committee will submit a recommendation to the Graduate Committee that the student's performance is either 'satisfactory' or 'unsatisfactory'.

A decision of 'satisfactory' means the committee feels that the student's preparation and progress is adequate such that the student will be able to be successful in independent dissertation-level research. Even if the committee determines that the student is 'satisfactory', it is expected they will prepare constructive feedback and guidance on the proposed research, including recommended courses or mentoring plan to address any identified areas of weakness or additional preparation needed.

A decision of ‘unsatisfactory’ means that the committee feels that the student’s present areas of weakness and/or insufficient preparation are significant enough to prevent the student from successfully achieving programmatic milestones necessary to demonstrate and complete independent dissertation-level research. In some cases, the Committee will consider that these deficiencies cannot be sufficiently corrected within the timeframe set by the Graduate Program for accomplishing remaining degree milestones and will recommend dismissal from the program. In other cases, the Committee may consider that deficiencies may be corrected if an adequate Study and Mentoring Plan is completed in a certain time frame, likely 3 to 6 months, where the student will need to show sufficient improvement to the committee to remain in the program. This plan shall be submitted to the Graduate Director using the Study and Mentoring Plan form within one week of the completion of the oral examination.

All recommendations by the committees will be reviewed by the Graduate Director and Graduate Committee. The Graduate Director or Graduate Program Advisor will communicate the approved decision to the student and their faculty advisor and will provide and retain a written copy of the Study and Mentoring Plan.

Progress made on the Study and Mentoring Plan shall be documented on subsequent Annual Progress Reports, or earlier if specified in the plan. Inadequate progress in the Study and Mentoring Plan recommended by the committee may be grounds for dismissal from the PhD program. If the student is recommended for dismissal from the PhD program, they may continue in the MS program if they meet all necessary requirements.

## **CANDIDACY REQUIREMENTS + TRANSITIONING TO SUSTAINING STATUS**

To qualify to be a PhD Candidate, students must complete the following:

- a. Complete a one semester Teaching Aid Requirement.
- b. Establish a Dissertation Committee.
- c. Pass the Qualifying Exam.
- d. Complete all coursework; inclusive of 3 credits of BMEG 868 *Research* and 9 credits of BMEG969 *Doctoral Dissertation* (see below).

During the semester that a student is expected to complete the coursework and research credits required for the BME Ph.D. Degree, typically semester four after matriculation, the student can submit their [Doctoral Degree Candidacy Recommendation Form](#) to the Graduate College. This form must be approved and signed by the student’s Dissertation committee and the Graduate Director. University policy requires that students must advance to candidacy a minimum of six months prior to the defense of their dissertation.

If a student has registered for, or completed all course requirements in a program of study but has not yet met all of the stipulations for passing into candidacy, the student must maintain full-time registration during the fall and spring semesters in course(s) and/or Pre-Candidacy Study (964) (minimum of 9-credits per semester is considered full-time). Pre-Candidacy Study (964) is graded pass/fail. If the student registered in Pre-Candidacy Study is admitted to candidacy before the end of the free drop/add period of the following semester, their registration in Pre-Candidacy Study (964) for the preceding semester may be changed to the course Doctoral Dissertation (969) and used to fulfill the 9-credit Doctoral Dissertation requirement.

Once a student has completed all credit-bearing coursework required for the BME PhD degree, completed their Teaching Aid requirement, established a Dissertation Committee, passed the Qualifying Exam, and qualified for Candidacy, they will be considered eligible for transitioning to Sustaining Status by the BME Department. Completion of credit-bearing course work includes completion of 9 credits of BMEG969 Doctoral Dissertation.

Once a graduate student has transitioned to Sustaining Status, having completed all requirements for the degree except the submission of their dissertation, the student must maintain matriculation in the BME PhD program during the fall and spring semesters by registering for Doctoral Sustaining (UNIV 999). Additionally, all students must be registered in the semester in which the degree is officially awarded. Sustaining registration is required for summer and winter session only if the degree is awarded at the conclusion of the summer or winter session. Students in sustaining status are considered full time.

### **DISSERTATION PROPOSAL**

The Dissertation Proposal requires a written proposal outlining the plan of research for the PhD and an oral presentation and defense of this proposal to the Dissertation Committee. The written proposal will follow either a NIH R01 or NSF grant submission format, with length of 10-12 pages, excluding references. A curriculum vita, the most recent Progress Report form, and a graduatelevel transcript should also be included with the proposal. All materials should be distributed to the Dissertation Committee at least 2 weeks before the oral proposal. The defense will include approximately 30 min presentation by the student, followed by approximately 60 min Q&A discussion. There are no guidelines as to whether the proposal is open or closed to an external audience, and determination of this is left up to the student and advisor(s). Students are encouraged to complete the Dissertation Proposal following their sixth semester after matriculation (typically after their third year in the program), and must complete it by the end of their eighth semester. Students wishing to complete the Dissertation Proposal later or must petition the Graduate Director, in writing, for an extension of this deadline. The Dissertation Proposal must be completed at least one year in advance of completing the Dissertation Exam.

### **COMPLETING THE PHD**

To complete the PhD, students must pass a Dissertation Exam. This exam involves approval of the written dissertation and an oral defense of the dissertation. The oral defense must be scheduled through the BME Department and the UD Graduate College must be notified of the defense using their [online form](#). The written dissertation must be deposited with the BME department for submission to the student's Dissertation Committee at least 2 weeks before the oral defense. The oral presentation will be announced to the University community and open to the public, and will last approximately 45 min. After questions from the public not to exceed 15 minutes, a closed Q&A session with the Dissertation Committee of approximately 30-60 minutes will follow. The student will be responsible for making corrections to the dissertation document and for meeting all Graduate College deadlines for submission. All paperwork that must be submitted prior to and following the defense of the dissertation and approval of the written dissertation document can be

found [online](#). These include the [Advanced Degree Application](#), [Dissertation Defense Notification](#), and the [Dissertation Defense Certification](#) forms. Detailed instructions regarding dissertation style guidelines and dissertation deposition deadlines can be found on the [UD Graduate College website](#).

The Dissertation Exam must occur no sooner than one year after the Dissertation Proposal. Students are encouraged to hold a meeting with their entire Dissertation Committee prior to their defense, particularly in there is a significant gap in time between Dissertation Proposal and Dissertation Exam, where they will review technical and scientific content of their research prior to completing and defending their Dissertation. Department policy is that students must complete the Dissertation Exam by the end of 7 years from matriculation, or must petition the Graduate Director, in writing, for an extension of this deadline, else they risk being designated a Student Not in Academic Compliance (see below).

The University also has established [Degree Time Limits](#) for the completion of doctoral program degrees. Students entering a doctoral program without a master’s degree are given fourteen consecutive semesters to complete the necessary requirements. For students that require a time extension beyond the fourteen consecutive semesters to complete their degree must request a time limit extension from the University. This requires the student to make the request in writing, have it approved by the student’s advisory committee and the chair of the department’s graduate committee. The department must then forward the request to the Graduate College, and the Graduate College will determine the student’s eligibility for a time extension and will notify the student in writing of its decision to grant an extension of time. Students entering a doctoral program with a master’s degree are given ten consecutive semesters to complete the requirements.

## **MS PROGRAM**

The MS program in Biomedical Engineering consists of 30 credits of graduate level course work, including 6 credits of Master’s Thesis if electing the Thesis option. The program allows for considerable flexibility in course selection. The MS program with thesis option also requires completion of an approved Master’s Thesis. If a student is switching into the MS program after initially being in the PhD program, they must submit a [Change of Major/Concentration or Degree Form](#) to the Graduate College.

The tables below list the credit requirements for a MS degree in BME.

<b>MS requirements in Biomedical Engineering (Thesis option): 30 credits total</b>	
3 Core courses	
Physiology	3 credits
Advanced Math	3 credits
Statistics	3 credits
2 BMEG electives (600-level or higher)	6 credits
3 Technical electives (minimum)	9 credits
Thesis	6 credits

<b>MS requirements in Biomedical Engineering (non-Thesis option): 30 credits total</b>	
3 Core courses	
Physiology	3 credits
Advanced Math	3 credits
Statistics	3 credits
2 BMEG electives (600-level or higher)	6 credits
5 Technical electives (minimum)	15 credits

### Course Requirements

<b>Core Courses (9 credits)</b>	
Physiology (3 credits)	BMEG 804 Quantitative Human Physiology
Advanced Math (3 credits)	BMEG 671 Mathematical Physiology
Statistics (3 credits)	BMEG 802 Advanced Biomedical Experiment Design & Analysis

Other classes may be substituted for the approved core courses at the recommendation of the Faculty Advisor with the approval of the Graduate Director and Graduate Committee.

### Technical Electives

Technical Electives can be chosen from courses offered across engineering departments. Classes may be chosen from the list approved for the PhD program as above, and at least two technical electives must be a 600-level or higher BMEG technical elective. Courses not on the above Technical Elective list can be substituted with permission of the Faculty Advisor and the Graduate Director. Students electing the non-thesis option may use up to 6 credits of BMEG 868 (Research) toward the 15-unit technical elective requirement. Check for updated lists periodically. For descriptions of technical electives, please refer to the [UD Course Catalog](#).

### Choosing a Faculty Advisor

If a student is pursuing a non-thesis option MS, the student will be advised by the Graduate Director, or a BME-affiliated faculty member appointed by the Graduate Director. If a student is pursuing a thesis-option MS, the student will be advised by the BME-affiliated faculty member most directly involved in supervising the thesis research. Students are responsible for identifying potential faculty advisors by meeting with faculty, attending faculty presentations, and attending research group meetings, and/or by participating in research rotations during their first semester in the program. With the consent of both student and advisor, the Graduate Director will match the student to a Faculty Advisor before work is begun on the thesis research.

The Faculty Advisor will be the primary contact of the student for questions and advice on his/her training and thesis research throughout the remainder of the program. The student will develop a plan of study for the program with the Faculty Advisor by the end of the second semester of their first year. Any changes to a student's program of study must be approved by the Faculty Advisor and the BME Graduate Director.

### **Thesis Committee**

Before beginning work on their thesis research, the student must establish a Thesis Committee. The Thesis Committee is selected by the Faculty Advisor and the student, and must have a minimum of three (3) members including the advisor and at least two (2) additional faculty. Two (2) members must have an appointment in BME (Primary, Joint, or Affiliated Faculty), at least one member must hold a Primary or Voting Joint appointment in BME. The student must submit a 1-2 page research plan approved by the committee to the Graduate Director. The research plan should contain a brief description of the student's proposed research area including major questions to be addressed, a brief summary of research accomplishments so far, one paragraph justifying the committee composition, and a preliminary timeline for the completion of the degree. The Graduate Director must approve the committee, and research plan, and any subsequent changes in committee members.

### **Thesis Submission**

To complete the MS with thesis option, students must submit a correctly formatted thesis meeting the University formatting rules, presenting novel, publishable research that has been reviewed and approved by the student's thesis committee. The thesis committee may, at their discretion, require a formal presentation of the thesis as a condition of approval. The student will be responsible for making corrections to the thesis document and for meeting all Graduate College deadlines for submission. Students must complete the thesis within 5 years of matriculation or must petition the Graduate Director for an extension.

### **Completing the MS Degree**

Once all requirements have been met (including the approved thesis for thesis-option MS students), the student must submit an [Advanced Degree Application](#) to the graduate office. Detailed instructions regarding thesis style guidelines and thesis deposition deadlines can be found on the [UD Graduate College website](#).

## **ACADEMIC STANDING**

### **Academic Load**

Full-time students are expected to complete the PhD program in 4-6 years, or the MS program in 2-3 years. The program may be completed over a longer time frame for part-time students. Students must be enrolled in at least 9 credit hours or in sustaining credit to be considered full-time students. Those enrolled for fewer than 9 credit hours are considered part-time students, although students holding assistantships are considered full-time with six credits. Students are expected to take 9 credit hours of course work for the first semester in order to be funded. All graduate students are expected to register for a minimum of three credits, typically research credits, during the summer term but not the winter term. Generally, a maximum load is 12 graduate credit hours in spring and

fall; however, additional credit hours may be taken with the approval of the student's adviser and the Office of Graduate and Professional Education.

### **Annual Progress Report**

The student's progress toward their PhD will be monitored annually by the BME Graduate Committee. Before July 1<sup>st</sup> of each year, the student must submit an annual **Progress Report** form to the Graduate Director that is signed by the Faculty Advisor. This form includes a checklist of course requirements, research accomplishments, self-assessment, individual development plan, advisor feedback, and verifications that programmatic milestones/requirements are completed. The progress includes verification that an annual meeting between the student and at least one member of the Dissertation Committee took place. This member will be other than their faculty advisor and also hold a voting appointment in BME. If the student, faculty advisor, Dissertation Committee member, or Graduate Committee believes a formal committee meeting is desired they can ask for one to take place, pending approval by the Graduate Director. Failure to submit the annual progress report on time may result in discontinuation of funding and cancellation of Fall registration until the Progress Report is completed.

### **Grade Requirements**

Only graduate courses completed with a grade of B- or higher will count towards the requirements of the BME program. Students must maintain at least a 3.0 cumulative grade point average to receive the degree. If student does not achieve a B- or higher in a core course, they must retake the course (or any of the optional core courses in that category), and if the retaken grade is below a B, the student will be recommended for dismissal. If student achieves lower than a B- on an elective course, they can retake the course or replace it with another elective course. University of Delaware has a No Replacement policy so both grades of a repeated course are included in the cumulative GPA and the University requires that this GPA must be over 3.0. However, the cumulative GPA for the courses that lead to the PhD degree only use the higher grade of the repeated course.

**Consequences of Unsatisfactory Progress/Being a Student Not in Academic Compliance** The BME Graduate Committee will meet at least once each year to evaluate each student's progress within the BME Graduate Program. As part of this monitoring process, each student must annually submit a **Progress Report** form to the BME Graduate Director before July 1. This form requires that the student meet, at a minimum, once-a-year with their Dissertation Committee (the Qualifying Exam and Dissertation Proposal meetings suffice for this requirement in years they occur) or with at least member of their Dissertation Committee other than their advisor (and with a voting appointment in BME), and that they meet with their advisor to sign-off on their annual progress report. If the advisor indicates that the student progress is deemed to be unsatisfactory, the advisor, in consultation with and through the approval of the student's dissertation committee, will provide details regarding expected remedies and an appropriate timeline for resolving any deficiencies. Continued unsatisfactory progress may be grounds for discontinuation of funding and/or dismissal from the graduate program. If the student continues in failing to make satisfactory progress towards a degree, the committee will recommend suitable action to the BME Graduate Director. Possible actions include (but are not limited to): (i) requirement for additional courses, (ii) suspension of financial support, and (iii) recommendation for dismissal.



## **Standards of Student Conduct**

All graduate students are subject to University of Delaware [regulations regarding academic honesty](#). Violations of the UD regulations regarding academic honesty or other forms of gross misconduct will be referred to the [Office of Student Conduct](#) may result in immediate dismissal from the Program.

## **Dismissal**

The procedures for dismissal as detailed in the [University Graduate Catalog](#) will be followed. Briefly, the BME Graduate Committee will report its recommendation and reason for dismissal to the BME Graduate Director. The Director will make a recommendation to the Graduate College, who will decide whether to dismiss the student. The student may appeal this decision to the Graduate College, following the procedures given in the University Catalog.

## **Graduate Student Grievance Procedure**

Students who feel that they have been graded inappropriately or have received what they perceive as an unfair evaluation by a faculty member may file grievances in accordance with University of Delaware [policies](#). Students are encouraged to contact the BME Graduate Director and/or the Chair of the BME Department prior to filing a formal grievance in an effort to resolve the situation informally.

## **Attendance at Conferences and Professional Meetings**

The BME program encourages students to attend conferences and professional meetings. They provide opportunities to meet future employers and colleagues, and can offer specialized training beyond course work.

## **FINANCIAL AID**

### **Financial Awards**

Financial assistance is awarded on a competitive basis to the pool of admitted applicants. The University of Delaware's policies apply to all forms of financial aid. Please refer to the University Policies for Graduate Student Assistantships and Fellowships.

The majority of students in the BME PhD program will be supported on research contracts and grants obtained by their Faculty Advisors. Students pursuing a terminal MS degree are not generally funded by the department, but may be supported on research contracts and grants as deemed appropriate by the PI on those projects. PhD and MS students without external funding may also be appointed as Teaching Assistants at the discretion of the graduate committee chair.

Students in the Biomedical Engineering program may be provided the following graduate assistantships:

- **Research Assistants (RAs)** are generally funded by research grants and contracts provided by external funding agencies. Students should be supported as an RA through their Faculty Advisor's research funds once they are matched (usually following the first

full semester of the student's matriculating year). RAships provide full tuition and a stipend.

- **Teaching Assistants (TAs)** are offered for graduate students to perform teaching and other instructional activities. Note that this is different from the Teaching Aid Requirement described in the **Candidacy Requirements** section. The amount of service may vary from week to week, but the average is usually expected to be 20 hours per week. A TA-ship provides full tuition and a stipend. In accordance with University of Delaware regulations, TAs must fulfill the requirements detailed for the Teaching Aid Requirement in the **Candidacy Requirements** section above in order to qualify for this type of assistantships.

### **Continuation of Financial Aid**

Students who are awarded financial aid must maintain satisfactory academic progress with satisfactory performance of assistantship duties (see below). Satisfactory academic progress includes maintaining full-time status and maintaining the grade requirements detailed in the **Satisfactory Progress** section.

The Faculty Advisor will establish the Research Assistant (RA) responsibilities and performance standards. In the event of an unsatisfactory performance by an RA, the Faculty Advisor will notify the BME Graduate Director and the student of the problem in writing. The Advisor will give the student a performance appraisal that lists the specific areas that need improvement and a timeline by which to rectify the situation (typically 1 to 3 months) before the assistantship is terminated.

The director of the course in which the student teaches will establish the Teaching Assistant (TA) responsibilities and performance standards. In the event of an unsatisfactory performance by a TA, the course director will notify the student and the BME Graduate Director in writing detailing the specific areas that need improvement. If the student does not rectify the situation (typically within 2-4 weeks), the BME Graduate Director may recommend termination of the assistantship.

## **BME PEOPLE**

### **BME Graduate Director**

The Associate Director for Graduate Studies in BME chairs the BME Graduate Committee and is called the BME Graduate Director. They will be responsible for the overall implementation, quality and progress of the degree program, and advised by the BME Graduate Committee. They will also act as advisor to students during their first semester, until they have been matched to a Faculty Advisor. The Graduate Director serves as a conduit of communication between the program's students, the BME faculty, administrative staff, the Graduate Committee, and the Department Chair. At the end of the PhD or MS program, the Graduate Director will approve the application for the degree upon verifying that the student has successfully completed the requirements.

### **BME Graduate Committee**

This committee consists of at least five BME-affiliated faculty. It is responsible for 1) recommending student admissions and visits, 2) matching students to research advisors, 3) developing and approving the curriculum, 4) reviewing annual Progress Reports, 5) assigning

Qualifying Exam committees, 6) reviewing and approving Dissertation Committee members and chairs, and 7) dealing with petitions for course substitutions.

## **FORMS**

All forms can be accessed at the bottom of the following page: <https://bme.udel.edu/graduate/>

## **ADDITIONAL GRADUATE STUDENT POLICIES**

Additional information regarding University-level graduate student policies can be found in the UD [Graduate Catalog](#), and at the website of the [Graduate College](#).