

## Table of Contents

Bioengineering Graduate Program Overview .....	2
Contact Information .....	3
Doctor of Philosophy (PhD) Program .....	4
1. Course Requirements .....	4
2. Laboratory Rotation Requirement .....	5
3. Research Advisor Match .....	6
4. Research Aptitude Examination .....	7
5. Teaching Assistant Requirement .....	9
6. PhD Proposal Examination .....	9
7. Advancement to Candidacy .....	11
8. Progress Checklists and Annual Progress Reports .....	12
9. PhD Dissertation .....	12
10. Time Line Recommendations .....	14
11. Candidacy and Graduation Forms .....	14
Master of Science (MS) Program .....	15
1. Course Requirements .....	15
2. Research Advisor Selection .....	16
3. MS Thesis .....	16
4. Time Line Recommendations .....	17
Academic Advising and Registration (MS and PhD) .....	18
Master of Engineering (MEng) Program .....	19
Advising and Registration (M.Eng.) .....	19
Doctor of Medicine / Master of Science (MD/MS) Program .....	20
Doctor of Medicine / Doctor of Philosophy (MD/PhD) Program .....	21

## **Bioengineering Graduate Program Overview**

The Bioengineering Graduate Program offers research and educational opportunities leading to the Doctor of Philosophy (PhD) degree, Master of Science (MS) degree, and the Master of Engineering (MEng) degree. In cooperation with the University of Maryland School of Medicine, the Bioengineering Graduate Program also offers the combined Doctor of Medicine/Doctor of Philosophy (MD/PhD) and Doctor of Medicine/Master of Science (MD/MS) degree programs.

All students in the Bioengineering Graduate Program are subject to both departmental and Graduate School policies and requirements. This handbook should serve as a ready-reference and is not meant to replace advising and mentoring, which should take place between students and their advisors on a regular basis. Students are urged to refer to the Graduate School's [Graduate Catalog](#) for details on policies referenced here and for additional information.

## Contact Information

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Bioengineering (BIOE) Graduate Office  
Room 2330 Jeong H. Kim Engineering Building  
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## Doctor of Philosophy (PhD) ! "#\$"%&

The PhD program consists of the following requirements:

1. Course Requirements
2. Laboratory Rotation Requirement
3. Research Advisor Match
4. Research Aptitude Examination
5. Teaching Assistant Requirement
6. PhD Proposal Examination
7. Dissertation of Original Research
8. Dissertation Defense

### 1. Course Requirements

The PhD course requirement consists of mandatory core courses, restricted and unrestricted elective courses, and program credits towards fulfillment of the degree.

#### Core Courses

All of the following three courses must be completed in order to fulfill the core course requirement.

- BIOE 601: Rate Processes in Biological Systems
- BIOE 604: Transport Phenomena in Bioengineering Systems
- BIOE 612: Physiological Evaluation of Bioengineering Designs

#### Restricted Elective Course

One of the following courses (3 credits) must be completed in order to fulfill the restricted elective course requirement.

- BIOE 602: Cellular and Tissue Biomechanics
- BIOE 611: Tissue Engineering
- BIOE 631: Biosensor Instrumentation and Techniques
- BIOE 632: Biophotonic Imaging and Microscopy
- BIOE 689A: Protein Design and Engineering
- BIOE 689D: Computational Molecular Bioengineering
- BIOE 689J: Bioengineering Devices for Cancer Research
- BIOE 689T: Biomaterials in Immunology and Immunotherapy

#### Unrestricted Elective Courses

Four unrestricted elective courses (12 credits), in topics such as engineering, biology, chemistry, mathematics, or computer science must be completed. These courses can be chosen in consultation with the Graduate Program and / or Faculty Research Advisor.

#### Program Credits

Students must successfully complete the following program credits towards fulfillment of the degree.

- BIOE 608: Bioengineering Seminar Series (1 credit), must be completed three times
- BIOE 605/606: Laboratory Rotation (1-2 credits)
- BIOE 899: Dissertation Research Credits (18 credits)

BIOE 608: Bioengineering Seminar Series is a one-credit course that must be successfully completed three times to fulfill this requirement. Please see the Laboratory Rotation Requirement and Advancement to Candidacy sections that follow for more information on BIOE 605/606 and BIOE 899.

## Typical Course Timeline

### Semester 1

- BIOE 601 (3 credits)
- BIOE 604 (3 credits)
- BIOE 605 (1 credit)
- Restricted Elective (3 credits)

### Semester 2

- BIOE 612 (3 credits)
- BIOE 606 (1 credit)
- Unrestricted Elective 1 (3 credits)
- Unrestricted Elective 2 (3 credits)

### Semesters 3 through 10

- BIOE 608 (1 credit) (x3)
- BIOE 898 (1 credit) (when needed)
- BIOE 899 (6 credits) (x3, post-candidacy)
- Unrestricted Elective (3 credits) (x2)

After students have completed all coursework and prior to advancement to candidacy, students may register for BIOE 898: Pre-Candidacy Research (2 credits) each semester to maintain full-time status. After passing the PhD Proposal Exam and advancement to candidacy, students are registered by the Graduate School for BIOE 899: Doctoral Dissertation Research (6 credits) each fall and spring semester until they graduate.

All students are required to maintain continuous registration until the degree is completed. Students receiving financial support from the department are required to maintain full-time registration each fall and spring semester.

### Transfer of Credit

A student may request that up to six credit hours of appropriate graduate coursework taken at another institution be applied towards the PhD unrestricted elective course requirement. A grade of B or better must have been earned in requested transfer courses. The courses must be graduate level and have been taken for graduate credit at the original institution.

The request may be submitted after the student's research advisor is confirmed. The student should consult with the advisor to discuss an entire course plan for the degree. The advisor in consultation with the student should determine how many remaining electives the student needs to take at UM (i.e. what topics or background the student needs in order to advance in research).

The student is responsible for providing a course syllabus, an official transcript, and advisor's support statement to the BIOE Graduate Office. The request will be reviewed by the Graduate Studies Committee, and the student will be notified.

The grades earned in approved transferred coursework do not calculate into the UM GPA, nor do the courses appear on the UM transcript.

## 2. Laboratory Rotation Requirement

The key for every successful PhD graduate is the relationship with the research advisor. To facilitate their learning about various research projects and lab environments, first-year PhD

students participate in laboratory rotation. Prior to the start of the academic year, the department arranges faculty presentations and provides project descriptions for lab rotations to introduce students to the active research in bioengineering. These presentations are typically given during departmental orientation, one week before classes begin. During the lab rotation periods, students are expected to continue their advisor/lab search by meeting with faculty members, consulting with other graduate students, and reading up on the research. As a part of the BIOE 605: Laboratory Rotation course credit, first-year students are required to attend the weekly Fischell Department of Bioengineering Seminar.

Below is an approximate timeline for lab rotation. Specific dates will be provided each academic year.

- By the end of the first week of fall semester, students will be required to submit a ranked list of three labs in which they would like to rotate; based on these rankings, students will be assigned to their first lab rotation, beginning the second week of the semester and lasting six weeks.
- Students will again be asked to submit a ranked list of three labs, and then assigned to their second lab rotation, beginning the seventh week of the semester and ending on the last day of fall classes.
- Students will again be asked to submit a final ranked list of three labs, and then assigned to their lab rotation, beginning the first week of the spring semester and lasting six weeks.

Please note that a student who was offered and accepted a first-year package to work directly with a particular research advisor will not participate in first-year lab rotation and is exempt from the BIOE 605/606 credit requirement.

### 3. Research Advisor Match

The rotation process is designed to provide students and advisors with the opportunity to consider potential research matches. Matching to a research lab involves three constituencies: students, advisors, and department faculty. During the rotation periods, students should demonstrate their abilities and high level of interest to potential research advisors who have active, funded research projects. An advisor's scientific body of work, evidenced largely by peer-reviewed publications, as well as job placement of former graduate students, provide some indication of research activity. Even students who are self-supported by fellowships or other means should seek to join research groups that actively seek funding. Funded research (GRA) support is the primary source of support for continuing graduate studies. Students are welcome to discuss research opportunities with faculty members with whom they did not rotate.

Below is an approximate timeline for the research advisor matching process.

- A student who has identified an advisor match at the end of the second rotation should consult with the BIOE Graduate Office by the last day of classes of the fall semester and submit a formal request to match with the research advisor of their choice. This selection will then be considered for approval by the Fischell Department of Bioengineering full-time faculty. If the match is approved, the student would begin working in the advisor's lab at the start of the spring semester, and the advisor would be expected to start funding the student from the beginning of January.
- Most students will complete their third rotation, and before spring break will turn in a ranked list of three potential research advisors. These selections will then be considered for approval by the Fischell Department of Bioengineering full-time

faculty. By the end of March, all first-year student and advisor matches are confirmed, and students and faculty are notified.

#### 4. Research Aptitude Examination

All PhD students must take the Research Aptitude Examination (RAE). All students must successfully complete the RAE in the first year of the PhD program. The RAE is typically held twice a year, once in January (between the fall and spring semesters) and once in June (after the end of the spring semester). The timeline for the examination period are announced by the BIOE Graduate Office before the end of the Fall semester.

The exam is distributed electronically and includes multiple problem statements. A student must choose one problem statement to answer and then email the BIOE Graduate Office [bioe-grad@umd.edu](mailto:bioe-grad@umd.edu) of the problem statement s/he is planning to address. Once the BIOE Graduate Office has been notified of the problem selection, changes are not permitted.

Students are then given approximately two weeks to prepare a written proposal and an oral presentation in response to the problem statement. The written proposal must be submitted electronically to [bioe-grad@umd.edu](mailto:bioe-grad@umd.edu). The oral presentation is delivered to a committee of three faculty members. The written copy must include the University Honor Pledge typed on the title page under your name: *"I pledge on my honor that I have neither given nor received any unauthorized assistance on this examination."* All work must be your own. Students are not permitted to speak to any fellow students, faculty, or anyone else regarding the exam. Questions should only be directed to [bioe-grad@umd.edu](mailto:bioe-grad@umd.edu) or in person to the Graduate Director.

##### **Part I: Written Proposal**

The objective of the written proposal is to communicate how a specific research problem may be investigated. The proposal format has been adapted from the requirements for a NIH R21 proposal. The proposal is not to exceed 6 pages using an 11-point Arial font, 1-inch margins, and 1.0 line spacing. The 6-page limitation covers the proposal body text, as well as any figures, tables, and schemes. The title page, abstract, specific aims, and cited references are the only sections that do not count toward the 6-page limitation. The specific aims, however, are limited to 1 page. The following details delineate the section requirements within the written proposal as well as the purpose of each section.

**Title Page:** The first page should include your name, title of your proposal, and signed honor pledge.

**Abstract:** A brief description of the problem of interest, its significance, and the proposed investigation.

**Specific Aims:** State concisely the goals of the proposed research and summarize the expected outcome(s), including the impact that the results of the proposed research may have on the research field(s) involved. List succinctly the specific objectives of the research proposed, e.g., to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology. The specific aims section is limited to 1 page.

**Research Strategy:** Organize the research strategy in the specified order and using the instructions provided below. Start each section with the appropriate section heading—Significance, Innovation, Approach.

### Significance

- Explain the importance of the problem or critical barrier to progress in the field that the proposed project addresses.
- Explain how the proposed project improves scientific knowledge, technical capability, and/or clinical practice in one or more broad fields.
- Describe how the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field may change if the proposed aims are achieved.

### Innovation

- Explain how the application challenges and seeks to shift current research or clinical practice paradigms.
- Describe any novel theoretical concepts, approaches or methodologies, instrumentation or intervention(s) to be developed or used, and any advantage over existing methodologies, instrumentation or intervention(s).
- Explain any refinements, improvements, or new applications of theoretical concepts, approaches or methodologies, instrumentation or interventions.

### Approach

- This is the core of the proposal. This section should occupy at least 70% of the allotted page limit.
- Describe the overall strategy, methodology, and analyses to be used to accomplish the specific aims of the project. Include how the data will be collected, analyzed, and interpreted.
- Discuss potential problems, alternative strategies, and benchmarks for success anticipated to achieve the aims.
- Describe strategies to establish feasibility, and address the management of any high-risk aspects of the proposed work.
- Point out any procedures, situations, or materials that may be hazardous to personnel and precautions to be exercised.

Cited References: Cite sources for background information and experimental plan.

### **Part II: Oral Presentation**

The objective of the oral presentation is to succinctly communicate the key points of the written proposal. Typically, this would require an introduction that presents the field of research and then a discussion of the experimental plan. The presentation should not exceed 30 minutes; therefore, it is recommended that the presentation not exceed 25 slides. Both during and after the presentation, the committee may ask questions about the proposal, as well as relevant background topics.

Each student will be notified by email of the place and time of the oral presentation. The presentations should be delivered using Microsoft PowerPoint or other equivalent presentation software. A laptop computer and LCD projector will be provided on the day of the presentation.

### **Evaluation**

The committee will evaluate the written proposal and oral presentation with regard to the following categories and scale. A minimum total score of 10 out of 20 possible points is considered a passing score.

### Categories

- Manuscript: Format and Organization



- Manuscript: Logic and Clarity
- Manuscript & Oral Presentation: Literature and Background
- Manuscript & Oral Presentation: Feasibility of Proposed Research
- Oral Presentation: Delivery and Answers to Committee Questions

#### Scale

- 0 = unacceptable
- 1 = marginally acceptable
- 2 = acceptable
- 3 = above average
- 4 = outstanding

Based on this scoring system, the committee has the following two alternatives.

- Pass. Consensus for the scoring of each category, or averages of mixed scoring, with a total score of 10 or higher.
- Fail. Consensus for the scoring of each category, or averages of mixed scoring, with a total score of less than 10. Detailed explanation of deficiencies must be submitted, and recommendations for the student must be provided.

If the student fails the first attempt at the exam, s/he can take the exam a second time at the next available offering of the RAE. If the student fails a second attempt, s/he must leave the PhD program and has the option of entering the Master of Science program.

## **5. Teaching Assistant Requirement**

As part of the PhD program's educational requirements, all PhD students must serve as Teaching Assistants (TAs) for a minimum of two semesters, preferably during their second year. The TA assignments are made by the department. There is no compensation associated with the TA assignment as it is an academic requirement.

## **6. PhD Proposal Examination**

The objectives of the PhD Proposal Examination are to set specific expectations for the successful defense of the dissertation, to give students experience in writing research proposals, to effectively communicate research results, and to allow for the development of research ideas that could be expanded for future opportunities. The oral presentation provides training in presentation skills and fielding questions on a scientific topic. Finally, the examination also provides valuable feedback on the student's research ideas.

The PhD Proposal Examination consists of the written proposal document and an oral presentation. Students must have passed the Research Aptitude Exam and earned a minimum grade of B (3.0) in each of the core courses to be eligible for the proposal exam.

### **PhD Proposal Examination Committee**

The research advisor serves as chair of the PhD Proposal Examination Committee, which must consist of a minimum of four voting members, two of whom must be full-time faculty in the Fischell Department of Bioengineering. (Affiliate and Adjunct faculty are not considered full-time in the department.) It is highly recommended that the Proposal Examination Committee members also serve as the Dissertation Examining Committee; therefore, please see the requirements for the membership of Dissertation Examining Committee. The student and advisor may choose to include more than four members for the proposal committee. Selection for this option should be determined by the student and advisor.

### **PhD Proposal Timing**

It is recommended that the PhD Proposal Examination be completed within two years after successful completion of the Research Aptitude Exam. By this deadline, the student is expected to have prepared the proposal, formed a committee, scheduled, and announced the proposal examination. If the student's proposal is not ready for examination, the student is still required to have formed a committee and scheduled a pre-examination meeting with the committee. During the pre-examination meeting, the student is expected to discuss his/her research progress and provide a detailed timeline towards an examination date. The committee documents the timeline and their recommendations for the student's file.

It is the student's responsibility to schedule the exam with the committee. Students must submit to the BIOE Graduate Office [bioe-grad@umd.edu](mailto:bioe-grad@umd.edu) an announcement including date, time, location, committee names, and abstract at least 10 business days prior to the exam. The presentation portion may be attended by any member or affiliate of the department.

All students must pass the proposal examination by the end of the fourth year. Each student is allowed two attempts to pass the proposal examination. Students who fail to meet the deadline for the first attempt or pre-examination meeting will have one failed attempt recorded in their file. If the student fails a second attempt, s/he must leave the PhD program and has the option of entering the Master of Science program.

### **Written Proposal**

The written proposal is prepared by the student in consultation with the chair/advisor. The objective of the written document is to communicate a vision of how the specific research problem for the student's PhD dissertation will be investigated. The proposal is approximately 30 pages in length using an 11-point Arial font, 1-inch margins, and 1.0 line spacing. The page recommendation covers the proposal body text, as well as any figures, tables, and schemes. The title page, abstract, specific aims, and cited references are the only sections that do not count toward this recommendation.

### **Proposal Examination**

The proposal examination consists of two parts: an oral presentation followed by formal questioning.

Part 1: Oral Presentation. The objective of the oral presentation is to communicate succinctly the key points of the written proposal. Typically, the presentation should include an introduction that presents the field of research, any preliminary research, and then a discussion of the specific aims and subsequent experimental plan. The presentation should not exceed 30 minutes; therefore, it is recommended that the presentation not exceed 25 slides. During Part 1, questions from the audience are permitted. For questions from persons who are not members of the proposal committee, the chair has discretion to decide whether such questions are germane to the topic of the proposal and how much time can be allotted for the answers.

Part 2: Formal Questioning. Members of the audience who are not Graduate Faculty members are asked to leave the room, and only the committee is permitted to ask questions. The chair then invites questions from each member of the committee. The questioning may continue as long as the committee feels that it is necessary and reasonable for the proper examination of the student. The student must have ample opportunity to answer the questions of the committee. Typically, the questioning period does not exceed 90 minutes. At this time the student must also present a detailed plan and timetable for publication goals from the time of the proposal to graduation.

## Evaluation

After questioning has been completed, the student and any others who are not members of the committee are asked to leave the room while the committee discusses whether or not the proposal is satisfactory. The committee will evaluate the written proposal and oral presentation with regard to the following categories and scale. A minimum total score of 10 out of 20 possible points is considered a passing score.

### Categories

- Manuscript: Format and Organization
- Manuscript: Logic and Clarity
- Manuscript & Oral Presentation: Literature and Background
- Manuscript & Oral Presentation: Originality and Significance
- Manuscript & Oral Presentation: Feasibility of Proposed Research

### Scale

- 0 = unacceptable
- 1 = marginally acceptable
- 2 = acceptable
- 3 = above average
- 4 = outstanding

Based on this scoring system, the committee has the following three alternatives.

- Pass. Consensus for the scoring of each category, or averages of mixed scoring, with a total score of 10 or higher.
- Conditional Pass. The committee shall define and document the circumstances for conditional pass and document specific recommendations.
- Fail. Consensus for the scoring of each category, or averages of mixed scoring, with a total score of less than 10.

For all of the above outcomes, a detailed explanation of any deficiencies must be submitted, and recommendations for the student must be provided.

## 7. Advancement to Candidacy

A student must be admitted to candidacy for the doctorate at least 12 months before the degree can be conferred. The 12-month period is the minimum time frame (two semesters plus summer term) needed to fulfill the graduation requirement of 18 credits of BIOE 899: Doctoral Dissertation Research. The following are required for the student's application for admission to candidacy:

- Successful completion of the PhD proposal exam
- Completion of all required coursework with a grade of B (3.0) or better in each of the core courses and a minimum cumulative GPA of 3.0
- [Application for Admission to Candidacy](#) form signed by advisor

All students must be admitted to candidacy within five years after admission to the PhD program. Prior to approval of the Application for Admission to Candidacy form, the BIOE Graduate Office conducts a candidacy audit of the student's file. The form must be received by the Graduate School prior to the 25<sup>th</sup> of each month in order for the admission to candidacy to be processed for the first day of the subsequent month.

## 8. Progress Checklists and Annual Progress Reports

Students must maintain reasonable progress toward the degree. In addition, it is both the advisor's and the committee's responsibility to make sure that the student is pursuing a reasonable path. Ultimately, however, it is the student's responsibility to help choose the path and to move along it purposefully. Reminders and specific deadlines are announced after the end of each spring semester. Progress reports and checklists are due around the beginning of each summer.

### Progress Checklist

Prior to candidacy, students are required to submit an annual Progress Checklist with an updated CV. The student is responsible for consulting with the advisor towards completing the form, obtaining the advisor's signature as approval of satisfactory progress, and submitting the form to the BIOE Graduate Office.

### Annual Progress Report

After advancing to candidacy, students are required to submit an Annual Progress Report. These reports are intended to ensure that adequate progress is being made toward the PhD and should consist of a 1-2 page written summary of research progress and future directions and a current CV. Any changes in topic or direction should be addressed in the Progress Report. If the scope of the dissertation changes significantly after the PhD Proposal Examination, then the student must arrange for a meeting with the Proposal Examination Committee to obtain input and their approval.

The Annual Progress Report should be submitted to the Proposal Examination Committee as well as forwarded to the BIOE Graduate Office ([bioe-grad@umd.edu](mailto:bioe-grad@umd.edu)) by the student's advisor. The advisor indicates whether the student's progress is satisfactory or unsatisfactory and includes comments and recommendations from the committee. The Proposal Examination Committee is informed of the student's progress at least once every year after the student advances to candidacy through the Annual Progress Report.

It is recommended that the Annual Progress Report contain the following sections.

- Overall Research Objective
- Specific Research Objective
- Background
- Methodology
- Accomplishments this Academic Year
- Goals for upcoming Academic Year
- List of student's publications
- List of student's conference presentations

## 9. PhD Dissertation

The ability to do independent research must be demonstrated by an original dissertation on a topic approved by the graduate program in which the student is earning the degree.

### Dissertation Examining Committee

It is recommended that the members of the Proposal Examination Committee also serve on the Dissertation Examining Committee, which must include a minimum of five members of the Graduate Faculty at the University of Maryland.

The Chair of the dissertation committee is the student's advisor, who must be a Full Member of the Graduate Faculty, or who has been granted an exception to the policy by the Dean of

the Graduate School. In some cases, a co-chair is named. Each committee also has appointed to it a Dean's Representative, who must be a tenured member of the Graduate Faculty. External scholars or affiliate faculty may also serve on the dissertation committee.

For more information on dissertation committee membership, see [Graduate School policy on doctoral degrees](#).

The student and advisor must complete a [Nomination of Thesis or Dissertation Committee form](#) no later than six weeks prior to the dissertation defense. The nomination of committee form should be submitted to the BIOE Graduate Office for the Graduate Director's signature. Once approved, the BIOE Graduate Office forwards the form to the Office of the Registrar.

It is the student's responsibility to schedule the date and time of the examination with the committee members. The members must receive the complete dissertation at least ten working days before the scheduled examination. The committee may require the dissertation more than ten working days in advance of the examination.

The student must also submit a defense announcement to the BIOE Graduate Office at least five business days before the defense for distribution to the department. Announcements must include the following: candidate's name, date, time, and location of the defense, dissertation title, committee members' names, and abstract. Oral defenses must be attended by all members of the student's approved Dissertation Examining Committee. Should an emergency substitution on the committee be required, the change must be approved by the Dean of the Graduate School in consultation with the Graduate Director and the Chair/Advisor.

### **Dissertation Examination Procedure**

The dissertation examination consists of two parts: the public presentation and a formal examination.

Part 1: Public Presentation. The public presentation by the candidate covers the main aspects of the research reported in the dissertation. During Part 1, questions from the audience to the candidate are permitted. For questions from persons who are not members of the Dissertation Examining Committee, the Chair of the Dissertation Examining Committee has discretion to decide whether such questions are germane to the topic of the dissertation and how much time can be allotted for the answers.

Part 2: Formal Examination. The formal examination is open only to the Dissertation Examination Committee, other members of the Graduate Faculty, and graduate students from the candidate's graduate program. During Part 2, only members of the Dissertation Examination Committee are permitted to ask questions. Also during Part 2, the student presents, with the advisor's approval, publication goals met for graduation and lists them on the evaluation report, including the number and specific content of archival journal manuscripts to be produced from the dissertation.

For more information on dissertation and doctoral degree policies, see the [Graduate Catalog](#).

## 10. Time Line Recommendations

The recommended time for completion of the entire program for the PhD degree, including the dissertation and final examination, is within 5 years of matriculation. This is accomplished by passing the RAE exam in the winter term of the first year, successfully passing the proposal two years later, and defending the dissertation 2 years after the proposal.

Students must complete the entire program for the doctoral degree, including the dissertation and final examination, during a four-year period after admission to candidacy, but no later than nine years after admission to the doctoral program. Students must be advanced to candidacy within five years of admission to the doctoral program. Under certain circumstances, time extensions may be granted by the Graduate School as outlined below. Admission to the degree program terminates if the requirements are not completed in the time specified. Time taken for an approved Leave of Absence for Childbearing, Adoption, Illness or Dependent Care is not counted in these time limitations.

## 11. Candidacy and Graduation Forms

It is ultimately the student's responsibility to ensure that the proper paperwork is submitted by the posted deadlines. Please contact the BIOE Graduate Office (2330 KEB or [bioe-grad@umd.edu](mailto:bioe-grad@umd.edu)) for questions or assistance.

After the PhD proposal, the following paperwork must be submitted to the BIOE Graduate Office for the Graduate Director's signature and forwarding to the Graduate School;

1. [Application for Admission to Candidacy Form](#)
2. [Nomination of Dissertation Committee Form](#)

Please see the Graduate School's Web site for posted deadlines for graduate degree candidates. The following application must be completed online by the student no later than the beginning of the semester in which s/he plans to graduate:

3. [Application for Graduation](#) (online form)

Prior to the Dissertation Defense, the advisor must pick up the following forms, and submit them to the BIOE Graduate Office promptly after the defense:

4. Report of Examining Committee Form
5. BIOE PhD Dissertation Evaluation Form

After the Dissertation is approved and uploaded, the following form must be submitted directly to the Office of the Registrar (1113 Mitchell Bldg):

6. [Electronic Thesis and Dissertation Publication](#) form

# Master of Science (MS) Program

## 1. Course Requirements

The MS course requirement consists of mandatory core courses as well as restricted and unrestricted elective courses.

### Core Courses

All of the following three courses must be completed in order to fulfill the core course requirement.

- BIOE 601: Rate Processes in Biological Systems
- BIOE 604: Transport Phenomena in Bioengineering Systems
- BIOE 612: Physiological Evaluation of Bioengineering Designs

### Restricted Elective Course

One of the following courses (3 credits) must be completed in order to fulfill the restricted elective course requirement.

- BIOE 602: Cellular and Tissue Biomechanics
- BIOE 611: Tissue Engineering
- BIOE 631: Biosensor Instrumentation and Techniques
- BIOE 632: Biophotonic Imaging and Microscopy
- BIOE 689A: Protein Design and Engineering
- BIOE 689D: Computational Molecular Bioengineering
- BIOE 689J: Bioengineering Devices for Cancer Research
- BIOE 689T: Biomaterials in Immunology and Immunotherapy

### Unrestricted Elective Courses

Four unrestricted elective courses (12 credits), in topics such as engineering, biology, chemistry, mathematics, or computer science must be completed. These courses can be chosen in consultation with the Graduate Program and/or Faculty Research Advisor.

### Typical Course Timeline

#### Semester 1

- BIOE 601 (3 credits)
- BIOE 604 (3 credits)
- Restricted Elective (3 credits)

#### Semester 2

- BIOE 612 (3 credits)
- BIOE 799 (1 credit)
- Unrestricted Elective (3 credits)
- Unrestricted Elective (3 credits)

#### Semester 3

- BIOE 799 (1 credit)
- Unrestricted Elective (3 credits)
- Unrestricted Elective (3 credits)

#### Semester 4

- BIOE 799 (4 credits)

## **Transfer of Credit for the Master's Degree**

- No more than six credit hours of graduate work may be transferred from another institution, unless the program has special approval by the Graduate Council. When changing programs within the University of Maryland, the student may request inclusion of credits earned at the University of Maryland. When moving from non-degree to degree-seeking status, Advanced Special Students may transfer up to twelve (12) graduate credits to the degree program, subject to the approval of the Graduate Program.
- The advisor and Graduate Director will need to certify that transfer courses are applicable to the student's program and, for non-University of Maryland courses, that the courses have been revalidated.
- Credit must have been granted by a regionally accredited U.S. institution or foreign university. If the latter, evaluation by the staff of the International Education Services and the Graduate School is required.
- The courses must be graduate level and have been taken for graduate credit at the original institution.
- The student must have earned a grade of "B-" or better in the course.
- The credit must not have been used to satisfy the requirements for any other degree.
- The student must furnish an official transcript to the Graduate School.
- Transfer work satisfies only the 400-level requirements for the master's degree and does not apply to the upper-level requirements.

The transfer course work must have been taken within seven years of the award of a University of Maryland Master's degree for which the student is currently enrolled (all other course work must be taken within five years of the award of Master's degree.)

A student seeking acceptance of transfer credit is advised to submit the necessary transcripts and certification of program approval to the BIOE Graduate Office as promptly as possible for its review and decision. A form for Transfer or Inclusion of Credit is available online on the Graduate School's webpage:

[http://www.gradschool.umd.edu/images/uploads/Transfer\\_of\\_Inclusion\\_Form.pdf](http://www.gradschool.umd.edu/images/uploads/Transfer_of_Inclusion_Form.pdf)

## **2. Research Advisor Selection**

A research advisor should be identified by the MS student. Ideally, the identification of the research advisor should occur at the time of application to the MS program. However, a research advisor can be identified after enrolling into the MS program. There is no formal mechanism for identifying and selecting the research advisor. A research advisor must be identified by the end of the first semester in the MS program.

## **3. MS Thesis**

A final oral examination of the thesis will be held when the student has completed the thesis to the satisfaction of the student's advisor, all other requirements for the degree have been completed, and a 3.0 grade point average has been earned.

### **Thesis Examining Committee**

The Committee will include a minimum of three members of the Graduate Faculty, at least two of whom will be Full Members. The Chair of the Committee normally will be the



student's advisor, who will be a Full or Adjunct Member of the Graduate Faculty, or who has been granted an exception to the policy by the Dean of the Graduate School.

The student and advisor must complete a [Nomination of Thesis or Dissertation Committee form](#) no later than six weeks prior to the defense. The nomination of committee form should be submitted to the BIOE Graduate Office for the Graduate Director's signature. Once approved, the BIOE Graduate Office forwards the form to the Office of the Registrar.

### **Thesis Examination Procedure**

The thesis examination consists of two parts: the public presentation and a formal examination.

Part 1: Public Presentation. The public presentation by the candidate covers the main aspects of the research reported in the dissertation. During Part 1, questions from the audience to the candidate are permitted. For questions from persons who are not members of the Thesis Committee, the Chair of the Committee has discretion to decide whether such questions are germane to the topic of the thesis and how much time can be allotted for the answers.

Part 2: Formal Examination. The formal examination is open only to the Thesis Committee, other members of the Graduate Faculty, and graduate students from the candidate's graduate program. During Part 2, only members of the Thesis Committee are permitted to ask questions.

For more information on the thesis and Master's degree policies, see the [Graduate Catalog](#).

## **4. Time Line Recommendations**

The recommended time for completion of the entire program for the MS degree, including the thesis and final examination, is within 2 years of matriculation. All requirements for the MS degree must be completed within a five-year period.

## **Academic Advising and Registration!(MS and PhD)**

The Bioengineering Graduate Program has a mandatory advising policy. Initial advising is conducted by the Graduate Director. Once students are matched with faculty advisors, the faculty member conducts the advising.

Once students have completed coursework, they may register for the minimum required research credits to maintain full-time status (see below).

Registration typically begins three months before the start of the new semester. The last day to register without financial penalty is the last business day before the first day of classes. Students must consult with their advisors during the pre-registration period to discuss course selection. Then the advisor should send an email to the BIOE Graduate Office stating that the student has been advised, registration stamps should be given, and which courses the student will be taking. Students will then be notified that the stamps have been issued and they may register.

Students should consult academic and financial deadlines posted on Testudo's Schedule of Classes. Students are responsible for adhering to schedule adjustment (drop/add) policies and financial penalties associated with late changes.

The Graduate School uses a unit system when making calculations to determine full-time or part-time student status. Please note that units are different from credit hours. The number of units per credit hour is calculated in the following manner:

- Courses in the series: 000-399 carry 2 units per credit hour;
- Courses in the series: 400-499 carry 4 units per credit hour;
- Courses in the series: 500-599 carry 5 units per credit hour;
- Courses in the series: 600-897 carry 6 units per credit hour;
- Master's Research course: 799 carries 12 units per credit hour;
- Pre-candidacy Doctoral Research courses: 898 carries 18 units per credit hour;
- Doctoral Dissertation Research: 899 carries 18 units per credit hour.

Students holding regular Graduate Assistantship appointments (20 hours) must be registered for a minimum of 24 units to maintain full-time status.

## Master of Engineering (MEng) Program

The Professional Master of Engineering (MEng) and Graduate Certificate in Bioengineering, administered by the Office of Advanced Engineering Education, are world-class, flexible educational programs designed to advance technical knowledge and career opportunities for working professionals. The requirements are entirely course-based, and courses are available on-campus and online for full-time or part-time study. To learn more about these programs, please visit the [Office of Advanced Engineering Education](#) (OAEE).

Students are admitted to the MEng (PMBI) or Certificate (GCEN) programs by the OAEE Director. Admission requirements and application instructions are posted on the [OAEE Web site](#).

### Advising and Registration (M.Eng.)

Student services, including orientation, enrollment, and graduation, are provided by OAEE staff to all MEng and Certificate students. Academic advising for students pursuing the Bioengineering option is provided by the BIOE Graduate Office. Students should send an email to [bioe-grad@umd.edu](mailto:bioe-grad@umd.edu) to request an advising appointment (in person or remote).

The 30-credit curriculum for the MEng includes 10 three-credit courses. No research or thesis is required for the degree. Students are expected to complete the following six core courses:

- BIOE601: Biomolecular and Cellular Rate Processes
- BIOE602: Cellular and Tissue Biomechanics
- BIOE604: Cellular and Physiological Transport Phenomena
- BIOE612: Physiological Evaluation of Bioengineering Designs
- BIOE631: Biosensor Techniques, Instrumentation, and Applications
- BIOE632: Biophotonic Imaging and Microscopy

Students are additionally expected to complete four elective courses. Electives may be chosen from BIOE offerings (outside of the core courses), or another department's offerings, at the approval of the BIOE Graduate Office.

Course permissions must be granted for all BIOE courses. One core course substitution may be considered for students on a case-by-case basis. Please contact the BIOE Graduate Office for advising.

## Doctor of Medicine / Master of Science (MD/MS) Program

The Doctor of Medicine / Master of Science (MD/MS) Program is a dual degree program offered with the University of Maryland School of Medicine. Students applying to the MD/MS Program must first apply to and be admitted to the MD program at the School of Medicine, and should indicate their interest in the dual-degree program when applying to the Medical School. The program is organized in the following fashion: 2 years MD studies + 1 year MS studies + 2 years MD studies.

The requirements for the MS degree include:

- 18 credits of coursework (six, three-credit courses)
- 6 credits of Master's thesis research (BIOE 799)
- MS thesis and defense

The requirements for the MD/MS program are essentially the same as those for the terminal MS (see Master of Science Program section above). The only variance is in the course requirement, where two Unrestricted Elective courses would be satisfied by courses taken in the MD portion of the curriculum.

Sample Time Line:

Years 1 and 2 of MD curriculum

- MD coursework completed towards Unrestricted Elective requirement (3 credits) (x2)

MS curriculum Summer 1

- BIOE 799 (3 credits)

MS curriculum Fall (Semester 1)

- BIOE 601 (3 credits)
- BIOE 604 (3 credits)
- Restricted Elective (3 credits)
- BIOE 799 (1 credit)

MS curriculum Spring (Semester 2)

- BIOE 612 (3 credits)
- BIOE 799 (1 credit)
- Unrestricted Elective (3 credits)

MS curriculum Summer 2

- BIOE 799 (1 credit)
- MS thesis defense

Years 3 and 4 of MD curriculum

## Doctor of Medicine / Doctor of Philosophy (MD/PhD) Program

The Doctor of Medicine / Master of Science (MD/PhD) Program is a dual degree program offered with the University of Maryland School of Medicine. Students applying to the MD/PhD Program must first apply to and be admitted to the MD program at the School of Medicine, and should indicate their interest in the dual-degree program when applying to the Medical School. The program is organized in the following fashion: 2 years MD studies + 4 years PhD studies + 2 years MD studies.

The PhD program consists of the following requirements:

1. Course Requirement
2. Laboratory Rotation Requirement
3. Research Advisor Match
4. Research Aptitude Examination
5. Teaching Assistant Requirement
6. PhD Proposal Examination
7. Dissertation of Original Research
8. Dissertation Defense

The requirements for the MD/PhD program are essentially the same as those for the PhD (see Doctor of Philosophy Program sections above). The only variance is in the course requirement, where two Unrestricted Elective courses would be satisfied by courses taken in the MD portion of the curriculum.

Sample Time Line:

Years 1 and 2 of MD curriculum

- MD coursework completed towards Unrestricted Elective requirement (3 credits) (x2)

Year 1 PhD program:

Summer

- BIOE 605 (1 credit)

Fall Semester

- BIOE 601 (3 credits)
- BIOE 604 (3 credits)
- BIOE 606 (1 credit)
- Restricted Elective (3 credits)

Winter

- Research Aptitude Examination

Spring Semester

- BIOE 612 (3 credits)
- Unrestricted Elective (3 credits)
- Unrestricted Elective (3 credits)

Years 2-4 PhD program

- TA requirement (2 semesters)
- BIOE 608 (1 credit) (x3)
- BIOE 898 (1 credit) (when needed)
- BIOE 899 (6 credits) (x3, post-candidacy)
- PhD Proposal Examination
- PhD Dissertation Defense

Years 3 and 4 of MD curriculum