

Bioengineering Integrated M.E., M.S. Student Handbook

For Entrance in 2015 Fall or Later

1. Introduction

The process of receiving a Master's Degree in Bioengineering from the University of Missouri can be divided into several distinct steps. This document will serve as a guide through these steps as they are applied by the Bioengineering Program faculty for the three types of Master's degrees (Master of Engineering, Master of Science - Thesis Option and Master of Science - Non-thesis Option) that are offered by the program. 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. Figures 1 - 3, below, show the overall process for each degree type. 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.

Also, please note that it is typical that students in the Master's programs are not offered a stipend, since a Master's degree is primarily class-based. Some faculty advisors may offer varying levels of financial support, including tuition, fees, and a modest stipend, depending on the amount of research being done by the student. This support will be clearly stated in your acceptance letter.

Lastly, in the Department of Bioengineering, students are currently admitted directly to an 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.

Steps to Graduation Master of Engineering

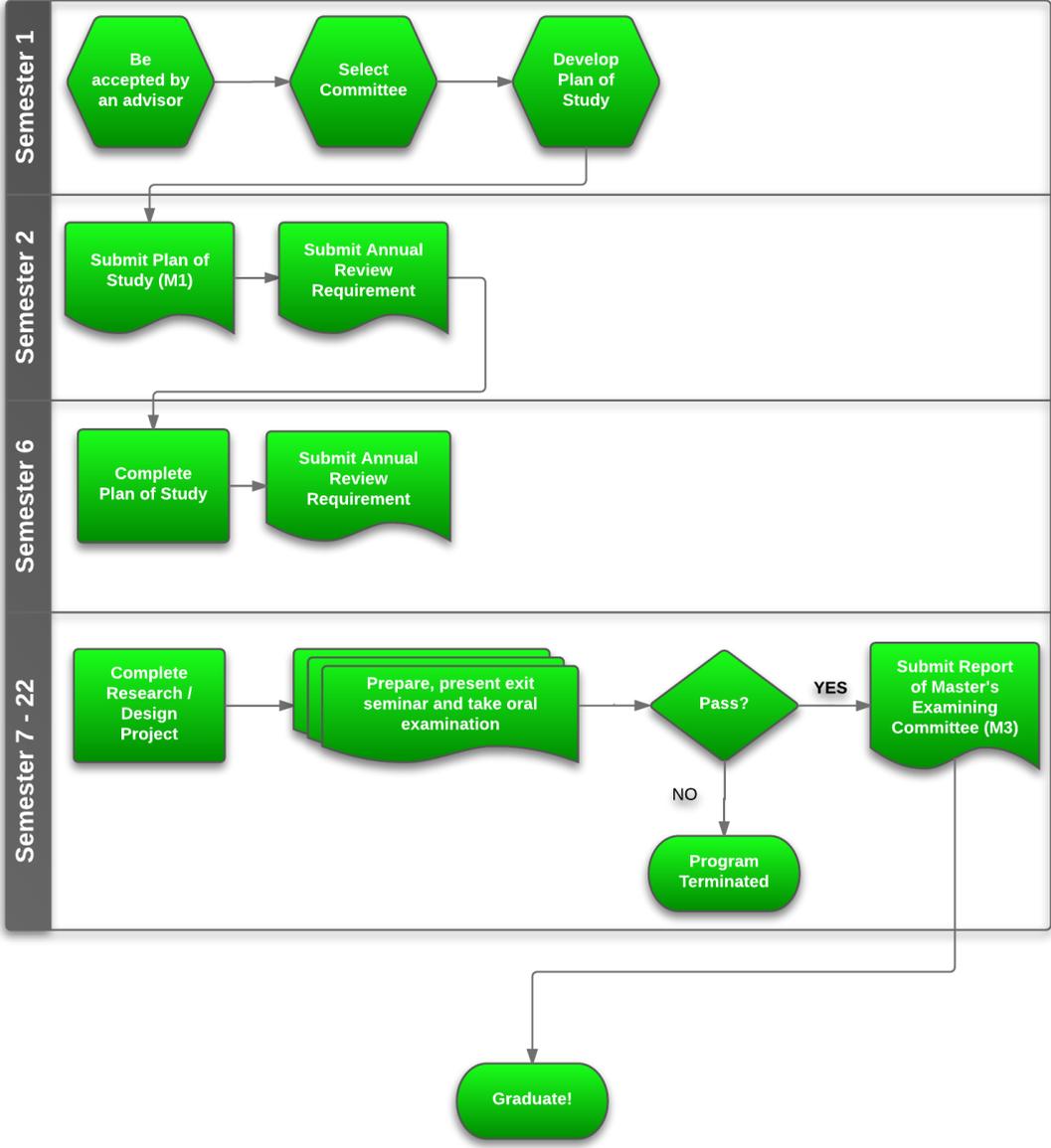


Figure 1: Flowchart for M.E. Program Requirements

Steps to Graduation Master of Science - Non-thesis Option

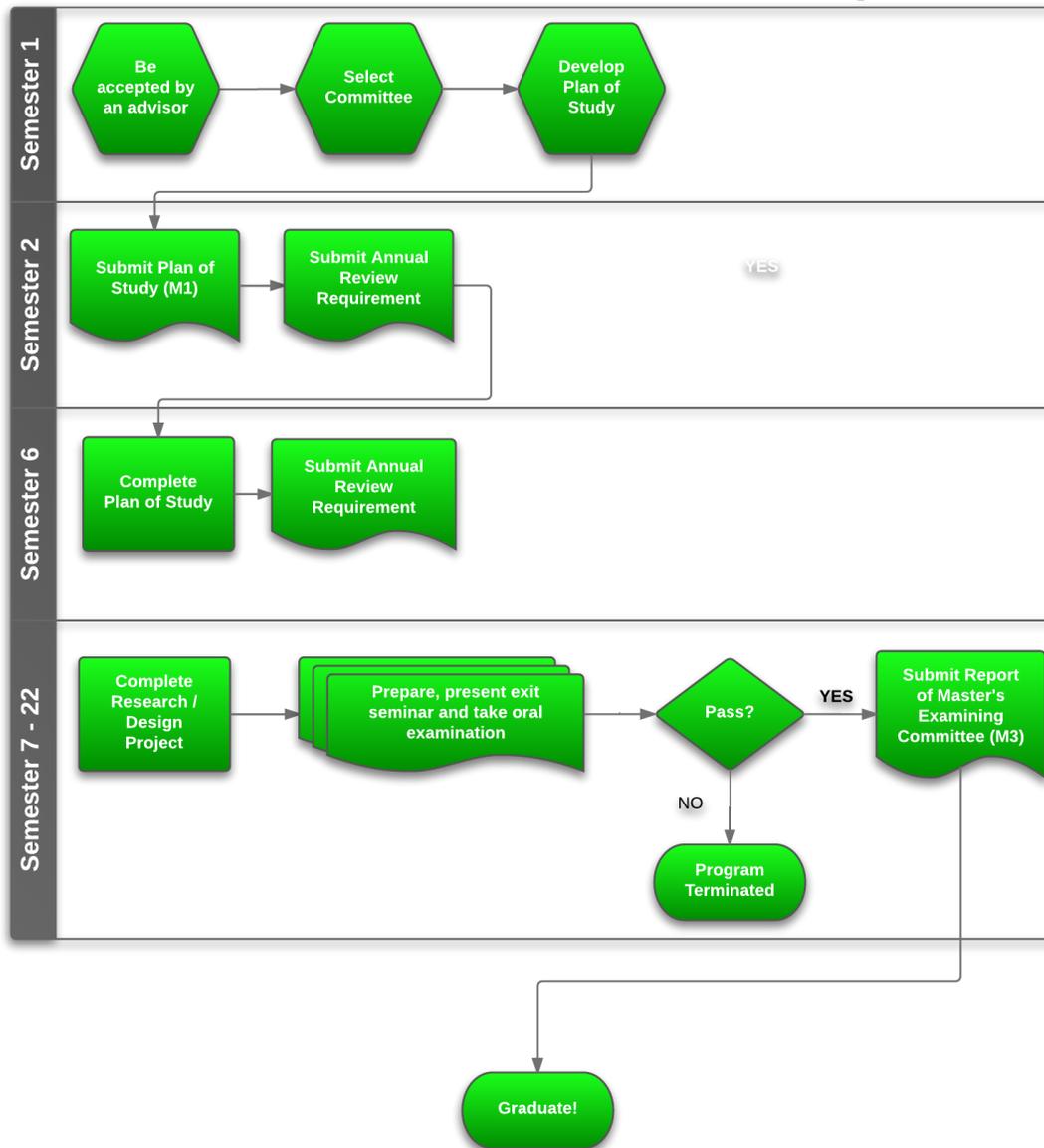


Figure 2: Flowchart for M.S. Non-Thesis Option Program Requirements

Steps to Graduation Master of Science - Thesis Option

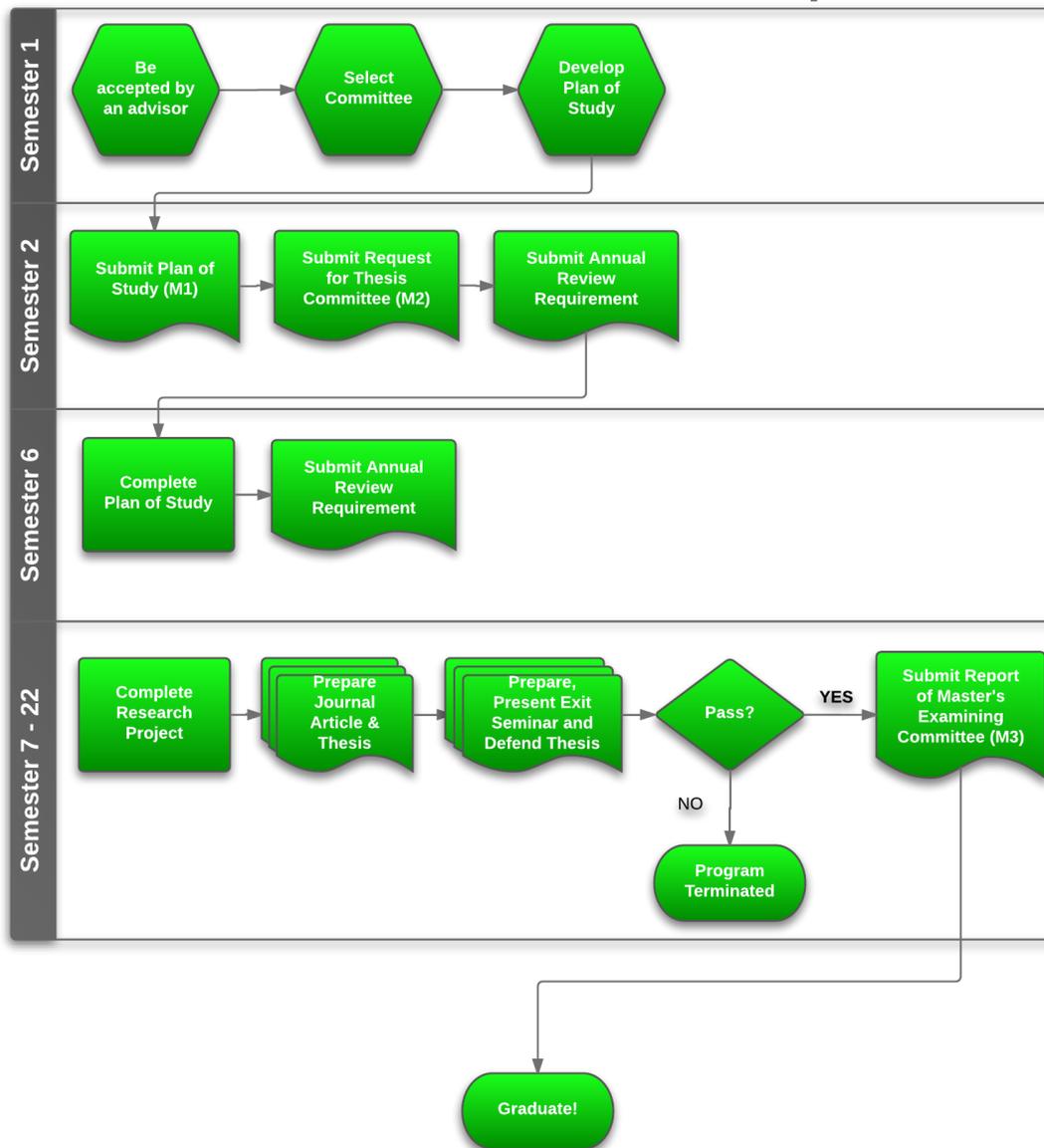


Figure 3: Flowchart for M.S. Program Requirements

Academic Process for Master's Students

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) – Second Semester

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 graduate examination

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.

Step 4: Master's Examining Committee (M3 Form) – Last Semester

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 Graduate School.

Non-thesis option

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 Graduate School. The [Report of the Master's Examining Committee form \(M3\)](#) signed by the director of graduate studies, is forwarded to the Graduate School. All candidates for the MA or MS degrees must complete either a thesis or a substantial independent project that cannot be coauthored.

2. Applying to the Program

2.1. Academic Requirements

Earn a bachelor's and master's degree from an approved course of study with a grade point average (GPA) of at least 3.2 on a four point scale or its equivalent for the last 60 hours of courses. This should be a B.S. and M.S. degree from an accredited university or its equivalent. In rare instances, an exceptional student will be allowed to study for the Ph.D. without first completing an M.S. degree.

2. Take the Graduate Record Exam (GRE) no earlier than five years prior to applying.

3. Take the Test of English as a Foreign Language (TOEFL) or the Academic International English Language Testing System (IELTS) if you did not attend high school (or equivalent) where English was the language of instruction. The minimum TOEFL score for acceptance into this program is 80. If the TOEFL score is between 80 and 100, the applicant will be required to take a remedial course. The minimum IELTS score for acceptance is 6.5.

All applications will be reviewed, however, only students meeting these 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.

2.2. Application Deadlines

Applications are accepted at any time during the year. The deadlines are:

- April 1 for Fall Term admittance in the same year
- October 31 for Spring Term admittance the following year

2.3 Application Instructions

1. Before applying, students must decide on the Master of Engineering (ME), Master of Science – Thesis Option (MST) or the Master of Science - Non-thesis Option (MSNT). 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.

2. To apply to the University, students need to go online and access the online application form. This form may be found at: <http://gradstudies.missouri.edu/admissions/apply/>

3. Application fees are \$65 for domestic students and \$90 for international students.

Upon receipt of the documents, the Graduate Admissions committee will examine the application materials. Each application will be uploaded to the graduate Apply Yourself System. Once all application materials are received, faculty members will decide if they are willing to serve as a mentor for the student. Students will be informed as to their provisional acceptance to the program usually within two months after submitting a complete application packet. Please note that provisional acceptance will only be given to students with an identified faculty mentor. 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.

3. Thesis or Examination Committee

Students, in consultation with their research advisor, will select faculty members to serve as their Thesis Committee (MST option) or Examination Committee (ME or MSNT options) 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 research advisor.

3.1. 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:

1. At least two graduate faculty members from the Bioengineering Program,
 - (a) At least two must be a Graduate Faculty Member
 - (b) One must be the student's research advisor
2. 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. A list of College of Engineering faculty, along with their research interests, may be found at:

<http://engineering.missouri.edu/research/researchers-a-z/>

3.2. 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
- Overseeing the writing of journal article(s) and, if appropriate, thesis
- Maintaining high standards of scholarship and ethical behavior
- Administering corrective and disciplinary actions when necessary

The 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

4. 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 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 Master's degree.

4.1 Proficiency Requirements

In addition to the core Bioengineering courses all Master's students are required to take, the student is required to demonstrate proficiency in at least two of the seven proficiency areas listed in Table 1, below, 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:

1. Successfully complete either an appropriate course at the University of Missouri, or an alternate course approved by the Committee, in the proficiency area
2. Demonstrate successful completion of an appropriate course listed in Table 1 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.

Table 1: 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 E_ect 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 Re_ning 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
Biosystems Engineering
BE 4580 / 7580 Mechanical Systems Engineering
BE 8380 Modeling and Identi_cation 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 Photomigration & 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

4.2. Class Requirements

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 ME and MSNT degrees.

These hours *may* include:

1. 6 hours of graduate credit transferred from another university or from another campus of the MU system

These hours *must* include:

1. Required courses:

- (a) BE 8087 (Seminar - 1 hour)
- (b) BE 8402 (Research Methods - 2 hours)
- (c) BE 8990 (Research)
 - i. ME / MSNT - 3 hours of course credit maximum
 - ii. MST - 6 hours of course credit minimum
- (d) Statistics (3 hours)

2. Elective courses:

- (a) Additional 8000 level courses, of which 6 hours of course credit must be from 8000 level Bioengineering courses (which may also be used to fulfill proficiency requirements)
 - i. MST - 2 8000 level courses total
 - ii. MSNT - 3 8000 level courses total
 - iii. ME - 4 8000 level courses
 - iv. Excluding research, problems or independent study courses
- (b) Additional 7000 level courses

Elective courses should be chosen to strengthen the student's ability to do research in their specific area or to fulfill proficiency areas. Please note that these are minimum requirements. 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. 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.

4.3. Changes to 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's research advisor should inform Logan Howard, 254 Agricultural Engineering Building, in writing, of any necessary changes as soon as possible to assure that the proper paperwork is filed with the Graduate Dean.

4.4. 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 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 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/>

4.5. Reasonable Rate of Progress

Every Master's student will be evaluated annually for satisfactory progress by their major 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 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 Graduate School 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.

4.6. Document Submission

Once the Plan of Study has been developed, the student should submit the Program of Study for the Master's Degree form (M-1), available at:

<http://gradstudies.missouri.edu/forms-downloads/>

to the Graduate Coordinator. The Coordinator will submit the completed form to the Director of Graduate Studies and the Graduate Dean.

5. Research Project

All Master's 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 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.

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 ME and MSNT degrees require preparation of a scholarly manuscript, while the MST degree requires both the preparation of a scholarly manuscript and a thesis.

5.1. Preparation of the Journal Article

The research project must culminate in a scholarly manuscript, 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 completed manuscript must be submitted to the Graduate Coordinator at least two weeks prior to the final examination (step 10). 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. (Note: after successfully completing the final examination (step 10), the student will make any needed adjustments in format and corrections/clarification based on input from the Master's Program Committee.)

5.2. Preparation of the Thesis

The Master's thesis project is the distinctive element of the Master of Science (thesis option) 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. Thesis projects must be defended at the Final Examination. To satisfy the Graduate School, 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 thesis. 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.

The goal of the Master of Engineering Program in Bioengineering 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 graduate. The ME program 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 this student, many of the courses may be available through the UM system and through distance learning.

5.3. Final Examination

The Final Examination will consist of an Exit Seminar that discusses the student's research project, 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. 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 at least two members of the committee, must be sent to the Graduate School before the deadline preceding the anticipated date of graduation. For the research project to be considered successfully defended, the student's Thesis Committee must vote to pass the student with no more than one dissenting or abstaining vote.

5.4. Document Submission

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

1. Their manuscript, signed by the Thesis Committee members
2. Their thesis, if they are seeking an MST degree
3. The Report of the Master's Examining Committee (form M-3).

The Coordinator will submit the completed form to the Director of Graduate Studies and the Graduate Dean. The form is available at:

<http://gradstudies.missouri.edu/forms-downloads/>