

# Graduate Student Handbook

Updated 25 May 2022



THE UNIVERSITY OF ARIZONA  
COLLEGE OF ENGINEERING

**Biomedical Engineering**

## Table of Contents

|   |    |
|---|----|
| Introduction  | 4  |
| Program Requirements                                      | 4  |
| General   | 4  |
| Admission Criteria  | 5  |
| AMP Admissions Criteria                                   | 5  |
| Graduate College Degree Requirements                      | 5  |
| Ph.D. Program   | 6  |
| Transfer Credits  | 6  |
| Qualifying Examination                                    | 7  |
| Selection of Mentor                                       | 8  |
| Plan of Study   | 10 |
| The Comprehensive Examination                             | 10 |
| Comprehensive Examination Committee                       | 11 |
| Overview of the Comprehensive Examination                 | 11 |
| Initial Preparation of the Comprehensive Examination      | 12 |
| Timeline  | 13 |
| Written Comprehensive Examination (Research Proposal)     | 13 |
| Oral Comprehensive Examination                            | 14 |
| Advancement to Candidacy                                  | 15 |
| Dissertation/Prospectus Form                              | 15 |
| Selection of the Dissertation Committee                   | 15 |
| Final Oral Examination (Dissertation Defense)             | 16 |
| Inclusion of Published Papers in the Thesis/Dissertation  | 16 |
| Penultimate Draft of Dissertation                         | 16 |
| Final Copies of Dissertation Document                     | 17 |
| Minor in Biomedical Engineering (Ph.D. Students Only)     | 17 |
| Master of Science (MS) Program                            | 17 |
| Transfer from M.S. to Ph.D. program                       | 19 |
| Transfer Credits  | 19 |
| Matriculation of M.D.-Ph.D. students in BME Ph.D. program | 19 |
| Accelerated Master's Program (AMP)                        | 20 |
| PROGRAM TIMELINE:   | 20 |
| YEAR 1  | 21 |

|   |    |
|---|----|
| YEAR 2  | 21 |
| YEAR 3  | 22 |
| FINAL SEMESTER  | 22 |
| Teaching  | 23 |
| Program administration                                    | 23 |
| Financial Structure                                       | 23 |
| Conferences   | 24 |
| Outside Activities  | 24 |
| Intellectual Property                                     | 25 |
| Deadlines   | 25 |
| Appendix I  | 26 |
| BME 592- Laboratory Rotation                              | 26 |
| Appendix II   | 27 |
| BME 592 Laboratory Rotation Final Report                  | 27 |
| Appendix III  | 28 |
| CODE OF RESEARCH ETHICS                                   | 28 |
| Appendix IV   | 29 |
| Biomedical Engineering Ph.D. Course Requirement Worksheet | 29 |
| Appendix V  | 30 |
| Biomedical Engineering MS Course Requirement Worksheet    | 30 |
| PhD Annual Report   | 31 |
| Appendix VII  | 32 |
| MS Annual Report  | 32 |
| Appendix VIII   | 33 |
| Sample Format for Mentor Acceptance Letter                | 33 |
| Appendix IX   | 34 |
| Biomedical Engineering Graduate Program                   | 34 |
| Appendix X  | 35 |
| Biomedical Engineering Absence Request Form               | 35 |
| Appendix XI   | 36 |
| Guidelines for Mentors                                    | 36 |
| Appendix XII  | 39 |
| Checklist for MS Students                                 | 39 |
| Appendix XIII   | 40 |
| Checklist for PhD Students                                | 40 |
| Appendix XIV  | 42 |
| Research Proposal Details                                 | 42 |
| Appendix XV   | 43 |
| BME Dissertation Prospectus/Proposal Approval Form        | 43 |

## Introduction

Welcome to the Graduate Program in Biomedical Engineering (BME). The purpose of this handbook is to introduce you to the various requirements that must be met before you are granted the Master of Science (M.S.) degree or the Doctor of Philosophy (Ph.D.) degree from the Graduate College of The University of Arizona.

The Department of Biomedical Engineering is committed to providing a welcoming environment, a highly relevant curriculum, and learning experience as a part of your graduate studies in Biomedical Engineering. The strength of the BME Graduate Program derives largely from the flexibility afforded by the interdisciplinary faculty who participate in the Program. This allows each student the freedom to design a unique program of study to meet individual career goals. However, the flexibility of this Program necessitates careful coordination of your program of study with your faculty mentor, the BME Graduate Studies Committee, the BME Graduate Advisor, and the Graduate College. This handbook should be read upon entering the Program, and used, henceforth, in conjunction with the UA General Catalog ([www.catalog.arizona.edu](http://www.catalog.arizona.edu)), as a reference regarding the policies and procedures of the BME Graduate Program at The University of Arizona.

The BME Graduate Program is intended to provide the foundation for a career in Biomedical Engineering. To achieve this, the student requires (a) an appropriate base knowledge of life sciences at the molecular, cellular, organ, and systems level, (b) an appropriate base knowledge of an engineering specialty at the graduate level, (c) experience and training in research, culminating in a major research project, (d) opportunities in teaching, and experience in disseminating research findings.

The BME Graduate Program is designed for completion of the M.S. degree in approximately two years and the Ph.D. degree in approximately five years. Obtaining the Ph.D. degree within this timeframe depends, in large part, on the motivation and self-discipline of the student. The Program is designed to introduce students to research activities during their first year. By design, the coursework requirements are flexible so that the needs of students with diverse areas of specialization can be accommodated. The student, in conjunction with a faculty mentor and the BME Graduate Studies Committee, designs an individualized program of study.

## Program Requirements

### General

At The University of Arizona, the Graduate College sets the overall framework for the completion of the M.S. and Ph.D. degrees. Within these guidelines, the BME Graduate Program establishes specific requirements and monitors student progress. The overall goals of these requirements are to ensure:

- breadth of knowledge in Biomedical Engineering
- depth of knowledge in the student's area of specialty
- rigorous research training

- training in career skills (writing, speaking, critical evaluation of the literature)
- opportunities for training in teaching skills
- exposure to employment opportunities in academic and industrial environments

In addition, the guidelines and requirements that are described in this handbook have been established to ensure the protection of student interests and successful completion of the M.S. or Ph.D. degree.

### Admission Criteria

A Bachelor's degree in engineering, physical or life sciences, or mathematics will be required for admission to the program. Calculus I and II, ordinary differential equations, and at least one course in life science are normally required for admissions. For applicable international students, English Proficiency credentials as stated on the Graduate College website: <https://grad.arizona.edu/admissions/requirements/international-applicants#english-proficiency>

- *Ph.D. application deadlines are December 1st for international students and January 6th for domestic students for admission for Fall semester.*
- *M.S. application deadlines are*
  - *Fall: February 1st for international students and March 1st for domestic students.*
  - *Spring: August 1st for international students and September 1st for domestic students.*
- *AMP application deadline is June 1<sup>st</sup> for students who expect to graduate in May of the following year.*

### AMP Admissions Criteria

Students interested in the Accelerated Master's Program (AMP) may apply after completion of a minimum of 75 eligible undergraduate credit hours and can enter the program after completion of a minimum of 90 eligible undergraduate credit hours. Applicants must have substantially completed their general education requirements and expect to complete their undergraduate degree in 4 years. The minimum GPA at the time of admission and entry to the program is a 3.3, per Graduate College.

Students applying to the BME AMP go through the regular graduate application process with the following exceptions:

1. In the personal statement, the student should indicate why they are interested in BME graduate education and the accelerated program specifically.
2. The student **does not** need to take the GRE.
3. Student is required to submit **unofficial** UA transcripts.
4. Application code required. **UAAMP721X01**

In addition to regular criteria, the admissions committee will evaluate whether the applicant has demonstrated the maturity necessary for success in an accelerated, highly competitive program.

### Graduate College Degree Requirements

Students are expected to comply with the regulations of the Graduate College with respect to residence, credit hour requirements, and the Qualifying and Comprehensive Examinations (please refer to the Graduate College website <http://grad.arizona.edu>). A high level of performance is expected of students who are

enrolled in graduate programs at The University of Arizona. Students must maintain a grade point average of 3.00 (letter grade of B) or better to continue enrollment in the degree-granting program, receive financial support, and to be awarded an M.S. or Ph.D. degree.

The BME Graduate Program considers full-time enrollment for funded PhD students to be 12 graduate units per semester/MS students to be 9 units for their first two semesters of enrollment. After that, full-time required enrollment will be at least 6 graduate units per semester, unless the student is funded via Graduate Assistantship Research or Teaching, in which case the College of Engineering policy requires enrollment in 9 graduate units.

Graduate College regulations stipulate that at least 22 units (i.e. half the required coursework) on the Ph.D. Plan of Study must be in courses in which regular grades (A, B or C) have been earned.

(<http://grad.arizona.edu/>).

### Ph.D. Program

Ph.D. students must complete a minimum of 63 units of graduate credit and meet the Graduate College's minimum units of courses in which regular grades (A or B) have been earned. Requirements include: 15 units of the core BME courses (BME **510**, **511**, 516, **517**, 520, 561, 566, 577, 581B, 586; bolds are required for all students; choose 6 additional units from the others); 10 units in the major; a minimum of 9 units in the minor; 6 units of BME seminar/student forum; 3 units in a BME approved ethics course; 2 units of laboratory rotations (BME 592) and 18 units of BME 920 (dissertation). Courses will include graduate engineering, life or physical sciences, or mathematics courses that focus on the student's biomedical engineering research interests according to the student's plan of study. A [Plan of Study](#) should be developed by the student and faculty mentor and a copy of the written plan, along with a one-paragraph summary of the proposed dissertation research area and a listing of the proposed Comprehensive Examination, shall be sent to the BME Program office for review and approval by the Graduate Studies Committee by **October 1** of the third semester in the program.

If the student and mentor decide to alter the Plan of Study, an amended plan shall be submitted to the Graduate Studies Committee for approval. Please see the BME Graduate Advisor for details on developing and submitting the Plan of Study.

During the course of study, the student must pass the Qualifying Examination (to continue in the Ph.D. program), the Comprehensive Examination, and a Final Examination (dissertation defense).

After completion of the required credits, a student in the Ph.D. program may wish to obtain the M.S. degree. Refer to [Master of Science section](#) of this handbook for the M.S. Program.

### Transfer Credits

In some cases, certain degree requirements may be waived if equivalent course work has been completed previously. Please see [Graduate College policies for transferring credits](#) (<https://catalog.arizona.edu/policy/acceptability-graduate-transfer-credit>). Once Graduate College policies have been followed, the BME Graduate Studies Committee will review requests and make decisions about

course acceptance. Additional information such as the course syllabus, course description, or other items may be requested. Please contact the BME Graduate Advisor for more information.

## Qualifying Examination

### Exam timing

Once each year at the beginning of each Fall semester, with the first being in Fall 2019, during the week before classes start. Full-time Ph.D. students are expected to take the exam in the week before their second year in the Ph.D. program begins.

### Eligibility

Students must have completed BME 510, BME 511, BME 517 (common cores), and two of the following: Core Electives, with no lower than a “B” grade these courses and not be on academic probation. If students have already taken 400-level version courses of these common cores and core electives at the University of Arizona, they are eligible for Qualifying Exam with the instructor’s consent. However, they should take additional 500-level courses to fulfill the unit requirement for graduation. If these core courses are changed in the future, students must complete the common cores and core electives from the updated lists.

### Content

A uniform, written examination, will cover three core subject areas:

- BME 510 (3) – Biology for Biomedical Engineering (Fall)
- BME 511 (3) – Physiology for Biomedical Engineering (Spring),
- BME 517 (3) – Measurement and Data Analysis in Biomedical Engineering (Fall)
- As well as two core-elective subject area (cannot be from the same category), chosen from
- Biomaterials:
  - BME 561 (3) – Biological and Synthetic Materials (Fall)
  - BME 586 (3) – Biomaterial-Tissue Interactions (Spring)
- Biomechanics
  - BME 566 (3) – Biomechanical Engineering (Fall)
- Biomedical Imaging & Optics
  - BME 516 (3) – Biomedical Imaging (Spring)
  - BME 520 – Biophotonics (Spring)
- Biomedical Informatics
  - BME 577 (3) – Intro to Biomedical Informatics (Fall)
- Cell and Tissue Engineering
  - BME 581B – Cell and Tissue Engineering (Spring)

- Students are allowed to ask the instructors of these core courses for guidance prior to the Qualifying Exam.
- Questions are required to be submitted for GSC review by the end of the preceding April.
- Each exam question will be reviewed by GSC.

## **Schedule**

Core exam would be administered over two hours for three common cores (40 minutes per subject), then students would receive one-hour lunch break, then return for one and a half hours for two core elective questions (45 minutes per subject).

## **Grading Methodology**

Each subject area must be passed in order to pass the exam and proceed to the Ph.D. Comprehensive Exam.

Each question on the exam is graded on a 100-point scale, and graded questions are turned in to the Graduate Studies Committee.

An average score for all students is then determined, separately for each question on the exam. If the average score for a question is below 75, all of the raw scores for that question are scaled up such that the average of the scaled scores is 75. If the average of the raw scores is above 75, the raw scores remain unscaled.

For each of the 5 subject areas, if the subject score is above 65, the student passes the topic. If the subject score is below 65, the Graduate Studies Committee evaluates the performance of the student and determines whether or not the student passes or fails the topic. The committee may consider factors such as overall group performance in a given subject area, and question difficulty. Thus, in some cases, students who score slightly below the passing threshold of 65 on a topic may be passed on that topic.

If a student passes all subject areas, the exam is passed. If a single subject is failed and the four other subjects are passed, the student's performance is evaluated as "conditional", and the student is given the option of a re-test in the failed subject area. Scheduling of this re-test will be determined by the Graduate Studies Committee, within the same fall semester. If two or more subject areas are failed, the student fails the exam and is permitted a single re-test of the exam when it is offered the following year. The student's Comprehensive Exam would also be delayed by a year.

All students are permitted to receive copies of their graded answers after the results of the exam have been announced.

Successful completion of the qualifying examination is required prior to taking the Comprehensive Examination.

## **Selection of Mentor**

Each student should select a faculty mentor no later than the end of the first semester in the program. A faculty mentor is a BME faculty member who will serve as an advisor, supporter, tutor, and role model. A



faculty mentor is expected to interact with the student on a regular basis providing guidance, advice, and the intellectual challenge necessary for the student to complete the degree program. Except in the case of self-funded M.S. students, the student is expected to work with the mentor and the BME Program to identify the source of the student's financial support after the initial semester.

The BME major advisor (mentor) cannot serve as the student's advisor for a non-BME minor.

The following suggestions may be of assistance to graduate students in choosing a mentor. There are two broad areas that come into play when choosing a mentor. The first area has a professional basis and the second a personal basis. The choice of a mentor may be the single most important decision made during graduate training. When considering the professional aspects of your selection of a mentor, the following questions may prove helpful:

1. What is this individual's reputation outside the University? Remember, when you have completed your dissertation and you are looking for a position, your mentor's reputation will initially be your reputation.
2. Does your prospective mentor have the funding available to support your research and stipend for at least four years? This area is probably the most problematic for graduate students. The money needed to fund your research project will most likely come from your mentor's laboratory. Therefore, you will need to know, not only the amount of money available, but also the stability of funding.
3. How does your prospective mentor's lab operate? You should critically evaluate the day-to-day operations of the lab and understand the goals of the lab and where you will "fit in". You should also understand the role of your mentor in those operations. Some principal investigators have lab managers or research assistants who run the laboratory. You should know almost as much about these individuals as about your prospective mentor.
4. What are the professional requirements of the prospective mentor on such issues as work habits, ethics, sharing of ideas, lab meetings, journal clubs, and authorship on papers?

On the personal side, the answers to the following questions may be extremely helpful:

1. Is the personality of my prospective mentor compatible with my own?
2. Is this individual going to be responsive to my needs and, just as important, am I going to be responsive to his or her needs? When you join a lab, your mentor will have certain expectations of you, and these should be identified when evaluating a prospective mentor. By the same token, what are your expectations of a mentor?
3. What do other students and faculty think about your prospective mentor? The collegial relationship of your prospective mentor with others will influence your interaction with other laboratories.

Be sure to place a great deal of importance and thought into your faculty mentor selection. Talk to other people (including the mentor's current and previous students) about your prospective mentor and ask clarifying questions. Provide yourself with honest answers to both the professional and personal aspects of

your decision. Laboratory rotations are an excellent way to learn more about prospective mentors and labs and can provide opportunities to answer these questions before choosing a mentor.

Once you have identified a faculty mentor, you and your mentor should inform the BME Graduate Program of this selection in writing. The letter should indicate that the professor has agreed to serve as your advisor for your graduate studies; they will endeavor to ensure that you have financial support (for Ph.D. students) during your tenure as a graduate student and that you complete the requirements for the M.S. or Ph.D. degree in a timely fashion. It should be signed by both the student and faculty member and submitted to the BME Graduate Advisor ([See Appendix for sample letter](#)).

### Plan of Study

A [Plan of Study](#) should be developed after passing the BME core courses. This should be done in conjunction with the Mentor, at the beginning of the second year in the Program. This Plan of Study identifies courses to be transferred (if any) from other institutions, courses completed at the University of Arizona to be applied toward the Ph.D., and any additional courses that may be needed to fulfill the requirements for the Ph.D. degree. In addition, students must submit a one-paragraph summary of the proposed dissertation research area and a listing of the proposed Comprehensive Examination Committee members. The student submits the Plan of Study to the BME Graduate Advisor, and needs approval by the student's advisor/mentor, and the Associate Department Head for Graduate Affairs in the Department of Biomedical Engineering. Once approved, the student will then submit their Plan of Study in GradPath.

### The Comprehensive Examination

Before admission to candidacy for the Ph.D. degree, the student must pass a written and an oral Comprehensive Examination.

A student must meet the following requirements to qualify for the Comprehensive Examination:

- The student has successfully passed the Qualifying Examination
- The student has satisfactorily completed the core coursework (with a B or better) for their major and minor. Minor coursework may be concurrently registered in the semester the student plans to take their Comprehensive Exam.
- The student has submitted their Plan of Study via GradPath.
- The student has selected a Major Advisor and finalized a Comprehensive Examination Committee, also submitted via GradPath.

The Comprehensive Examination is considered a single examination, although it consists of written and oral portions, both designed to meet two main objectives:

- To evaluate the proficiency of the student's knowledge of biomedical engineering
- To evaluate the ability of the student to:
  - independently evaluate and critique a body of biomedical engineering literature,
  - integrate the acquired information into broad conceptual schemes,
  - develop specific, measurable, and achievable goals
  - design experimental approaches to evaluate hypotheses or achieve stated goals
  - demonstrate the written and oral communication skills required to present, defend, and disseminate research ideas and plans.

The Comprehensive Examination must be taken no later than the fifth semester in the Program. The Associate Department Head for Graduate Affairs may grant an extension only for compelling reasons upon written petition by the student and recommendations from the student's Major Advisor (if selected).

### Comprehensive Examination Committee

Before the beginning of the second year in the program, the student selects a Comprehensive Exam Committee, which will conduct the exam. (This does not necessarily have to be identical to the student's eventual Dissertation Committee, but it can be.)

The Comprehensive Examination Committee must consist of at least four members, including at least three members of the BME Faculty (one of whom is the Major Advisor) and one faculty member from the student's minor field (if required). The Major Advisor and two additional members must be current tenured, or tenure-track faculty members, or approved tenure equivalent. The fourth member may be tenured or tenure-track, or an approved special member. Special members must be pre-approved by the Dean of the Graduate College. Any members beyond the fourth can also be current tenured or tenure-track faculty members or approved special members. Note: All members of the Exam Committee require Graduate Academic Advisor, Associate Department Head for Biomedical Engineering Graduate Affairs, and Graduate College approval. Additional representation on the Comprehensive Exam Committee may be requested.

One of the BME faculty members, other than the Major Advisor, will serve as chairperson and will preside over all examinations and deliberations of the committee.

### Scheduling

For scheduling requirements of the Graduate College, students are advised to consult the Graduate Academic Advisor and the Graduate College publication "Comprehensive Examination for Advancement to Candidacy."

To formally schedule a doctoral oral comprehensive examination, students must use GradPath using the link within the UAccess Student Center to submit the necessary forms. This process can take several business days and needs to be done well in advance of the examination.

Students must have submitted earlier the "Responsible Conduct of Research" confirmation form and have an approved "Plan of Study."

To schedule the oral comprehensive examination, students must submit the "Comprehensive Examination Committee Appointment Form" prior to submitting the "Announcement of Doctoral Comprehensive Examination".

### Overview of the Comprehensive Examination

The Comprehensive Examination consists of two parts, a written and an oral examination.

- For the written exam, students prepare a research grant proposal that follows the guidelines of a NIH Kirschstein Predoctoral fellowship (see "[written examination](#)" for guidelines). Other similar format (e.g., NIH R03/R21, NSF research proposal, DoD research proposal, etc.) may be used, if approved by

the student's Comprehensive Examination Committee and the Associate Department Head for Biomedical Engineering Graduate Affairs.

- The oral examination consists of an in-depth examination of the topic addressed in the research proposal and a broad examination that can cover any aspect of the BME graduate curriculum and/or the chosen minor field of study (see "[oral examination](#)" for guidelines).

The Comprehensive Examination will evaluate the written proposal, its oral defense, and fundamental knowledge of biomedical engineering. Proficiency in each of these areas is necessary.

### Initial Preparation of the Comprehensive Examination

The student must convene an initial meeting with the committee to select:

- a specific topic for the research proposal
- a date for submission of the research proposal (written examination): 6-8 weeks after the topic is approved by the committee
- a potential date for the oral examination: no later than 12 weeks after the initial meeting
- Notes from all committee meetings are required to be sent electronically to the Graduate Advisor for the student's file.

Prior to the first meeting, the student submits a pre-proposal to the committee (one page). The pre-proposal should outline a rationale for the topic/problem to be studied and 2-3 questions (or Aims) that will be addressed later in the proposal.

The questions addressed by the pre-proposal must allow the student to develop and address a working hypothesis regarding an unresolved issue, or an unmet need, in biomedical engineering. The pre-proposal should reflect an informed analysis of the problem and the relevant literature and should be supported by key citations.

At the first committee meeting, the committee will evaluate whether the topic and the outlined questions of the proposal are appropriate to design a hypothesis-driven or engineering design research proposal. The committee chair is charged with ensuring that an appropriate evaluation has been carried out and that appropriate dates for the written and oral examination (see timeline) have been selected.

It is recognized that sometimes it may be unavoidable that parts of a specific aim of a student's proposal are similar to that of an active or submitted grant application by the advisor. The committee is tasked to define what degree such a "thematic" overlap is tolerable. If in question, the advisor may provide copies of the respective grant application to the committee.

The written proposal must be primarily the work of the student. It is not permitted to cut and paste or "slightly" modify any part of an existing research proposal (being current or in draft form). If a partial thematic overlap exists, it is expected to exhibit significant divergence from existing ones.

Completed research work should not be used as a research proposal, even if the work was completed primarily by the student. This includes a journal article (published, submitted, or in preparation), a conference proceeding article (published, submitted, or in preparation), a conference presentation

(presented), or any other equivalent work. Such completed research work can only be used as a background material for the research proposal.

The research proposal can be used towards the student's future dissertation.

Before and during the preparation of the proposal, the student may have general discussions on background information, or the strengths and weaknesses of experimental approaches and techniques with members of the Comprehensive Examination Committee or the Major Advisor. It is not appropriate to ask any other person to review any parts of the written proposal, even in draft form.

### Timeline

- Initial committee meeting and identification of a specific topic for the research proposal: ideally during the third or fourth semester; at the latest by the end of the fifth semester
- Deadline for submission of research proposal (time of written exam): 8 weeks after initial committee meeting
- Written exam outcome, including written comments/feedback: no later than 2 weeks after submission of the proposal
- Oral examination: 2-6 weeks after successful completion of written proposal

### Written Comprehensive Examination (Research Proposal)

After selection of the specific research topic, the student will have 6-8 weeks to write a grant application based on the selected problem. The student will need to evaluate the literature in the selected area, formulate a significant and relevant hypotheses or engineering goals, and devise experimental strategies to test hypotheses or achieve goals.

The topic of the research proposal can be from any area of biomedical engineering, and may be part, or the focus of the student's planned dissertation research. The emphasis of the research proposal should not be just a review of the literature but a creative experimental dissection of the selected problem. The proposal should address an unresolved issue in biomedical engineering. The proposal can be "hypothesis-driven", where a hypothesis or hypotheses are generated, and experiments are designed to test them; or "engineering design" where technologies and methods are designed to solve a real-world problem.

There is an expectation of substantial depth of knowledge in the research area. A key element of the proposal defense will be to explain and defend the importance of the questions to be addressed, and to place these questions in the broader context of the field. Thus, in both the significance section of the written proposal and in the subsequent oral defense, the student should be able to marshal knowledge from the relevant literature and from broader areas of biomedical engineering.

The research proposal should follow the basic form of an NIH Predoctoral NRSA grant application. The proposal should aim to cover 3 years of research. Please see [Appendix](#) for additional guidance. As explained in Overview section, other similar format (e.g., NIH R03/R21, NSF research proposal, DoD research proposal, etc.) may be used, if approved by the student's Comprehensive Examination Committee and the Associate Department Head for Biomedical Engineering Graduate Affairs.

The Written Comprehensive Examination (research proposal) must be electronically submitted to the chair of the committee and copy to the Graduate Academic Advisor within 8 weeks after the initial meeting (PDF or Word format).

The student's research proposal will be distributed to all committee members for their evaluation, using the following criteria:

- Expectations that pertinent literature in the chosen area of interest is presented in substantial depth and that the addressed problem is presented in relation to a wider context (“big picture”).
- Expectation that the existing knowledge is critically and scholarly evaluated such that specific gaps in our knowledge are identified.
- Expectations that hypothesis-driven approaches are proposed and that the logic connecting the hypothesis, experiment approaches, experimental outcomes, and possible conclusions is clearly developed and presented.
- Proposal uses appropriate English language and grammar.

Each committee member will submit a score from 0-100 (100 being the best) and an average score of 70 is required for passing the written portion of the exam. The Comprehensive Examination Committee can request the Associate Department Head for Biomedical Engineering Graduate Affairs to provide a sample grading rubric.

Additionally, committee members are asked to provide constructive and useful written feedback to the student regarding major weaknesses of the proposal (either in the submitted file or as a formal review). The chair of the committee will compile these comments and transmit them to the student together with the average grade.

The chair of the committee will notify the student, the other members of the committee, and the Graduate Academic Advisor, within 2 weeks of submission of the proposal. The student must have passed the Written Comprehensive Examination in order to proceed to the Oral Comprehensive Examination.

**Written Comprehensive Exam Retake Policy:** At the discretion of the committee, a student who fails the Written Comprehensive Examination may be permitted to repeat the examination once. It is also the discretion of the student's committee to decide whether the student will be permitted to revise and resubmit the failed proposal, or whether the student must submit a new proposal on a different research topic. A repeated Written Comprehensive Examination must be completed within 5 months after the first examination.

### Oral Comprehensive Examination

The Oral Comprehensive Examination is intended to assess the student's general knowledge in biomedical engineering pertaining to their written proposal, at the level of the core BME courses, and to examine the student in more detail in those areas pertinent to the student's Plan of Study.

The Oral Comprehensive Examination will last not more than 3 hours, but be at least 1 hour. Students are encouraged to meet with the Comprehensive Examination committee frequently while preparing for the Oral Comprehensive Examination, and to discuss the possible scope of questions with them prior to the

examination. Students in the past have scheduled practice or mock oral examinations with peers who have completed exams, to practice the format and style of the Oral Comprehensive Examination.

The student is expected to answer the comprehensive questions related to their written proposal that are provided by the committee members.

At the end of the Oral Comprehensive Examination, the student will be excused, and the committee will make a recommendation on the outcome: pass or fail. The committee chair will report the result electronically via GradPath.

### **Advancement to Candidacy**

When the student has passed the written and oral portions of the Comprehensive Examination, and the Graduate Student Academic Services office has confirmed completion of the required courses on the approved Ph.D. Plan of Study, the student will advance to Ph.D. candidacy. The Chair of the Comprehensive Examination Committee must complete the “Results of the Oral Comprehensive Examination for Ph.D. Candidacy form”. This form is available in the GradPath system via UAccess. The form should be submitted electronically where it will be sent to the Graduate College for recording. Please review the [current Graduate College policy \(https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#comprehensive-exam\)](https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#comprehensive-exam) for details of completing this form.

### **Dissertation/Prospectus Form**

Every student in a doctoral program needs to have an approved dissertation prospectus or proposal file within their department. As soon as the student has an approved [prospectus/ proposal](#) on file with the department, the department’s Graduate Advisor will submit the prospectus/proposal conditional form in GradPath on behalf of the student.

### **Selection of the Dissertation Committee**

The composition of the Comprehensive Examination Committee and the Dissertation Committee can be the same but is often different. The student must complete the “Dissertation Committee Appointment” form via the GradPath system. The requirements regarding tenure and tenure-eligible status for Dissertation Committee members are the same as those for the Comprehensive Examination Committee. The chairperson for this committee is the student’s dissertation advisor (major advisor). The committee must consist of at least four faculty members, two of which must be BME faculty and one which must represent the minor. See [policies \(https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#dissertation-committee\)](https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#dissertation-committee) for additional criteria for composition of the Dissertation committee.

The student must meet with the dissertation committee at least once per year, beginning within one year of the approval of their Plan of Study, to allow an evaluation of progress and to receive feedback.

### **External Reviewer (optional)**

It may be appropriate that an external reviewer be appointed to the dissertation committee. Most often this person is from outside the University of Arizona. However, if circumstances warrant, this person could be

from within the University of Arizona. The concept of having an External Reviewer is to add strength and expertise to the Committee that may not exist within the University of Arizona. If an External Reviewer is chosen, it is strongly recommended that this occurs early to allow this person to make significant contributions to the student's graduate program. It is expected that the mentor covers any and all costs incurred in the participation by the External Reviewer. This external reviewer is not a voting member of the student's committee (unless the student petitions the Graduate College for an exception as noted above).

### Final Oral Examination (Dissertation Defense)

The Final Oral Examination is your dissertation defense. All Dissertation Committee members must be present for the dissertation defense, either in person or via teleconference. **The “Announcement of Final Oral Examination” form is a required form that must be submitted at least 10 working days prior to the examination (defense) date.** This form is available in the GradPath system via UAccess. The form should be submitted electronically through Grad Path where it will be routed to the BME Graduate Advisor, the student's committee members, the Chair of the BME Graduate Program and the Chair of the minor area's Graduate Program for their review and approval. Ph.D. students are required to attend the weekly BME seminar and present their dissertation research during the last year in the program.

### Inclusion of Published Papers in the Thesis/Dissertation

Upon recommendation of the student's mentor and thesis/dissertation committee, the BME Graduate Program permits dissertations and theses to include published and submitted papers, see [Graduate College Dissertation Formatting Guide \(https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#dissertation\)](https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#dissertation) . In addition to the requirements contained in the Graduate College guide, BME students must adhere to the following guidelines:

1. Each paper included in the thesis/dissertation must contain significant effort from the student, and be substantially written by the student. The body of the dissertation must include a description of which parts of each paper include the student's original, individual work.
2. The thesis/dissertation may include papers that are published in, accepted by, or submitted to refereed journals. Other publications (e.g. conference proceedings, non-refereed journal papers, or book chapters) may be included if approved by the student's mentor and thesis/dissertation committee.
3. It is the responsibility of the mentor and the thesis/dissertation committee to assure that each paper includes the significant effort of the student.
4. A student's thesis/dissertation committee must include at least one member who is not an author on the included papers.

### Penultimate Draft of Dissertation

Submit copies of the draft of your dissertation document to your committee. Make sure you allow adequate time for your committee to review and for you to prepare the final version. The final version must be submitted to the Graduate Student Academic Services Office at least two weeks prior to the Library deadline.



## Final Copies of Dissertation Document

Please see the Graduate College for [current requirements of microfilming and archiving of the final dissertation](https://grad.arizona.edu/gsas/dissertaions-theses/submitting-your-dissertation) (<https://grad.arizona.edu/gsas/dissertaions-theses/submitting-your-dissertation>). Also, be aware of requirements of a letter from the Human/Animal Subjects Committee (IRB or IACUC) if work included in your dissertation project was subject to such a review.

One final *electronic* copy of the final dissertation is to be emailed to the BME Graduate Advisor.

Please check with the Graduate College for appropriate [dates and deadlines](https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines) (<https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>) for submission of dissertation documents and forms for a particular semester.

## Minor in Biomedical Engineering (Ph.D. Students Only)

The Graduate College requires all Ph.D. students to complete a "minor" program of study. Ph.D. candidates in the disciplines other than BME may select a minor in BME.

- Life science majors: 9 units total - 6 units selected from BME core courses (BME 510, 511, 516, 517, 520, 561, 566, 577, 581B, 586) and 3 units from graduate BME courses in general. No non-traditional classroom experiences (rotations, independent study, internship, seminar, etc.) may be included in these 9 units.
- Engineering and Imaging majors: 9 units total – 6 units from BME core courses (BME 510, 511, 516, 517, 520, 561, 566, 577, 581B, 586; 3 units should be either BME 510 or 511) and 3 units from graduate BME courses in general. No non-traditional classroom experience (rotations, independent study, internship, seminar, etc.) may be included in these 9 units.

Completion of these courses with a "B" average for the required units is necessary for granting of the minor. BME does not require representation at the Written Comprehensive Examination, but does require a BME faculty member to be present at the Oral Comprehensive Examination, and BME-related material must be covered. The student's dissertation (Final Oral Examination) committee must contain one BME faculty member. This committee member must be present at the dissertation defense, either in person or by teleconference. The BME Program, via the BME faculty member and Graduate Studies Chair receives a GradPath approval request for the student's Ph.D. Plan of Study at the time they declare their minor in BME. The student's non-BME major advisor (mentor) cannot serve as the student's advisor for a BME minor.

A BME Ph.D. student may choose to major and minor in Biomedical Engineering, i.e. obtain a "Distributed Minor in Biomedical Engineering". The distributed minor consists of 9 units of formal graded course work in any area of Biomedical Engineering, excluding major course work, seminars, and lab rotations (does not need to be courses housed in the BME department, but in an associated area subject to Graduate Studies Committee approval).

## Master of Science (MS) Program

All M.S. students in the program must take a minimum of 30 units of graduate credit including the following courses:(a) two BME core courses (BME 510, 511); (b) either BME 517 - Measurement and Data Analysis in

Biomedical Engineering or BME 547 - Sensors and Controls, (c) one course of BME focus areas (BME 516, 561, 566, 577, or 586); (d) two units of BME seminar/student forum; (e) 1 unit of BME 592 (lab rotation); (f) 9 units in graduate engineering, life or physical sciences, or mathematics courses; and (g) 6 units of BME Thesis or 3 units of MS Report and another 3 unit graduate course. The units of (f) will focus on the student's biomedical engineering research interests such that the courses complement and broaden the student's undergraduate degree and provide the student with the skills necessary to complete the research. The courses will be established in consultation with the student's mentor and Thesis committee. The courses chosen should be based on the student's area of specialization.

Full-time M.S. students must register for at least 9 units their first two semesters. In subsequent semesters, M.S. students must register at least for the minimum number of units that leads to completion of all degree requirements by the end of the fourth semester, which satisfies Graduate College requirements, and which satisfies requirements of their funding source, if any. Unfunded M.S. students on approved part-time status must meet minimum Graduate College requirements.

The student and mentor should develop a "[Plan of Study](#)" for the M.S. degree as soon as possible and no later than March 1/October 1 in their 2<sup>nd</sup> semester, depending on their start date. This Plan of Study identifies courses to be transferred (if any) from other institutions, courses completed at the University of Arizona to be applied toward the degree, and any additional courses that may be needed to fulfill the requirements for the degree, along with a maximum one-page summary of the proposed thesis (background/significance and aims/objectives), and a listing of the proposed Thesis committee members. The student submits the Plan of Study to the BME Graduate Advisor, and it will then go to the BME Graduate Studies Chair for review and approval. Once approved, the BME Graduate Advisor will notify the student, and the student will then submit the approved Plan of Study to the Graduate College Degree Certification Office through the GradPath system via UAccess. If the student and mentor alter the original goals, an "amended" Plan of Study shall be submitted to the BME Graduate Advisor and onward to the Graduate Studies Chair for approval. All M.S. students must complete the "M.S. Committee Appointment" form via the GradPath system whether or not the student has a committee. The M.S. Thesis committee should be composed of at least three members, two of which must be BME tenure or tenure eligible faculty. The M.S. Thesis committee should meet within six months of submission of the Plan of Study, but no later than the beginning of the second year.

The [format for the thesis](https://grad.arizona.edu/gsas/dissertations-theses/dissertation-and-thesis-formatting-guides) (<https://grad.arizona.edu/gsas/dissertations-theses/dissertation-and-thesis-formatting-guides>) shall follow the instructions specified by the Graduate College. Students shall complete 6 units of BME Thesis and perform original laboratory research. A complete draft of the thesis should be delivered to all members of the student's graduate committee ***no later than 4 weeks prior*** to the anticipated M.S. defense date. All thesis committee members are required to be present at the defense, either in person or via teleconference. After successful defense and final editing of the thesis as per instructions from the student's committee at the defense, the student is required to submit one electronic copy of the thesis to the BME program. Please see the [Graduate College for requirements of microfilming and archiving of theses](https://grad.arizona.edu/gsas/dissertations-theses/submitting-and-archiving-your-thesis) (<https://grad.arizona.edu/gsas/dissertations-theses/submitting-and-archiving-your-thesis>).

In certain circumstances, a mentor may suggest a M.S. Report. In this case, please see the BME Graduate Advisor or BME Graduate Studies Committee Chair to discuss.

### Transfer from M.S. to Ph.D. program

Any BME graduate student wishing to transfer from their current M.S. program into the Ph.D. program must complete the following:

1. Students must submit an official graduate application through the Graduate College <http://grad.arizona.edu>
2. Letter of support from mentor (PI) stating that the candidate:
  - a. Is in good academic standing (GPA 3.0 or higher) (Satisfactory Progress – from Graduate college website – <http://grad.arizona.edu/academics/policies/academic-policies/satisfactory-academic-progress>).
  - b. Will have continued mentor support (funding) while matriculating in the program (or until graduation).

### Transfer Credits

In some cases, certain degree requirements may be waived if equivalent course work has been completed previously. Please see [Graduate College policies](#) for transferring credits. Once Graduate College policies have been followed, the BME Graduate Studies Committee will review requests and make decisions about course acceptance. Please contact the BME Graduate Advisor for more information.

### Matriculation of M.D.-Ph.D. students in BME Ph.D. program

Review Program Overview from the M.D.-Ph.D. website <http://mdphd.medicine.arizona.edu/admissions>

1. 2 rotations (2 credit hours of BME 592) will be completed prior to entering the BME Ph.D. program (typically completed in the summers following years 1 & 2).
2. The M.D.-Ph.D. student will receive a minor in Multidisciplinary Minor (9 credit hours) for completion of the first two years in M.D. program per guidelines
3. Applicable core courses may be waived if taken previously at a lower level and with approval by course instructor. *Students will need to take the same total number of credits for graduate degree.*
4. BME 517 is a required course and must be taken by students in Fall semester.
5. Choose at least **two** courses from different focus areas (6 units total) of:
  - Biomaterials:
    - BME 561 (3) – Biological and Synthetic Materials (Fall)
    - BME 586 (3) – Biomaterial-Tissue Interactions (Spring)
  - Biomechanics
    - BME 566 (3) – Biomechanical Engineering (Fall)
  - Biomedical Imaging & Optics
    - BME 516 (3) – Biomedical Imaging (Spring)
    - BME 520 – Biophotonics (Spring)
  - Biomedical Informatics
    - BME 577 (3) – Intro to Biomedical Informatics (Fall)
  - Cell and Tissue Engineering

- BME 581B – Cell and Tissue Engineering (Spring)
- 6. SLHS 649 Survival Skills & Ethics (3) (Alternate bioethics course option with GSC approval)
- 7. An additional 10 credit hours in coursework acceptable for BME Ph.D. must be completed. (Not to include seminar/forum or dissertation). It is advised that these courses provide the proper foundation for the Comprehensive Exam and dissertation (research) work.
- 8. The Comprehensive Exam will be taken at the end of year 1 in the BME program.

### Accelerated Master's Program (AMP)

Students take 12 units of BME graduate courses in their senior year (can include any BME 500 level graduate course). These courses apply towards both the Bachelor's and Master's degrees, though, AMP students are strongly advised to check with their Undergraduate Advisor to ensure courses selected meet their respective Bachelor's requirements. A graduate "Plan of Study" must be submitted to the BME Graduate Program office no later than March 1st of the senior year (October 1st for students admitted for spring). The student submits the Plan of Study to the BME Graduate Advisor, who will send it to the BME Graduate Studies Chair for review and approval. Once approved, the BME Graduate Advisor will notify the student and the student will then submit the approved Plan of Study to the Graduate College Degree Certification Office through the GradPath system via UAccess. The form will then be routed to the BME Graduate Advisor, the student's committee members, the Chair of the BME Graduate Program for their final review and approval. After completion of all Bachelor requirements and awarding of a "B" or better in the BME courses, students will be recommended for graduate status and enter the Master's program at the beginning of the second year (or the fifth year in their combined Bachelor's and Master's education).

During the second year of the program, students will take the remaining courses from (a) BME 510, 511 and 517, (b) one BME core course (BME 516, 520, 561, 566, 577, 581B, 586); (c) 1 unit each of BME seminar and student forum; (d) 1 unit of BME 592 (lab rotation); (e) remaining units which may be chosen by the student to supplement their plan of study; and (f) 6 units of M.S. Thesis, or M.S. Report and another 3 unit course. A final thesis defense or M.S. report is required. The units of (e) will focus on the student's biomedical engineering research interests such that the courses complement and broaden the student's undergraduate degree and provide the student with the skills necessary to complete the research. The courses will be established in consultation with the student's mentor and thesis committee. The courses chosen should be based on the student's area of specialization.

The AMP is not intended for students who wish to eventually obtain a Ph.D. If a student is subsequently admitted to the Ph.D. program, only units taken during the graduate year will be eligible for consideration of transfer into the Ph.D. program.

For AMP admissions information can be found [here](#) on page 6 of this Handbook.

### PROGRAM TIMELINE:

The following is the general timeframe in which students are expected to progress through the BME program. Typical grids of course work are included at the end of this handbook. Receipt of program funds is

contingent upon satisfactory progress and adherence to the timeline; requests for time extensions may be submitted to and granted by the BME Graduate Studies Committee.

## YEAR 1

Complete BME 510, 511 and 517 (or 547 if MS); two (or one for MS) of seven focus area courses (Biomaterials: BME 561 or BME 586, Biomechanics: BME 566, Biomedical Imaging & Optics: BME 516 or BME 520, Biomedical Informatics, Cell and Tissue Engineering: BME 581B); and for PhD only SLHS 649 or approved equivalent (Ethics), all with an average grade of 3.0 or better.

Begin laboratory rotation(s) BME 592 with the goal of choosing a faculty mentor and research project by the end of this year.

Attend mid-year meeting with the Chair of BME Graduate Program.

By the end of your first (M.S. students) or second (Ph.D. students) semester, you should have chosen a mentor from the Biomedical Engineering faculty. To formalize your selection, you and your mentor must submit a letter, indicating your choice and your mentor's acceptance of you into the laboratory, to the BME Graduate Advisor. See additional information under "Mentor Selection".

Masters students must prepare, in conjunction with their faculty mentor, and submit to the BME Graduate Studies Committee, a proposed Plan of Study by March 1<sup>st</sup>/October 1<sup>st</sup> of their first year depending on their start date.

The BME Graduate Studies Committee will evaluate student progress, annually, using input from both the student and mentor. All students must submit an Annual Progress Report each year.

## YEAR 2

Prior to their 2<sup>nd</sup> year, BME Ph.D. students will take a Qualifying Exam containing questions from BME 510, 511, 517 and their two core focus areas.

At the beginning of the second year, Ph.D. students should prepare, in conjunction with their faculty mentor, and submit to the BME Graduate Advisor, a proposed Plan of Study, no later than October 1<sup>st</sup> of their third semester. You and your mentor should work on this together. This Plan of Study should be revised and re-submitted as changes occur throughout your graduate studies. You should have established your major and minor fields of study and have determined the necessary course sequences. You should also be in the process of formulating a Ph.D. dissertation research project, and conducting preliminary experiments.

M.S. students should complete all required coursework including 6 credits of BME 910 Thesis or 3 units of BME 909 M.S. Report.

*[The remainder of the TIMELINE applies only to students working toward the Ph.D.]*

## YEAR 3

---

Ph.D. students should have formed, and be meeting with, their Comprehensive Examination Committee, and complete their Comprehensive Examination in the third year, no later than the fifth semester.

*Note that to remain eligible for program funding; you must complete the Comprehensive Examination by the end of the fifth semester. Coordinate the examination and schedule with the BME Graduate Program Office.*

---

The Comprehensive Examination consists of written and oral portions (see above). It is suggested that you schedule several meetings to discuss the possible scope of questions with your committee. At the end of your third year, you should have completed the courses required for a major in BME.

No later than your fifth semester in residence, finalize a Dissertation Committee. The earlier you meet with the committee members, the better. Inform your committee of your Plan of Study and your research project. Solicit input from the committee members during the writing of your Research Proposal. Note that students are required to have at least one meeting per year with the dissertation committee, during years 3-5. More frequent meetings are recommended. Typed, electronic minutes of these meetings must be sent to all committee members, and a copy sent to the BME Graduate Advisor.

### YEARS 3 – 5

Complete the presentation of the required full-length seminar. This seminar is one of two that you are required to give (the second may be a part of your final defense). It is your responsibility to contact the chairperson of the seminar series to be included in the list of scheduled speakers. Each year, update the previous year's research proposal, and submit with the Annual Progress Report.

### FINAL SEMESTER

Present your dissertation research at one of the weekly BME seminars during the last year in residence.

Obtain the "Manual for Theses and Dissertations" on the Degree Certification website at <http://grad.arizona.edu/gsas/dissertations-theses>. This manual contains the directions for formatting your dissertation; however, you and your mentor should determine the overall organization of the dissertation. It is the responsibility of your mentor to proof your dissertation.

The original form, the "Announcement of Oral Defense Examination" must be submitted to the Graduate College Degree Certification Office through the GradPath System at least two weeks before the date of your final examination (defense). Once you submit the form electronically, it will be routed for approval by the BME Graduate Advisor, your committee members, your mentor, and the BME Graduate Studies Committee Chair.

*Penultimate copies of your completed dissertation manuscript must be distributed to your committee members at least three weeks before your final examination.*

After passing your final examination, a final copy of your dissertation must be submitted electronically to the BME Graduate Program Office and UMI/Proquest for archiving purposes. Please visit <http://grad.arizona.edu/gsas/dissertations-theses/submitting-your-dissertations>.

Questions regarding submitting forms, Graduate Representatives, and/or deadlines should be directed to the BME Graduate Advisor.

## Teaching

The BME faculty believes that teaching experience is an integral part of the graduate training program. Accordingly, all students are encouraged to participate in teaching activities throughout their tenure in the Program.

## Program administration

1. The BME Graduate Program is administered by a BME Graduate Studies Committee (GSC), which is chaired by the Associate Head for Graduate Affairs (Graduate Studies Chair) in the Department of Biomedical Engineering. The GSC reports to the Head of the Department of Biomedical Engineering and is responsible for curriculum and course development, evaluation of graduate student progress, maintenance of the Graduate Handbook (which states the policies and procedures for graduate education), mediation of the concerns and grievances of graduate students and development of the financial plan for the graduate Program.
2. The BME Graduate Recruitment and Admissions Committee is responsible for publicizing the graduate program, recruiting applicants, evaluating applicants, and recommending admission of qualified candidates.

## Financial Structure

The funds utilized by the BME Graduate Program to support graduate student stipends are derived from Research Grants, Training Grants, Fellowships, Scholarships, and faculty contributions. In general, these funds dictate the number of students that can be supported by the BME Graduate Program. The maximum stipend for a 0.5 FTE graduate student during the academic year is determined by the College of Engineering. NIH training grant stipends, some teaching assistantships, and other sources of support can be lower than the maximum 0.5 FTE stipend of the College. In such cases, faculty mentors can supplement the student stipend to bring it more in line with the College standard. Student stipends during the academic year cannot exceed the maximum College of Engineering standard. It is recommended that faculty mentors support their graduate students on supplemental compensation at a level of 0.5 FTE during the summer. This gives the student time to work on their dissertation as well as the work specified on the mentor's project from which they are funded.

Incoming doctoral students are paid from the BME Department during the first semester or other fellowship/scholarships/grants. These students are responsible for identifying a mentor to support their GRA funding in the Spring of their first year and the subsequent years of their graduate program.

Graduate Teaching Assistantship (GTA) may also be available to support graduate students. GTA funding may come from BME or other departments, dependent on departmental needs. GTA support is identical to GRA support during the academic year, but is generally not available during summers.

Salary amounts are stipulated by the College of Engineering and may change in the future. Academic support level is expected to be available for up to 5 years, contingent upon satisfactory academic progress and good standing in the department/University and continued availability of funding. All academic appointments are reserved for those recommended graduate students who remain in good academic and University standing, and are subject to standard year-to-year renewals and continued availability of funds.

Students are eligible to increase to the Graduate Associate stipend rate the beginning of the next spring or fall semester after they have advanced to doctoral candidacy - successfully passed the Comprehensive Examination and the Graduate Student Academic Services office has confirmed completion of the required courses on the approved doctoral Plan of Study.

## Conferences

The Program believes that participation in scientific meetings and conferences is an important experience for graduate students and encourages all students to submit work for presentation at national meetings. To aid in this activity, BME graduate students can apply to the Program for travel support after their first year. The intent of the Program is that BME graduate students are able to attend one national meeting per year. Students applying for travel funds are expected to have submitted an abstract/paper to the meeting/conference as the presenting author. Students are also expected to be in good standing with the Program and progressing towards their degree along the appropriate timeline. Travel Request Application Forms are available in the Appendix. The program encourages all students to also apply for travel awards from sources outside the Program. One such possibility is the Graduate and Professional Student Travel Grant Fund (GPSC) - <https://gp.sc.arizona.edu/travel-grants>.

## Outside Activities

The Program believes graduate studies and research are a full-time effort. BME graduate students are expected to work diligently towards timely completion of their degree, and to avoid outside activities which could have a significant negative impact on their research and education. Graduate studies can require a time commitment that is extensive and/or outside of standard working hours.

Students considering, or currently engaged in, activities which could potentially create a conflict of interest, or a conflict of commitment, should discuss these activities with the BME Graduate Studies Committee Chair and their mentor, if applicable. According to the UA Office for the Responsible Conduct of Research, *"Conflicts of Interest exist when an individual's personal financial relationships could influence the execution of his/her University responsibilities. Conflicts of Commitment exist when an individual's outside activities could interfere with the*



*execution of his/her University responsibilities. Conflicts are not unethical or evidence of misconduct; rather, conflicts are situations that must be identified and managed to prevent damage to the individual, the research, and the institution."* Examples of activities which could create potential conflicts include, but are not limited to: employment (paid or unpaid) outside the Program, taking courses (at UA or elsewhere) not on the approved plan of study, service or volunteer work which requires a significant time commitment and/or restricts hours available to graduate studies, and ownership or involvement in a company. Paid employment outside the Program may be prohibited by the stipulations of a student's funding source. If in doubt about a possible conflict, discuss the situation with the BME Graduate Studies Committee Chair and/or mentor.

### **Intellectual Property**

Under most circumstances, intellectual property (IP) developed at the University of Arizona is the property of the University, regardless of the employment status of the student. Students with IP concerns or questions are encouraged to discuss them with their mentor, the BME Graduate Studies Committee Chair, and the UA Office of Technology Transfer.

Mentors and lab directors should make clear to the student what, if any, intellectual property of the laboratory should not be discussed publicly. The student's papers, reports, and posters should be approved by the lab director/mentor (as well as any other authors) prior to each publication or presentation.

### **Deadlines**

Any student that misses a stated deadline, for items related to the BME Graduate Studies Committee, will be required to submit a letter to the BME Graduate Studies Committee stating why the deadline was missed, and also have their mentor sign the letter before submission. The BME Graduate Studies Committee will consider the request, but does not guarantee the matter will be considered before the next scheduled BME Graduate Studies Committee meeting. If the student chooses to not write a justification letter to the BME Graduate Studies Committee, the item will be on the agenda of the next scheduled BME Graduate Studies Committee meeting. Visit the Graduate College at <http://grad.arizona.edu> for additional information regarding graduate deadlines.

# Appendix I

## BME 592- Laboratory Rotation

Student:

Rotation Advisor:

Please indicate rotation period (each rotation is 6-8 week period of 45-60 work hours):

\_\_\_\_\_ Rotation 1

\_\_\_\_\_ Rotation 2

Average number of hours per week:

Upon completion of the rotation, the student will prepare a summary of the accomplished research and the training experience. The Rotation Advisor will review and approve the final rotation report. Research activities may change during the rotation, yet beginning with an initial research plan can provide a beneficial rotation experience for the student.

### Research activities to be performed:

**\*Student & Rotation Advisor's electronic signature required. All forms must be turned in, typed and emailed to Andrea Anduaga ([aanduaga@arizona.edu](mailto:aanduaga@arizona.edu)) prior to start of rotation.**

### Signatures

\_\_\_\_\_  
Student Name

\_\_\_\_\_  
Date

\_\_\_\_\_  
Rotation Advisor's Name

\_\_\_\_\_  
Date

## Appendix II

### BME 592 Laboratory Rotation Final Report

Student:

Rotation Advisor: \_\_\_\_\_

Please indicate **completed** rotation period (each rotation is 6-8 week period of 45-60 work hours):

\_\_\_\_\_ Rotation 1      \_\_\_\_\_ Rotation 2

#### **Summary of research activities accomplished & training experience learned:**

#### **Rotation Advisor Comments:**

**\*Student & Rotation Advisor's electronic signature required. All forms must be turned in, typed and emailed to Andrea Anduaga ([aanduaga@arizona.edu](mailto:aanduaga@arizona.edu)).**

#### **Signatures**

\_\_\_\_\_  
Student Name

\_\_\_\_\_  
Date

\_\_\_\_\_  
Rotation Advisor's Name

\_\_\_\_\_  
Date

## Appendix III

### CODE OF RESEARCH ETHICS

Subscribed to and Adopted by the University of Arizona Faculty Senate on December 7, 1998 for University of Arizona Faculty and Research Personnel

We the members of the University of Arizona (U of A) faculty and U of A researchers (hereafter: research community) are engaged in the quest for knowledge, in scholarly and artistic pursuits (hereafter: research) with the ultimate goal of benefiting humankind. Our quest is founded on the fundamental principles of honesty and trust.

I. In fulfilling our obligation to the public as a whole, we expect that all individuals within the U of A research

Community shall:

- promote and follow research and professional practices that enhance the public interest and well-being;
- use public and private funds responsibly in the pursuit of research endeavors;
- adhere to government and institutional regulations for research such as those ensuring the welfare of human subjects, the welfare of fellow researchers, the comfort and humane treatment of animal subjects and the protection of the public and the environment; and
- report research findings resulting from public and private funding in a full, open, and timely fashion to the relevant research community;

II. In fulfilling our obligations to our colleagues, we expect that all individuals within the U of A research

Community shall:

- have actually carried out experiments, projects and other scholarly activity in the manner reported;
- represent their best understanding of the work in their descriptions and analyses of it;
- accurately describe experimental methods utilized in sufficient detail to help insure their repeatability by others;
- share unique propagative materials developed through publicly-funded research with others in the field in a reasonable fashion;
- not report the work of others as if it were their own; strive to insure that due recognition is given where credit is due to collaborators including students and trainees;
- adequately summarize previous relevant work and ideas with proper attribution to those who pioneered the work;
- when acting as reviewers or editors, treat submitted manuscripts and grant applications confidentially and refrain from inappropriate use;
- and disclose financial and other interests that might present a conflict-of-interest, and make every effort to avoid such conflicts perceived or real.

III. In fulfilling obligations to students and trainees, we expect that all individuals within the U of A research

Community shall:

- provide training and experience to advance the students' and trainees' scholarly skills and their understanding of the importance of ethical practice and behavior;
- provide appropriate support in advancing the careers of students and trainees;
- recognize publicly and appropriately the scholarly contributions of the trainees;
- encourage and support the publication of results of trainees' research in a timely fashion without undisclosed limitations; and
- work together to create and maintain a working environment that is safe and that encourages individual integrity, plurality, open communications, and fairness without regard to gender, race or belief.

## Appendix IV

# Biomedical Engineering Ph.D. Course Requirement Worksheet

(Include in Plan of Study)

Submit Ph.D. Course requirement worksheet, 1 paragraph summary of proposed dissertation research area, and a listing of proposed Comprehensive Examination committee members. *Due no later than October 1 of 3rd semester.*

|                     |  |
|---------------------|--|
| <b>Name</b>         |  |
| <b>Date</b>         |  |
| <b>Prior Degree</b> |  |
| <b>Minor</b>        |  |
| <b>Student ID</b>   |  |

| Required Units   | Semester(s) | Grades |
|--|-------------|--------|
| BME 510 (3) – Biology for Biomedical Engineering   | Fall        |        |
| BME 511 (3) – Physiology for Biomedical Engineering  | Spring      |        |
| BME 517 (3) – Measurement and Data Analysis in Biomedical Engineering  | Fall        |        |
| Choose at least <b>two</b> courses from different focus areas (6 units total) of:<br>Biomaterials:<br>- BME 561 (3) – Biological and Synthetic Materials (Fall)<br>- BME 586 (3) – Biomaterial-Tissue Interactions (Spring)<br>Biomechanics<br>- BME 566 (3) – Biomechanical Engineering (Fall)<br>Biomedical Imaging & Optics<br>- BME 516 (3) – Biomedical Imaging (Spring)<br>- BME 520 – Biophotonics (Spring)<br>Biomedical Informatics<br>- BME 577 (3) – Intro to Biomedical Informatics (Fall)<br>Cell and Tissue Engineering<br>- BME 581B – Cell and Tissue Engineering (Spring) |             |        |
| SLHS 649 Survival Skills & Ethics (3) <i>(Alternate course option with GSC approval)</i>   | Spring      |        |
| BME 696A Seminar/696C Forum (1)<br><small>(6 units count toward total unit requirement, full-time students required to register for/attend Seminar each semester in program)</small>   |             |        |
| BME 592 Rotation (2)*  |             |        |
| Graduate Coursework (10 units) – List:<br><small>Level 500+ courses, dependent on approval of mentor and Graduate Studies Committee</small>  |             |        |
|  |             |        |
|  |             |        |
|  |             |        |
| Units in the Minor (min. 9)<br><small>Minor unit amount based on that program's requirements</small>   |             |        |
|  |             |        |
|  |             |        |
| BME 920 Dissertation (min.18 units)  |             |        |

**TOTAL = 63 minimum**

**TOTAL =**

# Appendix V

## Biomedical Engineering MS Course Requirement Worksheet

(Include in Plan of Study)

Thesis: Submit MS Course requirement worksheet, 1 paragraph summary of proposed thesis research area, and a listing of proposed Thesis defense committee members.

MS Report: Submit MS Course requirement worksheet

*Due no later than March 1 of 2nd semester for Fall start/October 1<sup>st</sup> of 2<sup>nd</sup> semester for Spring Start.*

|              |  |
|--------------|--|
| Name         |  |
| Date         |  |
| Prior Degree |  |
| Student ID   |  |

| Required Units   | Semester(s) | Grades |
|--|-------------|--------|
| BME 510 (3) – Biology for Biomedical Engineering   | Fall        |        |
| BME 511 (3) – Physiology for Biomedical Engineering  | Spring      |        |
| BME 517 (3) – Measurement and Data Analysis in Biomedical Engineering<br><b>OR</b> BME 547 (3) – Sensors and Controls  | Fall        |        |
| Choose at least <b>one</b> focus areas (3 units total) of:<br>BME 516 (3) – Biomedical Imaging (Spring)<br>BME 520 (3) – Biophotonics (Spring)<br>BME 561 (3) – Biological and Synthetic Materials (Fall)<br>BME 566 (3) – Biomechanical Engineering (Fall)<br>BME 577 (3) – Intro to Biomedical Informatics (Fall)<br>BME 581B (3) – Cell and Tissue Engineering (Spring)<br>BME 586 (3) – Biomaterial-Tissue Interactions (Spring) |             |        |
| BME 696A Seminar/696C Forum (1)<br>(2 units required, up to 4 units can count toward total)  |             |        |
| BME 592 Rotation (1)*  |             |        |
| Graduate Coursework (9 units) – List:<br>Level 500+ courses, dependent on approval of mentor and Graduate Studies Committee  |             |        |
|  |             |        |
|  |             |        |
| BME 910 Thesis (6 units) or BME 909 Master’s Report (3 units) and additional coursework (3 units)  |             |        |
|  |             |        |
|  |             |        |

\*No more than 3 units total of non-traditional classroom experience (rotations, independent study, and internship) may be counted toward the unit total.

**TOTAL = 30 minimum**

**TOTAL (overall, not current) =**

## PhD Annual Report

|                      |                                  |                                  |                                  |
|----------------------|----------------------------------|----------------------------------|----------------------------------|
| <b>Student Name:</b> | Click or tap here to enter text. | <b>Student's Faculty Mentor:</b> | Click or tap here to enter text. |
|----------------------|----------------------------------|----------------------------------|----------------------------------|

|                              |                                  |                                     |                                  |
|------------------------------|----------------------------------|-------------------------------------|----------------------------------|
| <b>Date started program:</b> | Click or tap here to enter text. | <b>Anticipated Graduation Date:</b> | Click or tap here to enter text. |
|------------------------------|----------------------------------|-------------------------------------|----------------------------------|

**Courses Taken in current academic year and Grade received if known:**

### Qualifying Exam

|                            |                 |                         |                 |
|----------------------------|-----------------|-------------------------|-----------------|
| Qualifying Exam completed? | Choose an item. | Qualifying Exam passed? | Choose an item. |
|----------------------------|-----------------|-------------------------|-----------------|

### Comprehensive Exam

|                                   |                 |                     |                                  |
|-----------------------------------|-----------------|---------------------|----------------------------------|
| Written Comprehensive Exam taken? | Choose an item. | If scheduled, when? | Click or tap here to enter text. |
|-----------------------------------|-----------------|---------------------|----------------------------------|

|  |                 |  |
|--|-----------------|--|
| If taken, did you pass the Written Comprehensive Exam? | Choose an item. | Date passed: Click or tap to enter a date. |
|--|-----------------|--|

|                                |                 |                     |                                  |
|--------------------------------|-----------------|---------------------|----------------------------------|
| Oral Comprehensive Exam taken? | Choose an item. | If scheduled, when? | Click or tap here to enter text. |
|--------------------------------|-----------------|---------------------|----------------------------------|

|   |                 |  |
|---|-----------------|--|
| If taken, did you pass the Oral Comprehensive Exam? | Choose an item. | Date passed: Click or tap to enter a date. |
|---|-----------------|--|

**Any publications from current academic year, please cite:**

**Any presentations current academic year (you all presented at BME Research Expo), please cite:**

**Any comments, concerns, questions, etc.:**

Signatures are not required, but mentor acknowledgement is, this can be done via an email to Andrea stating that they have seen your annual report.

# Appendix VII

## MS Annual Report

|  |                                  |                                     |                                  |
|--|----------------------------------|-------------------------------------|----------------------------------|
| <b>Student Name:</b>   | Click or tap here to enter text. | <b>Student's Faculty Mentor:</b>    | Click or tap here to enter text. |
| <b>Date started program:</b>   | Click or tap here to enter text. | <b>Anticipated Graduation Date:</b> | Click or tap here to enter text. |
| <b>Courses Taken in current academic year and Grade received if known:</b> |                                  |                                     |                                  |

### Thesis/MS Report

|  |                 |                                      |                                  |
|--|-----------------|--------------------------------------|----------------------------------|
| Thesis or MS Report?                     | Choose an item. | Thesis Defense - If scheduled, when? | Click or tap here to enter text. |
| Thesis Defense - if taken, did you pass? | Choose an item. | MS Report - if completed, grade?     | Click or tap here to enter text. |

### Any publications from past year, please cite:

### Any presentations past year (Oral, Poster, Seminar, etc.), please cite:

### BME MS Program Objectives - Please rank based on your thoughts on reaching program objectives

|  | Exceeding                | Meeting                  | Not meeting              |
|--|--------------------------|--------------------------|--------------------------|
| <b>Objective 1:</b> Obtain a foundational knowledge of biomedical engineering principle including those in the disciplines of life sciences and engineering. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Objective 2:</b> Demonstrate the ability to think independently and creatively.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Objective 3:</b> Cultivate an in depth knowledge and appropriate skill set within a specific area of research.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Objective 4:</b> Develop skill and ability in written and/or oral communication.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

### Any comments, concerns, questions, etc.:

Signatures are not required, but mentor acknowledgement is, this can be done via an email to Andrea stating that they have seen your annual report.



## Appendix VIII

### Sample Format for Mentor Acceptance Letter

(Substitute actual information for examples *in italics*; both the faculty advisor and the student sign.  
The letter should be submitted on UA letterhead. For MS student, can remove financial support statement)

*Today's Date*

Ali Bilgin, Ph.D., Associate Department Head  
Biomedical Engineering Graduate Studies  
University of Arizona  
PO Box 210020  
Tucson, AZ 85721

Dear Dr. Bilgin:

This is to confirm that I will officially serve as *[Student's]* advisor and mentor during their Doctoral studies in Biomedical Engineering at the University of Arizona. I look forward to a productive and engaging collaboration with *[Student]*. *[Student]* and I have worked together on an initial project involving *mechanical tissue printing* and are now developing *a machine that will fabricate entire artificial organs utilizing cornstarch and flies as the raw material*. I will endeavor to ensure that *[Student]* has financial support during their tenure as a Ph.D. student, and that they complete the requirements for the Doctoral degree in a timely fashion.

Thank for you for the opportunity to participate in the Biomedical Engineering here at the University of Arizona, and work with such an outstanding student.

Sincerely,

*[Professor], Ph.D.*  
*Professor*  
*Math/Physics/Biomedical Engineering*

*[Student], B.S.*  
*Graduate Student*  
*Biomedical Engineering*

## Appendix IX

### Biomedical Engineering Graduate Program Travel Assistance Request

|                                 |                                    |
|---------------------------------|------------------------------------|
| _____<br>Name                   | _____<br>Date                      |
| _____<br>Name of Conference     | _____<br>Dates of Conference       |
| _____<br>Location of Conference | _____<br>Estimated Cost of Request |

To receive travel assistance, you must be the primary author on an abstract that has been accepted for presentation at the conference, and you must be a PhD or an MS student in good standing within the BME Graduate program.

Your signature below indicates that you are in compliance with these terms. Your mentor's signature indicates that they are also in agreement with these terms.

\_\_\_\_\_  
Student Signature (electronic preferred)

\_\_\_\_\_  
Mentor Signature (electronic preferred)

When completed, submit this form, a copy of your abstract, notification that your abstract has been accepted for presentation, and an itemized list of projected travel costs to Andrea Anduaga, [aanduaga@arizona.edu](mailto:aanduaga@arizona.edu). The BME Graduate Studies Committee will review the request and notify you of a decision.

#### **CONFERENCE REPORT**

If you receive travel assistance, you must submit a brief report about your experiences at the conference to Andrea Anduaga, [aanduaga@arizona.edu](mailto:aanduaga@arizona.edu), within one month of the end date of the conference. The report should include:

- A. The title, dates, and location of the conference
- B. The title and all authors of your presentation
- C. Your Abstract
- D. A photo from the conference

With your permission, items A-D may be included in the BME newsletter and other marketing materials for the BME Graduate Program.

## Appendix X

### Biomedical Engineering Absence Request Form

Must be submitted to the BME Graduate Advisor for all absences longer than 2 business days

Must be submitted at least one week prior to departure

Date:

Name:

Vacation

Conference (list name of conference and dates)

Sick (may be completed upon return, if unplanned)

Personal illness

Family illness

Funeral

Jury duty

Other \_\_\_\_\_

First day away from work:

Date of return to work:

During my absence, I can be reached as follows:

\_\_\_\_\_  
Employee signature

\_\_\_\_\_  
Mentor/Supervisor signature

# Appendix XI

## Guidelines for Mentors

Biomedical Engineering Graduate Program

Version Draft II July 12, 2006

*Introduction:* The purpose of these guidelines is to inform mentors of important aspects of the Biomedical Engineering Graduate Program. This handbook is not an all-inclusive document; official BME policy can be found in the BME Graduate Handbook, available on the BME website: ([www.bme.arizona.edu](http://www.bme.arizona.edu)).

---

*BME mentors advise, challenge, and guide their students. They assure that the student is making appropriate progress to [dehttps://bme.engineering.arizona.edu/grad-programs/admissionse](https://bme.engineering.arizona.edu/grad-programs/admissionse) and identify sources of support for the student. The following describes the specific and sometimes unique role of a BME mentor.*

***Mentor eligibility:*** Any tenured or tenure-track (or approved by the Graduate Studies Committee as equivalent) faculty who holds a core, split, or joint (courtesy) appointment in the BME department may mentor a BME student. Any tenured or tenure-track (or approved as equivalent) faculty who does not hold an appointment in the BME department can mentor a BME student if an eligible co-mentor in the BME Department is identified. Non-tenure-eligible faculty may serve as a day-to-day mentor for students, but the faculty and student must identify an eligible BME faculty member to serve in the official capacity of mentor. All mentors are expected to abide by BME mentor guidelines.

---

*Rotations:* BME students perform laboratory rotations during their first two semesters and select a mentor by the end of the second semester. The primary purpose of rotations is to facilitate the process of students finding a mentor, and potential mentors identifying students. In some cases, students who already have a mentor may wish to perform rotations in order to obtain training not available in their own laboratory. The purpose of the rotation should be made clear by the student. A rotation should last for approximately 45-60 hours. Longer time periods can be agreed upon by the student and faculty, for additional rotation units. The student should write up a short description of the rotation activities and objectives, to be agreed upon by the faculty. A one-page report is required from the student at the end of the rotation, to be signed by the mentor, and submitted to the BME Graduate Advisor.

The rotation is an opportunity for the potential mentor and the student to determine if they are compatible from a research qualifications/interest and a personality standpoint. BME students are expected to ask, and potential mentors are urged to honestly answer, questions about future research projects, student/project funding availability, and laboratory expectations.

*Selection of mentor:* Upon agreement to serve as a mentor, a letter needs to be sent to the BME Chairperson (sample letters are available in the appendix of the BME Student Handbook), The letter should state that the mentor has agreed to serve as the student's advisor, will endeavor to ensure that the student has financial

support during his/her tenure as a graduate student, and will assure that the student completes the requirements for the degree in a timely fashion. The letter must be signed by both the student and mentor.

*Student timeline:* The mentor should assure that the student adheres to the timeline set out in the BME Graduate Handbook. A copy of this timeline is attached. A summary of important deadlines (for Ph.D. students) is as follows:

- Submission of Annual Report: every year near the end of Spring
- Submission of Plan of Study: end of third semester
- Formation of Comprehensive Examination Committee: end of third semester Completion of Comprehensive Examination: end of fourth semester Formation of Dissertation Committee: end of fifth semester
- Dissertation committee meetings: end of sixth semester, subsequently at least annually Final Defense: expected to be by the end of the fifth year

Failure of the student to progress will make the student ineligible for BME travel funds, promotions, or raises. Assistance by the mentor in assuring that students follow this timeline is critical for student success. Additional information on each of these milestones is provided below.

*Annual report:* The student submits a report each year describing progress in coursework, research, BME activities, publications, and related activities. In later years, a description of the research plan is attached. The student should prepare the annual report, and the mentor and student jointly review it. The annual report is reviewed by the BME Graduate Studies Committee to evaluate student progress and compliance with the milestones. However, it is also intended to be an opportunity for the student and mentor to reflect on the year's achievements and develop plans for the subsequent year.

*Plan of study:* The plan of study should be submitted to the BME Graduate program office by the end of the third semester. The plan of study identifies the body of coursework to be taken, to fulfill the requirements of the BME Program, and should be jointly agreed upon by the student and mentor. A worksheet is available in the appendix of the BME Student Handbook to assist in assuring all BME requirements are met. In addition to the course listing, students must submit a one-paragraph summary of the proposed dissertation research area and a listing of the proposed Comprehensive Examination Committee members.

The mentor, BME Graduate Studies Committee, must all approve the plan of study, prior to submission to the Graduate College. A plan is unlikely to be approved if it contains less than two courses, each, that provide significant depth of knowledge in an area of life sciences and engineering (in addition to the core courses). However, the main criteria for acceptance are adequate preparation for the student's research activities. It is expected that the plan of study may change during the student's tenure; modified plans are approved by the same process as the original. The student may not meet with the comprehensive exam committee prior to approval of the plan of study.

*Comprehensive Examinations:* The details of the Comprehensive Examination process are provided in the BME handbook. The student is encouraged to take both the written and oral portions of the examination as early as practical, but not later than the fifth semester. Students should meet with their committee members individually, and as a group, to discuss the possible scope of questions with them, well in advance of the examination.

*Dissertation committee:* The student must meet with the dissertation committee by the end of the sixth semester, and subsequently no less than once per year. The purpose of the committee meetings is to define an acceptable scope of work for the dissertation, obtain feedback on research results, and gather suggestions for future research efforts.

*Defense:* The BME Ph.D. is designed to be a 5-year program. Significant extension beyond this time should be discussed with the dissertation committee and a plan for completion developed.

*Student difficulties:* The mentor is requested to notify the BME Graduate program office if he/she notices that the student is experiencing difficulties that are impacting research or academic progress. The BME Graduate Advisor, BME Graduate Studies Committee Chair, are available to assist in resolving student and/or student/mentor conflicts.



Questions? Please contact: BME Graduate Advisor, Andrea Anduaga, [aanduaga@arizona.edu](mailto:aanduaga@arizona.edu) 520-626-9134 BME Graduate Studies Committee Chair, Ali Bilgin, [bilgin@arizona.edu](mailto:bilgin@arizona.edu) 520-626-8943

## Appendix XII

### Checklist for MS Students

#### Coursework:

- BME 510 (Cell Biology)
- BME 511 (Physiology)
- BME 517 (Bioinstrumentation) or BME 547 (Sensors and Controls)
- One of the Following:
  - BME 516 (Bioimaging)
  - BME 520 (Biophotonics)
  - BME 566 (Biomechanics)
  - BME 577 (Biomedical Informatics)
  - BME 561 (Biological and Synthetic Materials)
  - BME 581B (Cell and Tissue Engineering)
  - BME 586 (Biomaterial-Tissue Interactions)
- Rotation 1 (signed rotation report submitted)
- 3 BME related courses
- 6 units of BME Thesis or 3 units of BME Master's Report and 3 units of additional coursework
- 30+ units completed

| <b>Approximate Timeline</b>   |   |
|---|---|
| 1 <sup>st</sup> semester  | Enroll in and complete BME 510, BME 517 or BME 547, BME 592 (rotation), and other coursework on Plan of Study that will bring you to 9 units for full-time  |
| 1 <sup>st</sup> year  | Attend Mid-Year meeting with Program Chair  |
| 2 <sup>nd</sup> Semester  | Enroll in and complete BME 511, and other coursework on Plan of Study that will bring you to the required to 9 units for full-time  |
| 2 <sup>nd</sup> Semester  | Chosen BME Faculty member and submit Mentor Acceptance letter   |
| March 1 <sup>st</sup> or<br>October 1 <sup>st</sup> of<br>2 <sup>nd</sup> Semester  | Submit Plan of Study <ul style="list-style-type: none"> <li><input type="checkbox"/> Submitted Course Requirement Worksheet (Appendix V) to Program Coordinator</li> <li><input type="checkbox"/> Submitted Graduate College Plan of Study via GradPath</li> <li><input type="checkbox"/> Submitted Proposed Thesis Committee Members to Program Coordinator</li> <li><input type="checkbox"/> Submitted Research Paragraph to Program Coordinator</li> </ul> |
| 2 <sup>nd</sup> Semester  | Assembled Thesis Committee (meet with committee at least once a year)   |
| 2 <sup>nd</sup> Semester  | Submit MS Annual Report ( <a href="#">Appendix VII</a> )  |
| 3 <sup>rd</sup> Semester  | Enroll in and complete coursework on Plan of Study  |
| 4 <sup>th</sup> Semester  | Enroll in and complete any remaining coursework on Plan of Study and either MS Report or MS Thesis  |
| 4 <sup>th</sup> Semester  | Submitted Completed Thesis (if applicable) to Members of Committee (submit at least 4 weeks before deadline)  |
| 4 <sup>th</sup> Semester  | Successfully defend Thesis or Master's Report Submission  |
| 4 <sup>th</sup> Semester  | Finish final editing of Thesis or Master's Report and submit to Committee Chair   |
| 4 <sup>th</sup> Semester  | Submit electronic copy of Thesis or Master's Report to BME Program Office   |
|  <b>GRADUATE</b>  |   |

## Appendix XIII



### Checklist for PhD Students

**Coursework:**

- BME 510 (Cell Biology)
- BME 511 (Physiology)
- BME 517 (Bioinstrumentation)
- Choose at least **two** courses from different focus areas (6 units total) of:
  - Biomaterials:
    - BME 561 (3) – Biological and Synthetic Materials (Fall)
    - BME 586 (3) – Biomaterial-Tissue Interactions (Spring)
  - Biomechanics
    - BME 566 (3) – Biomechanical Engineering (Fall)
  - Biomedical Imaging & Optics
    - BME 516 (3) – Biomedical Imaging (Spring)
    - BME 520 – Biophotonics (Spring)
  - Biomedical Informatics
    - BME 577 (3) – Intro to Biomedical Informatics (Fall)
  - Cell and Tissue Engineering
    - BME 581B – Cell and Tissue Engineering (Spring)
- SLHS 649 Survival Skills & Ethics (or approved alternate)
- Rotations Completed
  - Rotation 1 (signed rotation report submitted to Graduate Advisor)
  - Rotation 2 (signed rotation report submitted to Graduate Advisor)
- 5 BME Related Courses
- 9+ units completed for Minor
- 18 units of BME 920 (Dissertation)
- 63+ units completed

| <b>Approximate Timeline</b>                            |   |
|--|---|
| <b>First Year</b>                                      |   |
| 1 <sup>st</sup> semester                               | Enroll in and complete BME 510, BME 517, 2 BME 592 (rotations), BME 696A (seminar) and other coursework on Plan of Study that will bring you to the required 12 units   |
| 1 <sup>st</sup> semester                               | Completed Rotation 1 and 2, submit pre and post forms   |
| 1 <sup>st</sup> year                                   | Attend Mid-Year meeting with Program Chair  |
| 2 <sup>nd</sup> Semester                               | Enroll in and complete BME 511, BME 696C (seminar) and other coursework on Plan of Study that will bring you to the required 12 units   |
| 2 <sup>nd</sup> Semester                               | Chose BME Faculty member and submit Mentor Acceptance letter  |
| 2 <sup>nd</sup> Semester                               | Complete and submit annual report ( <a href="#">Appendix VI</a> )   |
| Summer before<br>3 <sup>rd</sup> Semester              | Take Qualifying Exam - Consists of BME 510, 511, 517, and two of the core focus area courses (BME 516, 520, 561, 566, 577, 581B, or 586)  |
| <b>Second Year</b>                                     |   |
| 3 <sup>rd</sup> Semester                               | Enroll in BME 696A (seminar) and complete courses applicable to plan of study that will bring you to required 9 units   |
| October 1 <sup>st</sup> of<br>3 <sup>rd</sup> Semester | Submit Plan of Study <ul style="list-style-type: none"> <li><input type="checkbox"/> Submitted Course Requirement Worksheet (<a href="#">Appendix IV</a>) to Grad Advisor</li> <li><input type="checkbox"/> Submitted Proposed Comprehensive Committee Members to Grad Advisor</li> <li><input type="checkbox"/> Submitted Research Summary to Grad Advisor</li> <li><input type="checkbox"/> Submitted Graduate College Plan of Study via GradPath, once approved</li> </ul> |



|   |  |
|---|--|
| 3 <sup>rd</sup> Semester  | Finalize Comprehensive Exam Committee, submit committee to Grad Path and schedule an initial meeting in 3 <sup>rd</sup> - 4 <sup>th</sup> semester   |
| 4 <sup>th</sup> Semester  | Enroll in BME 696C and complete courses applicable to plan of study that will bring you to required 9 units. You should be wrapping up remaining credit courses, including minor coursework. |
| 4 <sup>th</sup> Semester  | Complete and submit annual report ( <a href="#">Appendix VI</a> )  |
| 4 <sup>th</sup> - 5 <sup>th</sup> Semester  | You should be initiating and completing your written and oral comprehensive exam   |
| <b>Third Year</b> - can start to vary greatly based on experiments  |  |
| 5 <sup>th</sup> Semester →  | Enroll in BME 696A and wrap up any final credit courses needed. Once you pass your comprehensive exam, you are able to request dissertation units.   |
| 5 <sup>th</sup> Semester →  | Assembled Dissertation Committee (meet with committee at least once a year), submit Doctoral Dissertation Committee Appointment Form   |
| 6 <sup>th</sup> Semester →  | Enroll in BME 696C and wrap up any final credit courses if needed.   |
| 6 <sup>th</sup> Semester →  | Submitted Verification of Prospectus/Proposal Approval Form  |
| 6 <sup>th</sup> Semester  | Complete and submit annual report ( <a href="#">Appendix VI</a> )  |
| <b>Fourth &amp; Fifth Year</b>  |  |
| Enroll in BME Seminar 696A/696C each semester in program  |  |
| Meet with Dissertation Committee annually to update with progress toward completion   |  |
| Present Research in Full-length Seminar in final year   |  |
| Submit Announcement of Final Defense Form 10 business days prior to defense   |  |
| Successfully defend Dissertation Research, finalize any required revisions of dissertation, and submit final dissertation to Graduate College and Program Office                      |  |
|  <b>GRADUATE</b>  |  |

## Appendix XIV

### Research Proposal Details

The research proposal includes multiple subsections and must not exceed 10 pages, including all tables, graphs, figures, diagrams, and charts. References are not part of the page limit. Students should follow the formatting guideline of the NIH Predoctoral NRSA grant application.

Follow the format provided below:

**Specific Aims.** This section should include a concise statement of what the proposed research is intended to accomplish and/or what hypothesis is to be tested. It also lists the aims (2-3) of the proposal and brief statements of how each aim will be addressed.

**Background and Significance.** The section should include a concise presentation of pertinent literature to explain the significance of the chosen topic. It is expected that the relevant literature is critically and scholarly evaluated in substantial depth such that specific gaps are identified that the proposal intends to fill.

**Preliminary Results.** A description of preliminary results is not required but may be included at the discretion of the student and the Comprehensive Exam Committee. This description is restricted to a maximum of 2 pages.

**Research Plan.** Description of experiments that are proposed to achieve the research goals of the proposal. This section should place less emphasis on methodological details and more emphasis on anticipated and unexpected outcomes, potential experimental pitfalls and potential alternative strategies.

This discussion should include:

- Discussion of experimental or other procedures and their advantage over alternative methodologies, including a brief description of any new and non-standard methodology.
- Description of means by which the data will be analyzed and interpreted.
- Discussion of possible results, both positive and negative, and an interpretation of different outcomes.
- Discussion of potential difficulties and limitations of the proposed experiments and identification of alternative approaches that might be taken to achieve the aim.

**References.** (Not part of the page limit). Full citations of all referenced literature must be included. Any format of in-text citations can be used. In the bibliography each literature citation must include the names of all authors, the year of publication, the title of the publication, the name of the book or journal, volume number, and page numbers.

Students are encouraged to look at actual grant applications submitted by their advisor, other committee members or students to get a sense of what is included in an application. However, students are not allowed to receive assistance with written drafts of their exam or guidance in the construction of the proposal.

The degree of any third person's involvement in developing the hypotheses or goals, any of the proposed experiments, or possible conclusions must be stated at the end of the research proposal. Additionally, the student must certify that nobody other than the student has reviewed any parts of the written proposal, and that the written proposal is primarily the work of the student.

As mentioned above, general discussions on background information, or the strengths and weaknesses of experimental approaches and techniques are permitted with members of the Comprehensive Exam Committee or the Major Advisor but NOT with other colleagues. However, such discussions must be briefly described in the above statement.

## Appendix XV

### BME Dissertation Prospectus/Proposal Approval Form

Prior to Advancing to Candidacy, this internal form must be filled out, signed and returned to BME Graduate Program Office.

Student Name: \_\_\_\_\_ Date submitted: \_\_\_\_\_

Proposal Title: \_\_\_\_\_

---

---

---

Date Approved by Dissertation Committee: \_\_\_\_\_

Required Signatures (Please print name after signature)

Dissertation Director: \_\_\_\_\_

Faculty (Major) \_\_\_\_\_

Faculty (Major) \_\_\_\_\_

Faculty (Minor) \_\_\_\_\_

Faculty (Minor) \_\_\_\_\_

Additional Committee Member/Outside Reviewer if applicable  
(Provide title and location if outside UA)

---

---