



Department of Bioengineering  
University of Missouri

**Bioengineering  
Graduate Student Handbook**



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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 Bioengineering at the University of Missouri confers both master's and doctoral degrees to students who satisfy the general requirements of the Office of Research and 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](#). All bioengineering graduate students are admitted directly to an identified bioengineering faculty advisor, rather than to the department as a whole. This advisor will be your faculty mentor, academic advisor, and research mentor throughout 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:  
<http://gradstudies.missouri.edu/forms-downloads/>
- ❖ Academic policy set by the Graduate Faculty of the University of Missouri:  
<http://gradstudies.missouri.edu/policies/>
- ❖ Timelines & Deadlines for Graduation and Commencement:  
<http://gradstudies.missouri.edu/academics/graduation-commencement/timeline-deadlines/doctoral-timeline.php>

## II. Master's degree program

The Department of Bioengineering offers Master of Science degree – Thesis Option (MST) and Master of Science degree - Non-thesis Option (MSNT). Both MS degree options (MST and MSNT) require a research component. All MST and MSNT students are required to develop and execute a research project. However, the MST degree requires a research thesis that conforms to the Office of Graduate Studies' specification; whereas the MSNT requires additional course work and a research report instead of a thesis. The MS research project is a collaborative effort between the student, the research advisor and the thesis committee. A successful project will involve research and scholarship that will significantly contribute to an increased understanding of Bioengineering. The project must demonstrate the student's capacity for managing and interpreting research. All candidates for the MS degrees (thesis or non-thesis) must complete either a thesis or a substantial independent project that cannot be coauthored.

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 Bioengineering. 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 the BS graduates. 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. For such students, many of the courses may be available through the UM system and through distance learning.

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 in Bioengineering from the University of Missouri can be divided into several distinct steps. The student must also conform to any of the requirements and regulations of the University of Missouri Graduate School and the University of Missouri system. 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:** Submit Plan of Study ([M1 Form](#)) – **Second 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:** Form a thesis committee ([M2 Form](#), required only for MST) – **Second Semester**

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

### **STEP 3:** Pass the final examination ([M3 Form](#)) – **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 M3 Form can be found on the Office of Graduate Studies [website](#).

#### *MS Thesis option*

Where a thesis is presented in partial fulfillment of graduation requirements, students must form a thesis committee (see STEP 2 above). After the successful defense of the thesis, the members of the student's committee must sign the [Report of the Master's Examining Committee form \(M3\)](#), which is then forwarded through the academic program's director of graduate studies to the Office of Graduate Studies.

#### *MS Non-thesis option and ME with a focus in Biological Engineering*

Where no thesis is presented by the candidate, 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 [Report of the Master's Examining Committee form \(M3\)](#) signed by the director of graduate studies, is forwarded to the Office of Graduate Studies.

## **GRADUATION AND COMMENCEMENT**

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

## **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,
  - At least two must be a Graduate Faculty Member
  - One must be the student's research advisor
- At least one Graduate Faculty Member from the University of Missouri, but outside of the Bioengineering Program.

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. Additional members can only be added via special permission from the Graduate Dean.

### ***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 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 lists 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.**

	<b>MST</b>	<b>MSNT</b>	<b>ME</b>
<b>Total</b>	≥30-hr	≥36-hr	≥36-hr
<b>Required courses</b>	BE8087 Seminar (1) BE8402 Res. Meth. (2) BE8180 Num. Meth. (3) Statistics (3) 2 more BE 8000 level courses;	BE8087 Seminar (1) BE8402 Res. Meth. (2) BE8180 Num. Meth. (3) Statistics (3) 3 more BE 8000 level courses;	BE8087 Seminar (1) BE8000 Life Sci. Innov. (3) BE8180 Num. Meth. (3) Statistics (3) 2 more BE 8000 level courses;
<b>Electives</b>	7000+ courses from BE or other departments;	7000+ courses from BE or other departments;	7000+ courses from BE or other departments; ≥21-hr must be Engineering
<b>Research hours</b>	≥ 6-hr BE8990; ≤ 12-hr of Problems, Readings & Research	≤ 3-hr of Problems, Readings & Research Hours	≤ 3-hr of Problems, Readings & Research Hours
<b>Other requirements</b>	a M.S. thesis a scholarly manuscript	a research report	N/A

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. However, a student may take up to eight hours of correspondence courses that are authorized for graduate credit and offered through the UM Center for Distance and Independent Study. Courses to be taken for graduate credit must be approved by the Graduate Dean, and the enrollment form has a place designated for the Graduate Dean's signature. See <http://online.missouri.edu/> for more information on distance education opportunities.

### ***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.

Successful academic progress on the plan of study includes an acceptable Grade Point Average (GPA). For graduate work, the Bioengineering Program faculty and the MU Graduate School 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 Bioengineering Master's Program. Unsatisfactory academic performance may also result in a student being dismissed from the University.

The Office of Graduate Studies has a comprehensive policy covering the requirements and procedures to be followed when it becomes necessary to dismiss a student. They also have developed procedures for appealing any decision by the Bioengineering Program. Students should consult the University of Missouri Graduate Catalog for further details. A copy of the catalog is available at: <http://gradstudies.missouri.edu/policies/>

### ***3.4. Reasonable Rate of Progress***

Every Master's student will be evaluated annually for satisfactory progress by their major advisor as required by the Office of Graduate Studies (see Graduate School Catalog, Dismissal Policy and Appeals Process for Graduate Students). 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 September 1 of each year. It is important to note that a reasonable rate of progress towards the Master's degree is required.

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 in the Bioengineering Program 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 by the Bioengineering faculty to retake some or all of their course work.

### ***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 Bioengineering Graduate Coordinator as soon as possible to assure that the proper paperwork is filed with the Graduate Dean.

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

All MST and MSNT students are required to develop and execute a research project. Most students will begin their research project shortly after beginning their graduate study.

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 MSNT degree requires preparation of a research report, while the MST degree requires both the preparation of a scholarly manuscript and a thesis.

### ***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 the remaining 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 areas. 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 and must be announced at least two weeks prior to the scheduled date. 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.

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 form to the Director of Graduate Studies and the Graduate Dean. The M3 form is available to download from [here](#).

### III. PhD in Bioengineering

The process of receiving a Ph.D. in Bioengineering 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. The student must also conform to any of the requirements and regulations of the Office of Graduate Studies at the University of Missouri. 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.

#### 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 Bioengineering. 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:** Choose Doctoral Program Committee ([D1 Form](#)) – **Second Semester**

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:** Complete the Qualifying Examination ([D1 Form](#)) – **Second Semester**

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.

**STEP 3:** Submit Plan of Study ([D2 Form](#)) – **Second Semester**

The doctoral plan of study must include a minimum of 72 hours of graduate credits from course work taken at MU, transfer credit and research hours. Use [this template](#) to list all courses.

**STEP 4:** Take Comprehensive Examination ([D3 Form](#)) – **Seven Months *Before* Final Defense**

The comprehensive examination consists of written and oral sections. The two sections of the examination must be completed within one month.

**STEP 5:** Complete the Doctoral Dissertation

The dissertation must (1) be on a subject approved by your doctoral committee, (2) embody the results of original and significant investigation, and (3) be your own work.

**STEP 6:** Defend Dissertation ([D4 Form](#)) – **Last Semester**

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.

## **2. Doctoral Committee**

Students, in consultation with their research advisor, will select faculty members to serve as their Doctoral Committee by the end of the second semester of their tenure as a Ph.D. student. These committee members should have expertise in some aspect of the student's projected research. The chair of the Doctoral Committee will be the student's 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 Bioengineering Program,
  - One must be the student's research advisor
  - At least two must be a Doctoral Faculty Member
- At least one Graduate Faculty Member from the University of Missouri, but outside of the Bioengineering Program. 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. Additional members can only be added via special permission from the Graduate Dean.

### ***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 Qualifying Examination
- Conducting the Comprehensive Examination
- Guiding the research activities
- Overseeing the writing and defense of the Ph.D. Dissertation
- 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, Qualifying Examination, Comprehensive Examination, Dissertation Defense)
- Meeting all requirements at the appropriate time

### 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>	≥72-hr
<b>Total courses</b>	≥44-hr (excluding research, problems or independent study)
Transfer	≤30-hr of graduate credit from a regionally accredited university
Required courses	BE-8087 Seminar (1) BE-8402 Research Methods (2) BE-8180 Numerical Methods (3) Statistics (3) 2 more BE 8000 courses
Electives	other 7000+ 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 to earn a Ph.D.
<b>Other requirements</b>	Ph.D. dissertation at least two scholarly manuscripts

In general, the University of Missouri Graduate School does not accept correspondence or extension course credit earned at any other campus. However, a student may take up to eight hours of correspondence courses that are authorized for graduate credit and offered through the UM Center for Distance and Independent Study. Correspondence courses to be taken for graduate credit must be approved by the Graduate Dean, and the enrollment form has a place designated for the Graduate Dean's signature. See: <http://online.missouri.edu/> for more information on distance education opportunities.

#### 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 Bioengineering 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 will be somewhat like 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.

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, 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). For graduate work, the Bioengineering Program faculty and the MU Graduate School 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 Bioengineering Graduate Program. Unsatisfactory academic performance may also result in a student being dismissed from the University.

The Graduate School has a comprehensive policy covering the requirements and procedures to be followed when it becomes necessary to dismiss a student. They also have developed procedures for appealing any decision by the Bioengineering Program. Students should consult the University of Missouri Graduate Catalog for further details. A copy of the catalog is available at:

<http://gradstudies.missouri.edu/policies/>

### ***3.4. Reasonable Rate of Progress***

Every Ph.D. student will be evaluated annually for satisfactory progress by their research advisor as required by the Graduate School (see Graduate School Catalog, Dismissal Policy and Appeals Process for Graduate Students). Satisfactory progress includes adherence to a suitable timeline for

completing the doctoral degree as described in this document, and adequate academic performance. It is the student's responsibility to schedule this meeting before September 1 each year. Satisfactory progress includes adherence to a suitable timeline for completing the Ph.D. as described in this document, and adequate academic performance as described in the Plan of Study section. The student's academic advisor will inform the Director of Graduate Studies as to the outcome of the evaluation on or before September 1 of each year.

It is important to note that a reasonable rate of progress towards the doctoral degree is required. The doctoral degree must be completed within five years after passing the Comprehensive Examination. In unusual circumstances, it may be necessary to extend the time required to finish the degree. In these cases, the student 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 research advisor, the Director of Graduate Studies in the Bioengineering Program may endorse an extension of time. A request for an extension of time must be submitted to the Graduate School for approval. Students who take more than five years to complete the Ph.D. after passing the Comprehensive Examination may be required by the Bioengineering faculty to retake some or all of their course work.

### ***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 Thesis Committee. The student should submit the [Plan of Study Course Substitution Form](#) to the Bioengineering Graduate Coordinator as soon as possible to assure that the proper paperwork is filed with the Graduate Dean.

## **4. Qualifying Examination**

Ph.D. students in the Bioengineering Program are expected to have a general knowledge of Bioengineering and to be able to communicate in English. In addition, students are expected to show the ability to think clearly and critically and to express themselves adequately in both written and spoken English.

The student will take a formal Qualifying Examination by the end of the second semester of their tenure as a Ph.D. student. This exam is designed to test the academic and communication abilities of the student.

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

Expect the Qualifying Examination to be the most difficult exam you will ever take. Using the format bioengineering faculty deem appropriate, this exam will determine whether or not the student is qualified to pursue the Ph.D. For example, a typical exam may consist of:

- A written and an oral section. In this case, after completion of the written exam, the student, in consultation with their research advisor and Committee, should schedule the oral exam. The oral exam is designed to determine whether the student can think quickly and clearly and express themselves in English. The oral exam may take two to three hours. The student will be expected to defend their answers on the written portion of the Qualifying Exam.
- A set of grade requirements for the Bioengineering courses taken in the first two terms.

### ***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 and the Office of Graduate Studies.

## 5. Comprehensive Examination

Ph.D. students in the Bioengineering Program are expected to have general knowledge of their research field, and to demonstrate the skills necessary to successfully complete their projected research. The student will take a formal Comprehensive Examination by the end of the sixth semester of their tenure as a Ph.D. student. This exam is designed to test the research and communication abilities of the student. The student is allowed 2 attempts to successfully complete the Comprehensive Examination.

### *5.1. Comprehensive Examination Format*

Students must carry out the initial work of their projected research, and demonstrate that they will sincerely complete the Ph.D. requirements. Using the format faculty deem appropriate, this exam will determine whether or not the student can become a Ph.D. Candidate.

As a typical format, which includes both a written and oral portion, the student may be asked to prepare:

- A 10 page review, to be submitted to their Doctoral Committee, in standard format, of their research project and progress to date. Students should approach this like 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 5 page research proposal, to be submitted to their Doctoral Committee, in a standard format similar to those required by the NIH, NSF, or USDA, which should propose an in-field project that is not already being undertaken in their research group. The student should be prepared to orally defend his/her 5-page research proposal.
- A 30 minute presentation on their research project to date, to be given to their Doctoral Committee, in conference format. The student should be prepared to orally defend his / her work to date.

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. Students must be enrolled in MU at the time of the comprehensive exam. In addition, MU must be officially in session (fall, spring or summer semesters) when the comprehensive exam is administered. The comprehensive exam must be completed at least seven months before the final defense of the dissertation.

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 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. A report of this decision must be sent to the Graduate School and the student no later than two weeks after the Comprehensive Exam is completed. 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. The materials will be revised and resubmitted until the Doctoral Committee is satisfied. Failure to successfully revise the materials will result in dismissal from the Ph.D. program.

Failure on either the written or 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 and the Office of Graduate Studies.

## **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 research project must result in at least two 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 must be submitted to refereed journal, prior to submitting "Report of the Dissertation Defense" form (Form D-4) to the Graduate Coordinator. 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 research advisor and the Thesis Committee. A successful project will involve research and scholarship that will significantly contribute to an increased understanding of Bioengineering. The project must demonstrate the student's capacity for managing and interpreting research.

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

A dissertation based on the original research completed by the students must be reviewed by the student's Committee. The dissertation must be submitted to the Graduate Coordinator and Committee at least two weeks prior to the 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 style of the dissertation is left up to the discretion of the research advisor and the student, as long as the minimum requirements of the Graduate School are met.

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

After the dissertation has been completed and submitted, 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, must be announced at least two weeks prior to the scheduled date, and must be attended by all members of the Doctoral Committee. Lastly, the candidate must be enrolled at MU for that term.

To announce the dissertation defense to the general public, 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 parts: an open session, which may be attended by the general public, and a closed session, which may be attended by MU Graduate Faculty. 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 address any issues with their submitted dissertation.

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

A report of the examination, carrying the signatures of all members of the committee, must be sent to the Graduate School before the deadline preceding the anticipated date of graduation. For the dissertation to be considered successfully defended, the student's Doctoral Committee must vote to pass the student on the defense with no more than one dissenting or abstaining vote. A final copy of the dissertation, including any changes the Doctoral Committee asked the student to perform, must be submitted to the Graduate School in an electronic format with supplemental paper documents.

Finally, the student should submit the form [D4](#), "[Report of the Dissertation Defense](#)" to the Graduate Coordinator as soon as possible. The Coordinator will submit the completed form to the Director of Graduate Studies and the Office of Graduate Studies.

## 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: 3.2 in the last 60 hours
- ✓ BS from an accredited university or equivalent experience

### □ 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**

- BE 3170 Biomaterials
- BE 4170/7170 Biomaterials Interfaces of Implantable Devices
- BE 4370/7370 Orthopaedic Biomechanics
- BE 8001 Orthopaedic Failure Modes and Defect Analysis
- BE 8370 Materials Characterization Techniques
- BE 8870 Molecular and Cell Mechanics

- **Bioprocess Engineering**

- BE 3180 Heat and Mass Transfer in Biological Systems
- BE 4315/7315 Introduction to Bioprocess Engineering
- BE 4316/7316 Biomass Refining Operations
- BE 4160/7160 Food Process Engineering
- BE 8280 Advanced Biological Transport Processes

- **Bioenvironmental Engineering**

- BE 4150/7150 Soil and Water Conservation Engineering
- BE 4250/7250 Irrigation and Drainage Engineering
- BE 4350/7350 Watershed Modeling Using GIS
- BE 8250 Water Management Theory

- **Bioelectronics and Instrumentation**

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

- **Biophotonics**

- BE 4570/7570 Fluorescent Imaging
- BE 4770/7770 Biomedical Optics
- BE 8270 Principles and Applications of Fluorescence
- BE 8570 Microscopic Imaging
- BE 8770 Photon Migration & Optical Imaging in Turbid Media

- **BioMEMS and Biosensing**

- BE 4470/7470 Biomolecular Engineering and Nanobiotechnology
- BE 4670/7670 Photonics and Nanotechnologies in Optical Biosensors
- BE 8170 Sensors and Biosensors
- BE 8470 Ultrasensitive Bio-detection
- ECE 4620/7620 Introduction to BioMEMS
- ECE 4880/7880 Micro/Nano Systems
- ECE 8620 Advance MEMS