Ph.D. Student Handbook
Biomedical Engineering (BME)

August 2025

TABLE OF CONTENTS

BME GRADUATE PROGRAM GENERAL PROCESSES AND CONTACTS

For general questions, students should first consult their research advisor and the Vanderbilt Graduate School website. On the graduate school website, the Vanderbilt University Student Handbook and Vanderbilt University Graduate School Catalog can be found, in addition to other resources such as academic forms, graduation checklist and deadlines, applications for research travel grants and other professional development opportunities, and information related to health and wellness. Students are also able to pursue additional support available through the University Counseling Center (UCC), the office for International Student & Scholar Support (ISSS), the Center for Teaching (CFT), the Career Center, and others.

This handbook is a complement to the graduate school resources and should be consulted, along with the research advisor, by BME graduate students for more program-specific information on regulations and requirements. There is some overlap in the handbook content with information maintained by the graduate school. If there are future updates that cause a discrepancy between graduate school guidelines and this document, the graduate school will be generally considered the ultimate resource for procedures, regulations, and graduation requirements. However, this is not always the case. For example, the minimum number of didactic credit hours defined by the graduate school for a Ph.D. is 24; the BME requirement of 27 credit hours supersedes the graduate school minimum. If a discrepancy or gap in important information is noticed, please notify the Director of Graduate Studies to seek clarification and/or request updates to the BME Program Handbook.

After consulting the research advisor, the graduate school website, and the BME graduate handbook, students needing further support should contact the BME Graduate Program Manager. They will provide additional information to the student as they are able and will also, as needed, bring in additional support from the BME Director of Graduate Studies, BME Director of Graduate Recruiting, BME Department Chair, and/or centralized support staff at the Graduate School.

Note that work hours and vacation policies are lab-specific and set by the research advisor. Students should communicate with their advisor and be sure to have clarity on day-to-day research expectations, both during the academic year and summer.

Forms

Information on forms needed at various milestones is provided at the end of this document. Students should contact the Graduate Program Manager if additional support is needed with finding required forms, for seeking the signature of the Director of Graduate Studies, or for submission of completed forms.

Variances

Students wishing to request variances in didactic requirements or required timelines should first get approval of their research advisor and then contact the Director of Graduate studies. One example request would be related to counting engineering courses taught outside of BME toward the BME elective requirement. Note that classes must be engineering courses related to a biological or biomedical topic to receive consideration. Another request that can be considered under special circumstances is delay of the qualifying exam until after the 3rd year. This should be avoided, if possible, but can be considered if a student changes projects or faces other extreme challenges. Note that the Graduate School has an absolute requirement that doctoral candidacy must be achieved no later than the 4th year.

Lab / Research Advisor Grievances

Students should first consult their advisor to address grievances related to their project or other lab personnel. If issues cannot be resolved “locally”, the student should contact the Director of Graduate Studies, who will then intervene and/or direct the student to additional resources. Many students find it helpful to meet with a Vanderbilt Graduate Life Coach or Academic Success Coordinator (https://gradschool.vanderbilt.edu/student-resources/professional-development/gpas/) to discuss and receive guidance on managing personal conflicts within the lab or with the student’s advisor. Note that a Graduate Life Coach can also help students who are facing personal or other challenges during graduate school beyond laboratory conflicts.

Contact Information

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RESEARCH EXPECTATIONS / TRAINING FOR THE PROFESSION

Responsible Conduct of Research (RCR)- All students are required to receive training on RCR.

Fellowships and Publishing- It is expected that all eligible students apply for prestigious graduate research fellowships from sources such as NSF, NIH, DOD, and relevant foundations. It is also expected that students will publish their work in leading biomedical and engineering research journals and present their work externally at national conferences such as the Biomedical Engineering Society Annual Meeting. Students should consult directly with their advisor for lab-specific guidelines on hours spent on research, vacation time, publishing requirements, intellectual property, moonlighting, etc. Outside moonlighting or consulting should be approved by both the research advisor and the Director of Graduate Studies.

Supplemental Experiences**-** Students are encouraged to take advantage of the opportunities provided to them throughout their studies. Examples include: 1) pursuing a Certificate in College Teaching from our Institute for the Advancement of Higher Education (AdvancED) for students who are considering an academic/teaching career; 2) pursuing entrepreneurship opportunities through internships, the NSF i-Corps program, or our 'Innovation Realization' course that is offered jointly with the Vanderbilt Law School and the Owen School of Management.

Teaching- There is no strict requirement for serving as a teaching assistant as part of the BME Ph.D. program. However, the majority of Ph.D. students will complete 1-2 TAships, often but not always in the first year of the program. TA obligations will require up to 15-20 hours per week and include some or all of the following: answering student questions, holding office hours, grading, generation of content for teaching or assessments, assisting in undergraduate lab courses, and lecturing.

REQUIREMENTS TO PROGRESS TOWARDS THE DEGREE (PH.D. AND M.S.)

Master of Science Coursework Requirements

Candidates for the Master of Science (M.S.) degree must complete 30 hours of graduate-level credit. At least 24 credit hours must be didactic, and these cannot be pass/fail. The didactic credit hours should be distributed as follows:

- Biomedical Engineering: minimum of 12 credit hours
- Life Sciences: 3 credit hour, 6000-level or above. Approved courses are listed under 'Possible Courses' in the Degree Audit 'Life Science' tab on YES. Courses not listed must be approved by both the research adviser and Director of Graduate Studies **prior** to enrollment.
- Advanced Engineering/Science: minimum of 9 credit hours

*At least 6 of the BME hours and 3 of the Advanced Science or Engineering hours must be 6000+ level courses. A total of 6 credits can be counted from one (1) hour of BME seminar and thesis research credit hours toward the required 30 credit hours. M.S. candidates must also submit a research thesis to their faculty advisor and another faculty reader, in addition to giving a final oral presentation to the department.

Doctor of Philosophy Coursework Requirements

Candidates for the Ph.D. degree must complete a minimum of 27 credit hours of graduate-level didactic courses. Didactic credits cannot be taken on a Pass/Fail grading basis. The credit hours should be distributed as follows:

- Biomedical Engineering: minimum of 15 credit hours
    - BME 6110 Intro to Research and Professional Development in Biomedical Engineering is required (usually taken in the 2nd year) and counts toward 15 credit hour minimum.
    - ChBE classes on Immunoengineering (5820) and Biomolecular Engineering and Design (5805), along with the EECE Advanced Image Processing (6357), can be counted as BME courses. One other engineering course taught outside of BME but that has a biological or biomedical focus can also be counted with the approval of the Director of Graduate Studies. *Additional engineering courses may also be considered to count toward the BME course requirement but requires departmental approval.*
- Life Sciences: 3 credit hour, 6000-level or above. Approved courses are listed under 'Possible Courses' in the Degree Audit 'Life Science' tab on YES. Courses not listed must be approved by both the research adviser and Director of Graduate Studies **prior** to enrollment.
- Advanced Engineering/Science: minimum of 9 credit hours

*Of the 27 required didactic credits, at least one course is required to be strongly quantitative. Approved courses are listed under 'Possible Courses' in the Degree Audit 'Minimum 3 hours Quantitative Courses' tab on YES. Courses not listed must be approved by both the research adviser and Director of Graduate Studies **prior** to enrollment.

*At least 6 of the BME hours and 3 of the Advanced Science or Engineering hours must be 6000+ level courses.

*The remainder of the 72 hours required for a Ph.D. will typically consist of dissertation research but may also include seminar and other didactic courses.

TRANSFER CREDIT

Graduate level courses taken from another institution can be considered for transfer and to count toward the Vanderbilt graduate degree requirements if (1) a grade of B or higher was earned and (2) the course credit was not applied toward the requirements for earning a prior (*e.g.*, undergraduate) degree. Up to 6 credit hours can be transferred toward the M.S. degree, and up to 36 credit hours can be transferred toward the Ph.D. degree. Please acquire an official transcript that displays the course(s) to be transferred and contact the Graduate Program Manager to initiate the process. Regardless of number of credit hours transferred, all students are required to take at least 2 graduate-level BME didactic courses at Vanderbilt for a total of at least 6 credit hours.

ADVISOR SELECTION AND MENTORING COMMITTEES

Advisor selection- Most incoming BME students will match with their research advisor during the interview and recruitment process that occurs prior to matriculation at Vanderbilt. However, matching with a research advisor in advance is not required, and students are allowed to rotate or otherwise further consider research labs during their first semester. There is not a formal rotation length or process, and students are required to organize that individually or with the help of the Director of Graduate Studies, as needed. All students should match with their advisor by the end of their first semester in the program. The advisor matching process is negotiated between the student and faculty member, and a form is submitted by the student to formally declare their advisor.

Mentoring committee and meetings- All students must meet with a mentoring committee each semester (fall and spring) after entering the program until they form their dissertation committee. This typically entails 4 meetings over the first 2 years of the program. The mentoring committee is assigned by the Director of Graduate Studies and comprises 3 faculty, including the student's primary research advisor. Mentoring committee meetings are 30 minutes in length, during which time the faculty committee assesses the student's research and coursework progress. The student is given constructive feedback if there is a concern. It is expected that the student will show improvement in areas of concern by the next mentoring committee meeting. The mentoring committee can

recommend that the student exit the program with a terminal M.S. degree if the student is not ultimately able to demonstrate improvement after having received critical feedback in previous mentoring committee meetings.

DISSERTATION COMMITTEE FORMATION

The dissertation committee should be formed, in consultation with the student's advisor, early in the 3rd year of the program. The dissertation committee comprises 5 faculty members, including the research advisor, who is the chair of the committee. At least 3 committee members must be BME faculty members, and at least 1 must be a primary BME faculty member. At least 1 committee member must be from the school of medicine (clinical or basic sciences); with approval, this committee member can also be from a medical center outside of Vanderbilt. The dissertation committee is responsible for administering the Ph.D. Qualifying exam and oral examination at the student's Ph.D. defense. The qualifying exam should be completed before the end of the 3rd year in the program. Students are also required to organize one pre-qualifying exam meeting with their committee to introduce themselves and their work and to get preliminary feedback prior to the formal qualifying exam. The committee should receive the written proposal and written dissertation documents at least 2 weeks in advance of the in-person examinations.

Timing- The committee can be established first with 3-4 rather than the full 5 members. A pre-qualifying exam meeting with the committee should be held by the first semester of the 3rd year.

QUALIFYING EXAM

Pre-Qualifying Exam Meeting- A pre-qualifying exam meeting should occur in the fall semester of the 3rd year and should be scheduled following approval by the mentoring committee and research advisor. This meeting should include at least 3 committee members (including the student's research advisor), and at least 1 primary BME faculty. This can be either a group meeting or a series of individual meetings between the student and committee members. In this meeting, the student will give a brief introduction to their research project and potential proposed aims. The purpose of this meeting is to allow the student and committee members to become familiarized with each other in advance of the qualifying exam. It also serves as an opportunity for committee members to make suggestions regarding the aims or scope of work in advance of completing the written research proposal.

Degree Audit- Before scheduling your qualifying exam, please review your Degree Audit in YES. You will not be allowed to schedule your exam if you have not completed at least 24 didactic courses toward the degree requirement, and many students will have completed all coursework requirements prior to taking the qualifying exam. If you have courses that are not correctly allocated to their respective coursework requirement in Degree Audit, please send an email to the Director of Graduate Studies and Graduate Program Manager to request it be assessed for correction. Please clearly indicate the course number and corresponding coursework requirement.

Qualifying Exams will abide by the regulations of the Graduate School and administered by the Ph.D. committee. Predoctoral students are expected to advance to candidacy by passing the qualifying exam before the end of their 3rd year. Students must have completed 24 didactic hours prior to taking the qualifying exam. The exam will consist of a written research proposal and oral presentation/defense of the proposal.

The qualifying exam may probe concepts both directly and indirectly related to the dissertation proposal. The exam can be taken a maximum of two times. Outcomes for each exam can include: pass, fail, or pass with stipulations. For the latter, a student may be required to take a course on a specific topic or provide an updated written proposal to the committee in follow-up communication. Another exam meeting may not be required if the student adequately satisfies the committee's concerns by providing revised and/or appended information in follow-up communication.

The written proposal should be developed in consultation with the research advisor and detail the dissertation project research plan. This proposal should ideally include preliminary data generated by the student to support and justify the project. The written document must be sent by the student to the Ph.D. committee at least 2 weeks prior to the qualifying exam. The format of the written proposal is recommended, but not required, to follow the format of an NIH R01 proposal, which is limited to 13 single spaced pages (1-page for specific aims; 12-pages for the remaining sections; and references cited section does not count against the page limit). Students are encouraged to write in 1.5 line spacing and adjust the page length accordingly; page recommendations provided here and below are based on single spacing. Margins should be at least 0.5 inches, and font should be a minimum of 11 point. The proposal should include the following sections.

(1) Specific Aims should be a 1-page section of the proposal. This section summarizes the motivation for the research, project innovation, and significance in the first 1-2 paragraphs. This is followed by a clear statement of the overall goal of the project, which can be either a design-related goal or statement of a central hypothesis to be tested in the work. After this statement, the Specific Aims (typically 3) of the project should be outlined. At the end of the Specific Aims page, the impact of the work can be re-stated, and mention should be made, if applicable, of how collaborating labs or a broader research team will contribute to the success of the project.

(2) Significance of the work should be clearly stated in terms of how it addresses an unmet medical need or fills a fundamental gap in the understanding of scientific phenomena. This section will typically be 1-2 pages and include a brief review of the most closely related literature. The function of this section is to provide the “lay of the land” in the dissertation research area and to clearly identify the gap in knowledge/technical capability or unanswered question(s) that will be addressed by the proposed work.

(3) Innovation is included to emphasize the novelty of the proposed work. Innovation can be conceptual or technical in nature. Use of cutting-edge methods or new application of existing methods should also be described here. If the project is design oriented, previous or competing technologies should be clearly described along with clarification of how the proposed work will improve upon them. This section is typically 1-2 pages.

(4) Approach is the heart of the proposal (8-10 pages). The Approach section details the planned experiments that comprise each of the proposed research aims. There will be a subsection of the Approach dedicated to each of the Specific Aims. These will include at least 3 sections under each aim describing: (i) premise for the proposed research aim- this can include the student’s own preliminary data, data from the student’s research lab, and/or support from the literature to justify the aim; (ii) description of the experimental plan for the aim, including methodological details; (iii) rigor and reproducibility- provide details of statistical plan including a power analysis to support sample size for all experiments. See section below further explaining the use of and need for preliminary data.

(5) There is no strict requirement in terms of how much preliminary data is included, but it is expected that preliminary data supporting the feasibility of the project will be included. The captions of preliminary data figures should include sample size, statistical test used, and any other information critical to understanding the data set shown. Each caption should, at the end, include a statement of whether the data set was generated by the research advisor’s lab, fully by the candidate, or in part by the candidate. Preliminary data can be provided as a separate section of the document (prior to the Approach section). Alternatively, preliminary data can be mixed in with other sections of the proposal; for example, relevant preliminary data could be shown in the Innovation section or at the front of each research aim subsection within the Approach.

(6) Include a statement on IACUC or IRB protocol approvals needed for the work and the current status of those protocols.

(7) A proposed timeline for project completion and defense of the dissertation research should be included.

(8) References cited will be provided at the end of the document and do not factor into the page limit. Use conventional reference management software such as Endnote. Please consult with your research advisor first to learn about lab preferences for reference management; some reference software is not cross-compatible and can create problems when working with multiple authors on manuscripts, grant proposals, etc. Choose a reference style that includes the full author list, manuscript title, and journal information.

The oral portion of the qualifying exam should be scheduled for a 3-hour block with the committee. The student should bring all required paperwork to the meeting (i.e., qualifying exam outcome form and SACS form). In the oral qualifying examination, the student should be prepared to demonstrate competency with fundamentals in the interdisciplinary areas related to the research and demonstrate in-depth knowledge of subject matter directly related to the dissertation project

At the start of the exam, the student will be asked to leave the room for 5 minutes for a brief preliminary discussion among the committee. Upon invitation to rejoin the committee, the student's research advisor will introduce them and the presentation will commence. The presentation should include a background section that will serve to introduce the committee to the area of research and define the overall goal and significance of the project. The student will then outline the aims of the project, followed by a detailed description of the premise, experimental plan, and statistical considerations for each Specific Aim. As relevant, the student should show and provide their interpretation of the preliminary data generated for each aim. In some instances, the first aim of the project may be mostly completed or even published. The student should still review their data from those studies with the committee. The student should expect to be interrupted at times during the presentation whenever examination opportunities arise in the eyes of the committee. Example questions that may arise include asking the student to: describe the advantages and disadvantages of a model system being used in experimentation; provide a more in-depth explanation of a method that will be applied in the work; describe a signaling pathway or fundamental biological process that underlies their planned experimentation; relate new data to previously-published work; describe the planned statistical or analysis methods. These are examples of questions students can expect and should not be considered a comprehensive list.

COMMITTEE UPDATE MEETINGS

Students should meet with their Ph.D. committee no less than 1 time per year between the qualifying exam and the Ph.D. defense. Typically, the final committee meeting will be within 3-6 months of the defense. By this meeting, the student is expected to have completed the majority of work that will comprises the dissertation and should seek committee approval to schedule a defense date.

DISSERTATION AND DEFENSE GUIDELINES

Ph.D. candidates must write a dissertation showing the results of original research in biomedical engineering. Students must defend within 4 years of gaining Ph.D. candidacy. Please reference the Graduate School Academic Calendar to determine the deadline for final dissertation submission for graduation in a given semester. Because the committee may request dissertation edits prior to final approval, students are advised to schedule the defense to occur well in advance of the Graduate School's dissertation submission deadline. In general, May graduation requires defense in mid-March at the latest.

The written dissertation is presented to the faculty dissertation committee at least two weeks in advance of the public presentation. The dissertation formatting and submission guidelines can be found here. A BME dissertation at a minimum comprises the following core chapters: (**1**) an in-depth introduction, similar in nature to a review article, that summarizes the published work related to the topic of the student's research. (**2**) 2-3 or more "research" chapters; each chapter typically summarizes the results from one of the overall Specific Aims. Often, each research chapter comprises the content that has or will be used in publication of a journal article. (**3**) A summary chapter that summarizes the overall conclusions of the work and clearly describes the contributions to the broader research field. This chapter should also include a section that indicates gaps or limitations in the

work and identifies future steps for the project. (**4**) An appendix that includes research protocols and or supplementary/supporting information not included in the chapters. Including protocols that go beyond what is provided in the methods section of the chapters (or a typical journal publication) can be helpful as a reference for future researchers who may work on similar projects.

The presentation of the work is open to the public and is followed by a closed-door oral examination of the candidate by the faculty Ph.D. committee. Three hours should be scheduled for the defense presentation and examination. The defense presentation should be approximately 40 minutes in length, including a 5-minute introduction and 15 minutes for questions from the general audience. The public portion of the defense should last ~1 hour, after which all attendees will be cleared from the room and the student will be examined by the Ph.D. committee for 1-2 hours. The defense examination may include concepts both directly and indirectly related to the dissertation research. Outcomes for the defense can include: pass, fail, or pass with stipulations. For the latter, a student may be asked to make edits to the dissertation document prior to Ph.D. committee approval. The committee can also, at their discretion, require an additional in-person meeting before a final determination is made on the defense outcome.

DOCTORAL ACTIONS AND FORMS

The doctoral actions and forms required by the Vanderbilt Graduate School are maintained at this link. Commonly used Doctoral Actions and Graduate School forms, in addition to forms required by the BME department, are listed below. Please refer to the graduate school website above for doctoral actions and forms that apply to more specialized situations, as other less commonly-used forms are found there but not listed in this document. The forms listed in *italics* are department-specific forms, and those will not be found on the Graduate School website. For doctoral actions, follow the instructions in the workflow. For Departmental forms, please first send them to the Graduate Program Manager for review, help getting the signature of the Director of Graduate Studies, and for recording and filing with the BME office. Once these forms are submitted, a Kuali request need to be submitted for formal certification of your qualifying exam or dissertation.

- ❑ **Doctoral Workflow form** should be used to submit requests to:
  - **Appoint or Change Academic Advisor**
  - **Graduate Transfer Credit Request**
  - **Appoint or modify Ph.D. committee-** typically submitted early fall of 3rd year
  - **Grad Credit for Undergrad/Prof Course**
  - **Permission to Audit**
  - **Schedule or modify qualifying exam-** before end of spring semester 3rd year; submit at least two weeks before qualifying exam.
  - **Schedule or modify dissertation defense-** submit at least two weeks before the defense date. See Graduate School Academic Calendar to determine the deadline for final dissertation submission to be able to graduate in a given semester. Note that a defense typically needs to be held in early to mid-March to meet the timeline to graduate in May
  - **Extend deadline to enter candidacy or extend term of candidacy**
  - ☐ **Submit the results of the qualifying exam**
  - ☐ **Submit the results of the dissertation**

- ❑ ***Mentoring committee meeting*** *form; submitted with each mentoring meeting in first two years, typically four times total.*
  **Mentoring committee presentation should be prepared using the linked template.*

- ❑ ***Pre-qualifying exam meeting*** *form; submitted by end of fall semester 3rd year.*

- ❑ **Qualifying exam results**; before end of spring semester 3rd year; sent to Graduate Program Manager (with all signatures) immediately after completion of the qualifying exam.

- ❑ *Southern Association of Colleges and Schools **(SACS) qualifying exam** form. Program accreditation related form completed by committee at the end of the qualifying exam; signed form is returned by the committee to the student who submits to Graduate Program Manager .*

- ❑ **Intent to Graduate**; submit via YES portal early in graduating semester.

- ❑ **Defense results**; sent to Graduate Program Manager (with all signatures) asap after defense.

- ❑ **Other defense forms**: Take copy of **title page** and **abstract** to the defense to get the required committee signatures.

- ❑ ***Southern Association of Colleges and Schools Form**: This program accreditation-related form filled out by the committee at the end of the defense; signed form is returned to the student who submits it to the Graduate Program Manager.*

TRAVEL AND REIMBURSEMENT PROCESSES

If you are going to travel on university business, please read the Vanderbilt Travel Policy. This policy applies to you as a graduate student and explains the details for planning your trip, where to purchase an airplane ticket, etc. To summarize the travel process in a few steps please see below:

1) Acquire written preapproval for your trip from your research advisor, including the funding source(s).
2) **You can only book your trip through Concur. Concur is Vanderbilt's online booking tool.** Please note that Vanderbilt will not reimburse a flight purchase outside of the Concur online book tool.
3) For International flights - multileg we recommend that you call World Travel which is the VU travel agency. Phone Number: (877)271-9258
4) Are you considering applying for the travel award from the graduate school? https://gradschool.vanderbilt.edu/gli/gstravel/
5) After your travel, please submit a travel expense report in Oracle. Please follow this link for guidance on how to submit a travel expense report.