



# Department of Biomedical, Biological and Chemical Engineering

University of Missouri

## Student Handbook for Graduate Degrees in Biological Engineering



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## I. Overview

Bioengineering is a science-based engineering discipline that integrates engineering and biological sciences in one curriculum. Bioengineers apply scientific and engineering principles to design and develop products, systems, and/or processes to improve human and animal health, bio-resources utilization, and environment protection.

The Department of Biomedical, Biological and Chemical Engineering at University of Missouri confers both master's and doctoral degrees to students who satisfy the general requirements of the Office of Graduate Studies and the specific requirements of the department. Our bioengineering graduate programs have three emphasis areas: biomedical engineering, bioprocess engineering and bioenvironmental engineering.

- 1) **Biomedical Engineering** provides health care advances through:
  - Innovative disease detection and treatment;
  - Effective patient rehabilitation;
  - Optimized biomedical processes.
- 2) **Bioprocess Engineering** facilitates value-added products and food safety through:
  - Innovative technological use of renewable biological materials;
  - Enhanced packaging, quality and distribution of bioproducts.
- 3) **Bioenvironmental Engineering** provides advances in environmental protection through:
  - Innovative water and air quality systems;
  - Advanced conservation techniques.

A summary of the current application/admission requirements can be found in [Appendix-1](#). At the time of admission, each accepted bioengineering graduate student is assigned to an identified bioengineering faculty member. This faculty member will serve as your academic advisor and research mentor during your course of study. Please note that acceptance does not imply that the student will receive financial assistance. If financial assistance is provided, the acceptance letter will include that information.

### Useful Resources & Links

- ❖ The list of current bioengineering faculty and their research interests:  
<http://bioengineering.missouri.edu/faculty/>
- ❖ Download graduate study forms from the Office of Research and Graduate Studies:  
<https://gradstudies.missouri.edu/current-students/forms-cs/>
- ❖ Academic policy set by the Graduate Faculty of the University of Missouri:  
<https://gradstudies.missouri.edu/current-students/policies-cs/>
- ❖ Timelines & Deadlines for Graduation and Commencement:  
<https://gradstudies.missouri.edu/current-students/graduation-commencement/graduation-checklist/>

## II. Master's degree program

We offer the Master of Science degree in Biological Engineering with two options:

- Master of Science/Thesis Option (MST)
- Master of Science/Non-Thesis Option (MSNT).

The MST degree is research intensive. MST students will work closely with their advisors to develop a research project and explore relevant topics in depth. The research project is a collaborative effort between the student, the research advisor, and the thesis committee. A successful project involves research and scholarship that will significantly contribute to an increased understanding of a topic in bioengineering. The project must demonstrate the student's capacity for managing and interpreting research. MST students spend a significant amount of time working on their research projects such as reading literature, collecting & analyzing data, writing manuscripts and thesis. A research thesis is required and should conform to the Office of Graduate Studies' specification.

The MSNT degree is a coursework intensive degree program. It requires substantially more coursework than the MST degree. These courses allow MSNT students to explore a range of topics, develop new skill sets in the field of bioengineering. MSNT students have the flexibility to customize a plan of study to choose from a variety of courses according to their interests. MSNT students will also have the opportunity to develop some research skills by completing a substantial independent project. A research thesis is not required for the MSNT degree. However, MSNT students need to complete a written report describing their project.

A student may also choose to complete a [Master of Engineering \(ME\)](#) degree with a focus in Biological Engineering. The ME degree is offered by the College of Engineering and administered by the Department of Biomedical, Biological and Chemical Engineering. Please note that the transcript and the diploma of the ME degree will only indicate Master of Engineering with no designation of any specific department or focus area. The goal of the ME Program is to provide the student an opportunity to develop an area of expertise through advanced study. This ME may be done immediately after the undergraduate program to provide the student access to employment opportunities not available to students with only a BS degree. The ME program also works well for individuals who are mid-career and want to update their education and develop expertise in a new area, without pursuing a thesis research.

Students must specify one of the three Master's programs to apply for in the application for admission. Switching from the MST or the MSNT to the ME after starting the MST or the MSNT program is not allowed, although sometimes switching to the MST or MSNT from the ME may be approved.

## 1. Academic Process for Master's Students

The process of receiving a Master's Degree can be divided into several distinct steps as illustrated below. The remainder of the document will be broken down into the individual items that must be completed. Please note that we are assuming each year has 3 semesters: Fall, Spring, and Summer.

### **STEP 1: Plan of Study (M1 Form)** – Submit in your 2<sup>nd</sup> semester

After performing satisfactorily for a minimum of one semester, the student completes the [Plan of Study for the Master's Degree form \(M1\)](#) with the adviser's assistance. This form outlines the plan of study for the student's graduate program.

### **STEP 2: Thesis committee (M2 Form, required only for MST)** – Submit in your 2<sup>nd</sup> semester

This form is to be completed only by students in the program of M.S.-Thesis Option. A thesis committee is composed of three members of the MU faculty: a major adviser and a second reader both from the academic program, and an outside reader who is a member of the graduate faculty from a different MU graduate department. The student needs to complete the [Request for Thesis Committee \(M2\)](#) with the adviser's assistance.

### **STEP 3: The final graduate examination (M3 Form)** – Complete in your last semester

Each candidate must pass a final examination to demonstrate mastery of the fundamental principles of the work included in the course of study offered for the degree. The current [deadline](#) for submitting the Report of the Master's Examining Committee Form ([M3](#)) during the student's final semester is listed on the Office of Graduate Studies [website](#).

M.S.-Thesis option: a thesis must be presented in partial fulfillment of graduation requirements. After the successful defense of the thesis, the members of the student's committee must sign the [M3 form](#), which is then forwarded through the academic program's director of graduate studies to the Office of Graduate Studies.

M.S.-Non-thesis option and ME with a focus in Biological Engineering: the candidate is not required to present a thesis. A three-member final examination committee is designated by the academic program's director of graduate studies with the approval of the Office of Graduate Studies. The committee will decide on the format and manage the execution of the final examination. The committee must sign the [M3 form](#), which is then forwarded through the academic program's director of graduate studies to the Office of Graduate Studies.

## **Graduation & Commencement**

Please follow the required [procedures](#) from Office of Graduate Studies to [apply](#) for graduation and participate in the Commencement ceremony.

The student must conform to any of the requirements and regulations of the Office of Graduate Studies and the University of Missouri system. Check the Academic Process for Master's Students from the Office of Graduate Studies:

<https://gradstudies.missouri.edu/current-students/masters/>

## **2. Thesis or Examination Committee**

Students, in consultation with their research advisor, will select faculty members to serve as their Thesis Committee (MST) or Examination Committee (MSNT and ME) by the end of the second semester of their tenure as a graduate student. These committee members should have expertise in some aspect of the student's projected research. The chair of the Thesis or Examination Committee will be the student's primary academic or research advisor.

### ***2.1. Thesis or Examination Committee Composition***

The Committee is composed of a Committee Chair, and at least two additional Graduate Faculty Members. The composition of the committee must include:

- At least two graduate faculty members from the Bioengineering Program with one being the student's research advisor;
- At least one Graduate Faculty Member from the University of Missouri, but outside of the department.

If the student wishes to include additional University of Missouri Graduate Faculty in their committee, these members should have specialized expertise critical to the success of the student's projected research. Members from outside MU need approval from the Office of Graduate Studies to serve on a thesis committee.

### ***2.2. Committee Responsibilities***

The members of the committee will actively participate in the education of the student. This committee is responsible for:

- Evaluating the student's completion of proficiency requirements
- Confirming the Plan of Study
- Conducting the Annual Review
- Conducting the Final Examination
- Guiding the research activities if applicable
- Overseeing the writing of journal article(s) and thesis if applicable
- Maintaining high standards of scholarship and ethical behavior
- Administering corrective and disciplinary actions when necessary

The graduate student is responsible for:

- Developing a plan of study
- Scheduling all meetings (Annual Reviews, Exit Seminar, Final Examination)
- Meeting all requirements at the appropriate time

### 3. Plan of Study

While a basic goal of the Master's program is to provide students with highly specialized skills in a particular subdivision of bioengineering, the faculty believes that it is important that our students understand the breadth of the discipline as well. The students, with the advice of their advisor and committees, will prepare and submit a plan of study by the end of the second semester of their tenure as a graduate student. The plan of study includes a list of the courses that the students will use to fulfill the requirements for the Master's degree.

#### 3.1. Requirements for the Master's degree

Table 1 below shows a brief summary of the courses and other requirements for the bioengineering Master's degrees.

**Table 1. Course/other requirements for the Master's degree program.**

	MST	MSNT	ME
<b>Total*</b>	a minimum of 30-hr	a minimum of 36-hr	a minimum of 36-hr
<b>Required courses</b>	BE8087 Seminar (1) BE8402 Res. Meth. (2) BE8180 Num. Meth. (3) Statistics (3) 2 additional BE 8000+ level courses (6);	BE8180 Num. Meth. (3) Statistics (3) 3 additional BE 8000+ level courses (9);	BE8087 Seminar (1) BE8000 Life Sci. Innov. (3) BE8180 Num. Meth. (3) Statistics (3) 2 additional BE 8000 level courses (6);
<b>Electives</b>	7000/8000/9000 level courses from BE or other MU departments;	7000/8000/9000 level courses from BE or other MU departments;	Other 7000+ courses from BE or other departments; ≥21-hr must be Engineering
<b>Research hours</b>	≥ 6-hr BE8990; Total hours from Research (8990) and Problems (8085) cannot be more than 12-hr	Total hours from Research (8990) and Problems (8085) cannot be more than 3-hr	Total hours from Research (8990) and Problems (8085) cannot be more than 3-hr
<b>Other requirements</b>	a M.S. thesis and a scholarly manuscript	a project report; ≥ 15-hr 8000+ courses	N/A

\*The course hours *may* include 6 hours of graduate credit transferred from another university or from another campus of the MU system.

The University of Missouri requires that a minimum of 30 hours of course credit be completed to earn a Master's degree. The Bioengineering Program requires a minimum of 30 hours of course credit for the MST degree, and 36 hours of course credit for the MSNT and ME with a focus in Biological Engineering. The course hours *may* include 6 hours of graduate credit transferred from another university or from another campus of the MU system.

In general, the Office of Graduate Studies does not accept correspondence or extension course credit earned at any other campus.

### ***3.2. Proficiency Requirements***

In addition to the core bioengineering courses all Master's students are required to take, elective courses should be chosen to strengthen the student's ability to do research in their specific area or to fulfill proficiency areas. Graduate students in bioengineering are required to demonstrate proficiency in at least two of the proficiency areas listed in [Appendix-2](#), as part of their Plan of Study, before they are allowed to graduate. Therefore, when developing the Plan of Study, the student's first step is to select at least two proficiency areas.

To demonstrate proficiency, the student must do one of the following in each of the two or more proficiency areas:

- Successfully complete either an appropriate course at the University of Missouri, or an alternate course approved by the committee, in the proficiency area
- Demonstrate successful completion of an appropriate course listed in [Appendix-2](#) as an undergraduate student at the University of Missouri within the five years prior to starting the Bioengineering Master's Program

Note that problems courses, readings and research hours cannot be used to fulfill proficiency requirements.

### ***3.3. Completing the Plan of Study***

The student must successfully complete all the classes listed in their Plan of Study before being allowed to take the Final Examination.

The Master's degree must be completed within eight years after beginning. In unusual circumstances, it may be necessary to extend the time required to finish the degree. In these cases, the candidate requiring additional time must submit a request for extension prior to the expiration of the applicable period. On petition of the student, together with their major advisor, the Director of Graduate Studies may endorse an extension of time. A request for an extension of time must be submitted to the Office of Graduate Studies for approval. Students who take more than five years to complete the Master's may be required to retake some or all of their course work.

Successful academic progress on the plan of study includes an acceptable Grade Point Average (GPA). For graduate work, the Bioengineering Program faculty and the Office of Graduate Studies require all students to maintain at least a cumulative 3.0 GPA (on a 4 point scale). A student receiving a cumulative or semester GPA of less than 2.0 is subject to immediate dismissal from the Bioengineering Program and MU. Students falling below a 3.0 cumulative GPA in any semester will be put on academic probation for the following semester. If at the end of the first probationary semester the student's cumulative GPA is greater than or equal to 3.0, the probationary status is removed. If the cumulative GPA has not reached 3.0, the student is allowed one more probationary semester. Failure to achieve a cumulative 3.0 GPA in two successive probationary semesters will result in the immediate dismissal of the student from the graduate program.

### ***3.4. Satisfactory Progress***

It is important to note that a reasonable rate of progress towards the Master's degree is required. Every Master's student will be evaluated annually for satisfactory progress by their major advisor as [required by the Office of Graduate Studies](#). Satisfactory progress includes adherence to a suitable timeline for completing the Master's degree as described in this document, and adequate academic performance. The student's academic advisor will inform the Director of Graduate Studies as to the outcome of the evaluation on or before the fall semester of each year.

Unsatisfactory academic performance may result in a student being placed on departmental probation and dismissed from the program. Students can consult the Director of Graduate Studies and the Office of Graduate Studies regarding the policies on probation, termination, and appeals (<https://gradstudies.missouri.edu/policy/probation-termination-and-appeals/>).

### ***3.5. Document Submission***

Once the Plan of Study has been developed, the student should submit the Program of Study for the Master's Degree form ([M1](#)) to the Bioengineering Graduate Coordinator. The Coordinator will submit the completed form to the Director of Graduate Studies and the Office of Graduate Studies.

### ***3.6. Change of the Plan of Study***

In some unusual circumstances, it may become necessary to change a Plan of Study after it has been developed by the student and their committee. Any substitutions, deletions or modifications of a student's Plan of Study must be approved by the thesis committee. The student should submit the [Plan of Study Course Substitution Form](#) to the graduate coordinator as soon as possible to assure that the proper paperwork is filed with the Office of Graduate Studies.

## **4. Research Project (for MST and MSNT only)**

All MST students are required to develop and execute a research project. MSNT students are required to complete an independent research project.

Most MST students start to work on their research projects shortly after beginning their graduate study. All students are expected to maintain the highest standards of ethical behavior while engaged in research at MU. Plagiarism or falsification of data will result in a student being immediately dismissed from the program and MU.

The requirements for successful completion of the research portion of the Master's program vary by degree types. The MST degree requires both the preparation of a scholarly manuscript and a thesis; whereas the MSNT degree requires preparation of a research report.

### ***4.1. Preparation of the Journal Article (for MST only)***

The research project must culminate in a scholarly manuscript for the MST students, prepared in a style suitable for publication in an appropriate peer-reviewed journal. The manuscript must be reviewed and approved by the student's committee.

The journal style of the manuscript is left up to the discretion of the research advisor and the student. After the research advisor approves the student's manuscript, the document should be submitted to all members of the committee for their approval, at least two weeks prior to the Final Examination. After successfully completing the final examination, the student will make any needed adjustments in format and corrections/clarification based on input from the thesis committee.

### ***4.2. Preparation of the Thesis (for MST only)***

The Master's thesis project is the distinctive element of the MST degree program. Documentation of the project work is an extended report on a technically substantive research project that involves basic bioengineering science and, possibly, one of its many application areas. Interdisciplinary topics for thesis project reports are encouraged. Specific regulations regarding completing and filing the dissertation are outlined in "Guidelines for Preparing Theses and Dissertations." Every graduate student in the MST program should obtain this document, which is available at:

<http://gradstudies.missouri.edu/academics/thesis-dissertation/diss-thesis-guideline/>

Thesis projects must be defended at the Final Examination. The Master's thesis must be the student's own work and must demonstrate a capacity for research and independent thought. It is not required that the Master's thesis involve the discovery or creation of new knowledge, as is the case for the PhD dissertation. A Master's thesis must show the student's ability to carry through to completion a project of a credible level of difficulty that draws on the knowledge and experience gained through advanced graduate course work.

## 5. Final Examination

The Final Examination will consist of an Exit Seminar that discusses the student's graduate study including the research project if applicable, as well as a closed-door examination of the student by members of their committee. The student should be prepared to defend their research project and discuss any related topics. For the research project to be considered successfully defended, the student's Thesis/examination committee must vote to pass the student with no more than one dissenting or abstaining vote.

The Exit Seminar must take place when MU is officially in session. The student must be enrolled at MU at the time of the examination. The Exit Seminar will be open to the general university audience, and will be attended by members of the student's Thesis Committee. Please notify the graduate coordinator, at least two weeks prior to the scheduled date, the title of your thesis, your degree and your advisor, the time and location of the seminar, so that this event can be announced to the public.

A report of the examination, carrying the signatures of members of the committee, must be sent to the Office of Graduate Studies before the deadline preceding the anticipated date of graduation.

If the student has successfully passed their Final Examination, a copy of the following must be submitted to the Graduate Coordinator:

- The MS thesis, if they are seeking an MST degree
- The Report of the Master's Examining Committee (form [M3](#)).

The Coordinator will submit the completed M3 form to the Director of Graduate Studies for approval and then to the Office of Graduate Studies. The M3 form is available to download from the [Office of Graduate Studies](#).

### III. PhD in Biological Engineering

The process of receiving a Ph.D. in biological engineering from the University of Missouri can be divided into several distinct steps. This section will serve as a guide through these steps as they are applied by the bioengineering faculty. Please note that we are assuming each year has 3 semesters: Fall, Spring, and Summer.

#### 1. Academic Process for Doctoral Students

Below is an overview of the key steps and corresponding deadlines (highlighted) leading toward a Ph.D. degree in biological engineering. All the deadlines are measured from the first day of classes in the first semester in which a student begins her/his Ph.D. program of study.

- STEP 1:** Doctoral Program Committee ([D1 Form](#)) – no later than 18-month from your start  
The doctoral program committee is composed of a minimum of four members of MU Graduate Faculty: at least three members from the student's home academic program and one outside member from a different academic program at MU.
- STEP 2:** Qualifying Examination ([D1 Form](#)) – no later than 18-month from your start  
To be officially admitted to a PhD program, the student must pass a qualifying examination or process. The department may limit the number of times this examination may be attempted. D1 form has to be submitted before the D2 form.
- STEP 3:** Plan of Study ([D2 Form](#)) – no later than 18-month from your start  
The study plan must include a minimum of 72 hours of graduate credits from courses taken at MU, transfer credit and research hours. Use [this template](#) to list all courses.
- STEP 4:** Comprehensive Examination ([D3 Form](#)) – within 5-year from your start  
The comprehensive examination consists of written and oral sections. The two sections of the examination must be completed within one month.
- STEP 5:** Doctoral Dissertation  
The dissertation must be on a subject approved by your doctoral committee, embody the results of original and significant investigation, and be your own work.
- STEP 6:** Defend Dissertation ([D4 Form](#)) – within 5-year and no less than 7-month after comprehensive examination. The current deadline for submitting the D4 Form can be found on the Office of Graduate Studies [website](#).

#### Graduation and Commencement

Please follow the required [procedures](#) from Office of Graduate Studies to [apply](#) for graduation and participate in the Commencement ceremony.

The student must conform to all the requirements and regulations of the Office of Graduate Studies and the University of Missouri system. Check the information from the Office of Graduate Studies: <https://gradstudies.missouri.edu/current-students/doctoral/>

## 2. Doctoral Committee

Students, in consultation with their research advisor, will select faculty members to serve as their doctoral committee by the 18-month of their tenure as a Ph.D. student. The committee members shall have specialized expertise critical to the success of the student's dissertation studies. The chair of the doctoral committee will be the student's primary research advisor.

### 2.1. Committee Composition

The Committee is composed of a Committee Chair, and at least three additional Graduate Faculty members. The composition of the committee must include:

- At least three graduate faculty members from the student's academic program, where
  - one must be the student's primary research advisor
  - at least two (including the research advisor) must be a member of MU doctoral faculty
- At least one Graduate Faculty Member from the University of Missouri, but outside of the student's academic program. Members from outside of University of Missouri can be added if approved by the Office of Graduate Studies.

To change the doctoral committee after submitting the Doctoral Program Committee Form ([D1](#)), the [Change of Committee Form](#) must be submitted and approved by the Office of Graduate Studies.

### 2.2. Committee Responsibilities

The members of the doctoral committee will actively participate in the education of the student. All members of the doctoral committee are expected to:

- interact with students in a professional and civil manner in accordance with the accepted standards of the discipline and the University of Missouri's policies
- provide guidance in students' research, study, and professional development
- evaluate the student's plan of study and completion of proficiency requirements
- provide evaluation and feedback on students' academic performance (more in Section 7)
- conduct relevant graduate examinations (qualifying examination, comprehensive examination, dissertation defense)
- oversee the writing and defense of the Ph.D. dissertation
- maintain high standards of scholarship and ethical behavior
- administer corrective and disciplinary actions when necessary

Graduate students are expected to:

- exercise the highest integrity and conform to all relevant regulations and policies in their research and studies
- conduct themselves in a mature, professional, ethical, and civil manner in all activities at University of Missouri
- develop a rigorous plan of study to become professionally competitive
- schedule all examinations/meetings (annual review, qualifying examination, comprehensive examination, dissertation defense)

### 3. Plan of Study

While a basic goal of the Ph.D. program is to provide students with highly specialized skills in a particular subdivision of Bioengineering, the faculty believes that it is important that our students understand the breadth of the discipline as well. The student, with the advice of their committee, will prepare and submit a plan of study by the end of the second semester of their tenure as a graduate student. The plan of study includes a list of the formal courses, readings, problems, research hours and seminars that the students will use to fulfill the requirements for the doctoral degree.

#### 3.1. Course Requirements

The University of Missouri requires that a minimum of 72 hours of course credit be completed to earn a Ph.D. Please see Table 2 below for a summary of the course requirements.

**Table 2. Course/other requirements for the Doctoral degree program.**

Category	Requirements
<b>Total hours</b>	A minimum of 72-hr in total beyond the bachelor's degree.
<b>Total courses</b>	A minimum of 44-hr (excluding research, problems or independent study)
Transfer*	Up to 30-hr of post-baccalaureate graduate credit from a regionally accredited university.
Required Courses**	BE-8087 Seminar (1-hr) BE-8402 Research Methods (2-hr) BE-8180 Numerical Methods (3-hr) A graduate level Statistics course (3-hr) A minimum of 2 more BE 8000+ level courses (6-hr)
Electives	Other 7000/8000/9000 level courses from BE or other MU departments
<b>Research hours</b>	≤28-hr of BE-9990 are allowed to count towards the 72-hr minimum
<b>Other requirements</b>	Ph.D. dissertation A minimum of two scholarly manuscripts (see Sec. 6.1)

\* Only courses that have been completed within 8-year prior to filing the study plan can be transferred.

\*\* The Office of Graduate Studies requires a minimum of 15 credit hours of MU coursework at the 8000/9000 level (exclusive of research, problems and independent study experiences).

#### 3.2. Proficiency Requirements

Elective courses should be chosen to strengthen the student's ability to do research in their specific area or to fulfill proficiency areas. In addition to the core required bioengineering courses, the student is required to demonstrate proficiency in at least two of the seven proficiency areas listed in [Appendix-2](#) as part of their Plan of Study, before they are allowed to graduate. Therefore, when developing the Plan of Study, the student's first step is to select at least two proficiency areas.

To demonstrate proficiency, the student must do one of the following in each of the two or more proficiency areas:

- Successfully complete either an appropriate course at the University of Missouri, or an alternate course approved by the committee, in the proficiency area

- Demonstrate successful completion of an appropriate course listed in [Appendix-2](#) as an undergraduate student at the University of Missouri within the five years prior to starting the Ph.D. Program
- Pass the proficiency exam in the area. Proficiency exams will be offered by the instructors in each area when requested by the Ph.D. student and her / his advisor. These exams may be similar to the “final” examinations in each of the classes. Students failing the proficiency exam will have to take an appropriate course to show proficiency in the area prior to undertaking the comprehensive examination.

The problems courses, readings and research hours cannot be used to fulfill proficiency requirements.

### ***3.3. Completing the Plan of Study***

The student must successfully complete all the classes, except the research, problems, or readings courses, listed in their Plan of Study before being allowed to take the comprehensive examination. Successful academic progress on the plan of study includes an acceptable grade point average (GPA) of at least 3.0 (on a 4-point scale) each semester.

### ***3.5. Document Submission***

Once the Plan of Study has been developed, the student should submit the Program of Study for the Doctoral Degree form ([D2](#)) to the Graduate Coordinator. The Coordinator will submit the completed form to the Director of Graduate Studies and the Office of Graduate Studies.

### ***3.6. Change of the Plan of Study***

In some unusual circumstances, it may become necessary to change a Plan of Study after it has been developed by the student and their committee. Any substitutions, deletions or modifications of a student's Plan of Study must be approved by the committee. The student should submit the [Plan of Study Course Substitution Form](#) to the graduate coordinator as soon as possible to assure that the proper paperwork is filed with the Office of Graduate Studies.

## **4. Qualifying Examination**

The qualifying examination is designed to test the academic and communication abilities of the student. Ph.D. students in the bioengineering program are expected to have a general knowledge of bioengineering. In addition, students are expected to show the ability to think clearly and critically, and to communicate adequately in both written and spoken English.

The doctoral student should work with the committee chair to schedule the qualifying exam. The student must take the Qualifying Examination no later than 18-month from their starting date as a Ph.D. student. The exam should be administered only when University of Missouri is officially in session (fall, spring or summer semesters), and the student must be enrolled to take this examination.

### ***4.1. Qualifying Examination Format***

Expect the Qualifying Examination to be comprehensive and challenging. Using the format that the bioengineering faculty deem appropriate, this exam will help the committee to determine whether the student is qualified to pursue the Ph.D. degree.

The doctoral committee chair shall work with the other committee members to decide on the specific format of the qualifying examination. The exam usually will have both a written part and an oral part. For examples, the written part of the examination may consist of written exams prepared by individual committee members, or/and an essay on an assigned topic, or/and a literature review on a chosen topic, or/and a brief research proposal for the doctoral research.

After completion of the written part of the examination, the student, in consultation with their research advisor and committee, will schedule the oral part of the examination. The oral exam provides an opportunity for the committee to evaluate whether the student can think critically and express themselves well in English. It also provides an opportunity for the student to respond to any questions raised by the committee regarding the written part of the qualifying examination. The student shall be prepared to defend their opinions/answers in the written portion of the exam. In addition, the doctoral committee often take the opportunity to evaluate the student' performance in courses taken so far and discuss the proposed plan of study.

A student who fails the qualifying examination may take a second exam before the end of the following semester. Failure to pass the second examination will result in dismissal from the bioengineering Ph.D. program.

### ***4.2. Document Submission***

If the student has passed the Qualifying Examination, the student should submit a completed "Qualifying Examination Results and Doctoral Committee Approval form" ([form D1](#)) to the graduate coordinator. The coordinator will submit the completed form to the Director of Graduate Studies for approval and then submit the form to the Office of Graduate Studies. If your committee decides to use a non-exam format for your qualifying exam, they are required to explain it on the D1 form.

## **5. Comprehensive Examination**

In the comprehensive examination, a Ph.D. student is expected to demonstrate their in-depth knowledge on their research topic, and the skills necessary to complete their dissertation research. Using the format faculty deem appropriate, this exam will determine whether the student can become a Ph.D. Candidate. A doctoral student is allowed two attempts to complete successfully the comprehensive examination.

The doctoral student should work with the committee chair to schedule the comprehensive exam. The comprehensive examination must be completed within 5-year from the student's starting date as a Ph.D. student, and it must be completed at least 7-month before the final defense of the dissertation.

The exam should be administered only when University of Missouri is officially in session (fall, spring or summer semesters), and the student must be enrolled to take this examination.

### ***5.1. Comprehensive Examination Format***

Students must have carried out the initial work of their projected research, and demonstrate that they will be able to complete all the remaining requirements for the doctoral degree.

The comprehensive examination shall in general include both a written and an oral section. These two sections must be completed within one month. The doctoral committee chair shall work with other committee members to decide on the specific format of the examination. For examples, the student may be asked to prepare:

- A comprehensive review of their research project and progress to date in a standard format in their research field. Students should approach this in the same way as they would approach writing a paper for submission, except with more detail on their plans, research experiments and results. This review should include all pertinent data the student has already obtained, as well as a clear discussion of their results. This type of preliminary data is essential if the student wishes to demonstrate their work ethic and sincerity.
- A research proposal in a standard format similar to those required by the NIH, NSF, USDA, or other funding agencies, which should propose a project that is not already being undertaken in their research group.
- An oral presentation on their research project to date and the proposed research. The student should be prepared to defend his / her work to date as well as the research proposal during this oral section of the comprehensive examination.

The student will be responsible for scheduling the exam and arranging a meeting place for the event. The student will submit a copy of the comprehensive exam materials to each member of the Doctoral Program Committee at least two weeks prior to the date of the exam.

At the end of the comprehensive examination, the doctoral committee will determine if the student has performed adequately to become a Ph.D. Candidate in the bioengineering graduate program. For the comprehensive examination to be successfully completed, the doctoral committee must vote to pass the student on the entire examination, both written and oral sections, with no more

than one dissenting or abstaining vote. Two or more dissenting or abstaining votes will result in a determination that the student has failed the comprehensive examination. If any part of the comprehensive examination materials is unacceptable to the committee, the student will be informed of the deficiencies within two weeks after the comprehensive examination date.

Failure on either the written or the oral section of the exam constitutes failure of the entire comprehensive examination. If a failure is reported, the committee must also include in the report an outline of the general weaknesses or deficiencies observed in the student's work. The student and committee members are encouraged to work together to identify steps the student might take to become fully prepared for the next examination. If, at any time, the student believes that the advice given by the committee is inadequate, the student may send a written request for clarification to the committee. A copy of this request should be sent to the Office of Graduate Studies as well. The committee must respond to this request in writing within two weeks and have a copy of the response filed with the Office of Graduate Studies.

A student who fails the comprehensive examination may take a second exam, no sooner than twelve weeks after the first exam. Failure to pass the second comprehensive examination will automatically prevent a student from becoming a Ph.D. candidate. This will result in dismissal from the bioengineering Ph.D. program.

## ***5.2. Document Submission***

Once the comprehensive examination process is completed, the student or the major advisor should prepare the form “[Doctoral Comprehensive Examination Results](#)” (D3). The D3 form should be submitted to the Graduate Coordinator, even if the student fails the comprehensive exam. The Coordinator will submit the completed form to the Director of Graduate Studies in the department and the Office of Graduate Studies. The signed D3 form must be sent to the Office of Graduate Studies and the student no later than two weeks after the comprehensive exam is completed.

## **6. Research Dissertation**

All Ph.D. students are required to develop and execute a research project. Most students will begin their research project shortly after beginning their Program of Study. The research project is a collaborative effort between the student, the major advisor and the Doctoral Program Committee. A successful project will involve original research and scholarship that will significantly contribute to an increased understanding of Bioengineering. The project must be a reflection of the student's own work and must demonstrate a capacity for research and independent thought. Students are expected to maintain the highest standards of ethical behavior while engaged in research at MU. Plagiarism or falsification of data will result in a student being immediately dismissed from the program and MU.

### ***6.1. Manuscripts***

The dissertation research project shall result in at least two primary research manuscripts (not including review articles), judged acceptable by their research advisor and at least one additional member of the student's doctoral committee. These manuscripts can be part of the dissertation and shall be submitted to refereed journals, prior to submitting "Report of the Dissertation Defense" form (Form D-4) to the Graduate Coordinator.

### ***6.2. Written Dissertation***

A dissertation based on the original research completed by the students constitutes the written part of the final dissertation defense. Specific regulations regarding completing and filing the dissertation are outlined in "Guidelines for Preparing Theses and Dissertations." Every Ph.D. candidate should obtain this document, which is available at:

<http://gradstudies.missouri.edu/academics/thesis-dissertation/diss-thesis-guideline/>

The specific style of the dissertation is up to the discretion of the research advisor and the committee, as long as the minimum requirements of the Office of Graduate Studies are met. The dissertation must be submitted to all committee members for review at least two weeks prior to the dissertation defense.

### ***6.3. Oral Dissertation Defense***

After the dissertation has been completed and submitted to the doctoral committee, a dissertation defense will be conducted by the doctoral committee. The candidate should be prepared to defend the dissertation and discuss any related areas. The dissertation defense must take place when MU is officially in session and the candidate must be enrolled at MU for that term.

The dissertation defense shall be announced to the public and must be attended by all members of the doctoral committee. The doctoral candidate must inform the graduate coordinator the time and location of the defense meeting and the title of the dissertation at least two weeks before the defense.

The dissertation defense will consist of two sessions: an open session, which may be attended by the general public, and a closed session attended by your committee. For the open session, the

student will prepare and present a ~50 minute seminar on their research project to the general university audience. For the closed session, the student will defend their work to the members of the MU Graduate Faculty in attendance. Moreover, the student will have the opportunity to address any issues raised by the committee regarding the submitted written dissertation.

#### ***6.4. Document Submission***

For the dissertation to be considered successfully defended, the student's doctoral committee must vote to pass the student at the end of the defense with no more than one dissenting or abstaining vote. A report of the oral examination, the [Report of the Dissertation Defense \(D4 form\)](#) carrying the signatures of all members of the committee, demonstrates the passing of the oral part of the final dissertation defense. The student should submit the signed D4 form to the graduate coordinator as soon as possible so that it can be approved by the departmental Director of Graduate Studies and submitted to the Office of Graduate Studies.

The doctoral committee may request additional changes to the written dissertation after oral defense. In that case, the student can have up to one more semester to make changes so that the dissertation can be approved by the committee. The signing of the signature page of the dissertation by all doctoral committee members represents the passing of the written part of the final dissertation defense. A final copy of the approved dissertation must be submitted to the Office of Graduate Studies in an electronic format with supplemental paper documents. Check details in the [“Guidelines for Preparing Theses and Dissertations”](#) from the Office of Graduate Studies.

## 7. Satisfactory Progress

Every Ph.D. student will be evaluated annually for satisfactory progress by his or her research advisor as required by the Office of Graduate Studies. Satisfactory progress includes adherence to a suitable timeline for completing the doctoral degree as described in this document, and adequate academic performance in course work and research. It is the student's responsibility to schedule this meeting before the fall semester each year. The student's academic advisor will inform the Director of Graduate Studies as to the outcome of the evaluation on or before each fall semester.

### 7.1. Academic Performance

A graduate student should maintain a minimum cumulative GPA of 3.0 (on a 4 point scale) each semester in all graduate courses taken at MU.

Students falling below a 3.0 cumulative GPA in any semester will be put on academic probation by the Office of Graduate Studies for the following semester. If at the end of the first probationary semester the student's cumulative GPA is greater than or equal to 3.0, the probationary status is removed. If the cumulative GPA has not reached 3.0, the student is allowed one more probationary semester. Failure to achieve a cumulative 3.0 GPA in two successive probationary semesters will result in the immediate dismissal of the student from the graduate program.

A student receiving a cumulative or semester/term GPA of less than 2.0 is subject to immediate dismissal from the graduate program.

Unsatisfactory performance in academic research may also result in a student being placed on departmental probation. If the student does not comply with the conditions of probation, the student will be dismissed from the graduate program.

### 7.2. PhD Timelines

It is important to note that a reasonable rate of progress towards the doctoral degree is required as described below:

- Qualifying (D1) & Plan of Study (D2): 18-month from the start
- Comprehensive (D3): 5-year from the start & no less than 7-month before final defense
- Final defense (D4): 5-year from the comprehensive exam

In unusual circumstances, it may be necessary to extend the time required to finish the degree. In these cases, the student should follow the steps below to request an extension **before the aforementioned timelines expire:**

- (1) Submit a petition letter to the primary research advisor/committee chair prior to the expiration of the applicable period. In the letter, please explain the reason for the extension and provide a detailed plan to catch up with the timeline.
- (2) The primary advisor will review the student's request and make recommendations to the Director of Graduate Studies.
- (3) If both the primary advisor and Director of Graduate Studies support the student's extension petition, the Director of Graduate Studies will submit the extension request

(including the student's petition letter and her/his advisor's support letter) to the Office of Graduate Studies for approval.

If the extension request is approved by the Office of Graduate Studies, it is the student's responsibility to follow through the submitted plan. Additional extensions are rarely granted by the Office of Graduate Studies and the student will be dismissed from the graduate program. Please note that students who take more than five years to complete the Ph.D. after passing the Comprehensive Examination may be required by the department and/or the Office of Graduate Studies to retake some or all of their course work.

If a student has missed the above timeline and has not submitted a petition for extension, the student will be placed on departmental probation. The student should prepare a detailed plan to complete the missing examination, discuss with the research adviser and the Director of Graduate Studies, and submit an extension petition immediately. Failure to complete these steps within 30 days will result in the immediate dismissal of the student from the graduate program. The probation status will be removed when the student completes the missing examination as described in the extension petition. Failure to achieve the compliance in the semester following the probation can result in the dismissal of the student from the graduate program.

### ***7.3. Academic Integrity & Honesty***

Graduate students are expected to exercise the highest integrity and conform to all relevant regulations and policies in their research and studies. The Office of Graduate Studies at MU is fully committed to the principles of Responsible Conduct of Research. All acts of academic dishonesty and research misconduct such as cheating, fabrication, falsification, plagiarism, etc. will be reported to the academic program chair and the provost's office. Because of the importance of honesty to academic and professional life, acts of dishonesty by graduate students may result in suspension or dismissal from the university.

Please refer to [§ 200.010 of the University of Missouri System Collected Rules and Regulations](#) for expectations of student conduct.

### ***7.4. Appeal Process***

Students have the right to appeal dismissal by submitting an appeal letter to the Director of Graduate Studies with supporting materials. A copy of the appeal letter should also be sent to the Associate Vice Chancellor for Graduate Studies. The appeal will be discussed by the department faculty and the student will be notified of the final departmental decision.

To appeal the final dismissal decision from the department, the student can appeal to the Graduate Faculty Senate by following the guidelines on the website of the Office of Graduate Studies: <https://gradstudies.missouri.edu/policy/probation-termination-and-appeals/>

## Appendix 1. Bioengineering Graduate Admission

### □ Application Deadlines:

Fall Semester

June 1\*

Spring Semester

October 31

Summer Semester

April 1

\*Please note that the “priority deadline” for admission with funding support is **Jan 1<sup>st</sup>**.

### □ Basic Admission Criteria:

- ✓ Minimum GPA: 3.0 in the last 60 hours
- ✓ BS from an accredited university

### □ Minimum English Proficiency Requirements (for International Applicants)

Test Type	Total Score	Reading	Listening	Speaking	Writing
TOEFL Internet -based	80	17	17	17	17
TOEFL Paper-based	550	52	52	N/A	52
IELTS Academic	6.5	6	6	6	6

### □ Required Application Materials

- ✓ Completed Graduate Studies online application: <https://applygrad.missouri.edu/apply/>
  - ✓ Transcripts
  - ✓ English Proficiency Exams (International applicants only)
  - ✓ Statement of Purpose
  - ✓ Resume or CV
  - ✓ GRE scores
  - ✓ Three Recommendation Letters
- ✓ Application fees (\$65 for domestic students, \$90 for international students).

All applications will be reviewed, however, only students meeting the above standards are normally admitted to the Bioengineering graduate program. In exceptional cases (such as strong evidence of prior research experience, teaching experience, or field-related work experience), these eligibility standards may be relaxed at the discretion of the faculty. Financial support is not guaranteed and is offered on a case-by-case basis. Please contact the Director of the Graduate Program directly for more information about whether the eligibility standards might be relaxed.

#### **Please check the current information from the Office of Graduate Studies website**

- ❖ The detailed application requirements for our graduate programs are listed [here](http://gradstudies.missouri.edu/academics/programs/biological-engineering/):
- ❖ A detailed description of the online application process can be found [here](http://gradstudies.missouri.edu/admissions/eligibility-process/degree-certificate-seeking-applicants/):

## Appendix 2. Courses Covering the Proficiency Areas

- **Biomaterials**

- BIOL\_EN 3170 – Biomaterials
- BIOL\_EN 4170/7170 – Biomaterials Interfaces of Implantable Devices
- BIOL\_EN 4370/7370 – Orthopaedic Biomechanics
- BIOL\_EN 8370 – Materials Characterization Techniques
- BIOL\_EN 8670 – Orthopaedic Failure Modes and Defect Analysis
- BIOL\_EN 8870 – Molecular and Cell Mechanics

- **Bioprocess Engineering**

- BIOL\_EN 3180 – Heat and Mass Transfer in Biological Systems
- BIOL\_EN 4315/7315 – Introduction to Bioprocess Engineering
- BIOL\_EN 4316/7316 – Biomass Refining Operations
- BIOL\_EN 4160/7160 – Food Process Engineering
- BIOL\_EN 8280 – Advanced Biological Transport Processes
- BIOL\_EN 7001 – Biomanufacturing Technologies
- BIOL\_EN 8001 – Advanced Bioprocessing & Biocatalyst

- **Bioenvironmental Engineering**

- BIOL\_EN 4150/7150 – Soil and Water Conservation Engineering
- BIOL\_EN 4250/7250 – Irrigation and Drainage Engineering
- BIOL\_EN 4350/7350 – Watershed Modeling Using GIS
- BIOL\_EN 8250 – Water Management Theory
- BIOL\_EN 7001 – Environmental Hydrology

- **Bioelectronics and Instrumentation**

- BIOL\_EN 4070/7070 – Bioelectricity
- BIOL\_EN 4380/7380 – Applied Electronic Instrumentation
- BIOL\_EN 4580/7580 – Mechanical Systems Engineering
- BIOL\_EN 8380 – Modeling and Identification of Engineering Systems

- **Biophotonics**

- BIOL\_EN 4420/7420 – Introduction to Biomedical Imaging
- BIOL\_EN 4570/7570 – Fluorescent Imaging
- BIOL\_EN 4770/7770 – Biomedical Optics
- BIOL\_EN 8270 – Principles and Applications of Fluorescence
- BIOL\_EN 8570 – Microscopic Imaging
- BIOL\_EN 8770 – Photon Migration & Optical Imaging in Turbid Media
- BIOL\_EN 8001 – Magnetic Resonance Imaging

- **BioMEMS and Biosensing**

- BIOL\_EN 4470/7470 – Biomolecular Engineering and Nanobiotechnology
- BIOL\_EN 4670/7670 – Photonics and Nanotechnologies in Optical Biosensors
- BIOL\_EN 8170 – Sensors and Biosensors

BIOL\_EN 8470 – Ultrasensitive Bio-detection  
ECE 4620/7620 – Introduction to BioMEMS  
ECE 4880/7880 – Micro/Nano Systems  
ECE 8620 – Advanced Microelectromechanical Systems