



*The Foundation for The Gator Nation*

**J. CRAYTON PRUITT FAMILY  
DEPARTMENT OF BIOMEDICAL ENGINEERING  
(BME)**

# **GRADUATE GUIDELINES**

**2015/2016**

This Guide contains information that supplements the University's Graduate Catalog which is the primary document governing all academic programs. Although every effort has been made to maintain accuracy, the Department of Biomedical Engineering reserves the right to correct errors when found, without further notice to students. The presence of errors will not affect the application of the rules and requirements applicable to all students.

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# **GRADUATE GUIDELINES**

**Department of Biomedical Engineering  
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Gainesville, Florida 32611**

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# OBJECTIVES AND OVERVIEW OF THE DEPARTMENT

The mission of the Department of Biomedical Engineering (BME) is to educate students with strong engineering and science backgrounds for Master's and/or PhD degrees in Biomedical Engineering so that they can productively apply their training to the solution of engineering problems in the fields of medicine, biology and related fields.

## Biomedical Engineering Objectives

1. Provide students with a strong knowledge base of biomedical engineering and specialized knowledge and experience in at least one of the core areas: Neural Engineering, Imaging & Medical Physics, Biomaterials & Regenerative Medicine, and Biomedical Informatics & Modeling.
2. Provide students with the ability to apply fundamental engineering principles to identify, analyze, and solve clinical problems and improve health care.
3. Provide students with the ability to design and conduct scientific and engineering experiments, and to analyze and interpret the resulting data.
4. Provide students with experience and understanding of design requirements and constraints in the clinical and biological science environment, including technology transfer.
5. Provide students with the skills needed to communicate effectively, work collaboratively, and understand their professional and ethical responsibilities and the impact of clinically significant engineering solutions in a societal and economic context.

The Department of BME is highly interdisciplinary and collaborative, with interactions in departments in the College of Engineering (COE), and College of Medicine (COM) acting as partners in the education of Biomedical Engineers.

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## GRADUATE FACULTY

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*Graduate Coordinator:* C. Stabler

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# INTRODUCTION

The Department of Biomedical Engineering (BME) at the University of Florida offers the Master of Engineering (ME), the Master of Science (MS) and the Doctorate of Philosophy (PhD) degrees in Biomedical Engineering. In addition to the general BME program, a concentration in Medical Physics is offered. The BME Graduate Guidelines detail the policies and regulations governing these programs and should be used in conjunction with the University of Florida Graduate Guidelines. It is **the responsibility of the student** to be familiar with both publications and to adhere to the stated rules.

## REQUIREMENTS FOR DEGREES

A summary of the pertinent degree requirements are shown in the table.

SCH (Semester Credits Hour) Requirements (minimum number)	Master (Thesis)	Master (Non-thesis)	Doctor of Philosophy	Medical Physics concentration
Total SCH	32 <sup>a</sup>	30 <sup>a</sup>	90 <sup>a,b</sup>	41 MS & 90 PhD
BME Core Requirements	11	11	11	
BME Electives	9	9	9	
Specialization Electives <sup>c</sup>	9	9	9	
Supervised Teaching	N/A	N/A	4	4 (for Ph.D.)
Research/Special Project	3	1	(var)	(var)
Supervisory committee members (minimum number)	3	1 <sup>d</sup>	4	Same as BME
Comprehensive Exam	None	None	Yes	Same as BME <sup>e</sup>
Qualifying Exam	None	None	Yes	Same as BME
Final Exam	Oral and Written <sup>e</sup>	Written <sup>f</sup>	Oral and Written	Same as BME
Time limit for completing degree	7 years	7 years	5 years <sup>h</sup>	Same as BME

- a. Beyond BS
- b. May include credit hours from Master's program
- c. Graduate level coursework with the College of Engineering (COE) or College of Medicine (COM)
- d. Supervisory Chair only
- e. Different format than general BME program
- f. Capstone project supervised by Supervisory Chair
- g. 5 years from admission to Ph.D. Candidacy.

# 1. GENERAL INFORMATION

## 1.1. Graduate Student Office

The Graduate Student Office (GSO) serves as the graduate advising and administration unit and is administered by the Graduate Coordinator and Graduate Advisor. The Graduate Advisor serves to assist graduate students in admission, deadlines, course requirements, registration, and routine administrative issues. The Graduate Coordinator is responsible for the overall program administration and policy directions. Inquiries regarding the graduate program should first be made to the Graduate Advisor ([grad@bme.ufl.edu](mailto:grad@bme.ufl.edu)), which can then be forwarded to the Coordinator, if needed. Both the Advisor and Coordinator hold office hours and are free to meet with any student. Email [grad@bme.ufl.edu](mailto:grad@bme.ufl.edu) to schedule an appointment.

## 1.1. BME Graduate Affairs Committee

The BME Graduate Affairs Committee serves to oversee the operation of the BME Graduate Program, ensuring policy compliance with both BME and the overall Graduate School, overseeing admission of incoming students, suggesting and approving policy changes, and reviewing student petitions. A student may petition the BME GAC with academic issues by submitting a formal request with the GSO. The Graduate Advisor will serve to provide the appropriate forms for formal petitions and requests. Petitions must be formally approved by the GAC prior to enforcement.

## 1.2. BME Graduate Student Council

The purpose of Biomedical Engineering Graduate Student Council (GSC) is to 1) provide an agency for the coordination of biomedical engineering student activities to promote common goals and interests of the BME graduate student body, 2) advance and enrich the academic and educational experience of graduate students in the UF BME Department, and 3) seek the improvement of BME graduate student education through active communication and representation between BME students and faculty, and other governing bodies at the University of Florida such as the Graduate Student Council and UF Student Government. All BME graduate students are welcome to attend GSC meetings and are encouraged to become involved in this organization. See the website for more information: <http://gsc.bme.ufl.edu/>

## 1.3. Graduate Assistantships and Fellowships

The Department of Biomedical Engineering offers Graduate Assistantships to select students in good academic standing. Stipend rates paid are determined by the department and based on graduate standing and degree program. Interested students should follow up with the Graduate Student Office (GSO) regarding the availability of assistantships and the procedure for applying. Students are highly encouraged to apply for external fellowships such as NSF, NIH NRSA, NDSEG, DoD, DoE, and DoHS. See the the BME website for more information on these opportunities: [https://www.bme.ufl.edu/academics/student\\_resources/fellowship](https://www.bme.ufl.edu/academics/student_resources/fellowship).

Graduate assistants are responsible for paying applicable student fees per semester credit hour. Further, they will be financially liable for excess credits beyond the required registration (see appointment letter for details). If a student on appointment drops below the required registration at any time in the semester, the student becomes financially liable for the entire registration.

## 1.4. Registration Requirements

Full-Time Registration is considered as 9-12 credits. Graduate students on appointments as Graduate Research Assistants with an FTE between .25 and .74 are required to register for 9 credits in the Fall/Spring term and 6 in the summer C term (or 3 in summer A and 3 in summer B). Students not on appointment may wish to enroll full time to finish their degrees in the minimum timeframe or may be required to enroll full time by external funding agencies or their academic units.

Students should register via ISIS ([www.isis.ufl.edu](http://www.isis.ufl.edu)) by the published registration deadline. Record holds and late registration fees will be enforced. To review the anticipated schedule of courses for an upcoming semester, students should go to: <http://www.registrar.ufl.edu/soc/> For selected courses, registration is restricted (indicated by “DEPT” listed in the section column) and requires a completed Semester Registration Form (see [www.bme.ufl.edu](http://www.bme.ufl.edu) under *student forms*). All required signatures must be complete prior to submission to the GSO. GSO will then register the student for this selected course(s). Students have access to their degree audit online at [www.isis.ufl.edu](http://www.isis.ufl.edu).

During the term in which the final examination is given, the student *must* be registered for **at least three credits** in fall or spring and **two credits** in the summer in the following courses for each degree option: Master’s Nonthesis students must enroll in course work that counts toward the graduate degree; Master’s Thesis students must enroll in 6971; and Doctoral students must enroll in 7980. This minimum final term registration is applicable to all graduate students. The Graduate School will not accept petitions to this policy. Note, graduate assistants may be required to register for more credits and should see their letter of appointment for guidance.

Ph.D. students who complete all graduate degree requirements during a given semester, but narrowly miss a deadline specified by the Graduate School due to an unforeseeable event, may receive their degree in the following semester without registering for the minimum three credits (clearing prior). Please see the GSO for more information.

## 1.5. Add/Drop

Courses may be dropped or added during the drop/add period without penalty. This period typically lasts five UF calendar days, or two days for summer sessions, beginning with the first day of the semester (exact dates available on [www.registrar.ufl.edu](http://www.registrar.ufl.edu)). Classes that meet for the first time after the drop/add period may be dropped without academic penalty or fee liability by the end of the next business day after the first meeting. Note, this does not apply to laboratory sections. After this period, a course may be dropped and a W will appear on the transcript. **Students become financially liable for any course added or dropped after the deadline, including students with fee waivers.**

### 1.5.1. Retaking Courses

Graduate students may repeat courses in which they earn failing grades. Grade points from both the initial failed attempt and the first attempt earning a grade of C or better are included in computing the grade point average. The student receives credit for the satisfactory attempt only.

## **1.6. Courses and Credits**

Courses listed at 5000 and above are considered graduate courses and are limited to graduate students. Courses numbered 7000 and above are designed primarily for advanced graduate students.

Generally graduate courses may not be repeated for credit; however, selected courses may be repeated. These courses are designed and typically subjected to a maximum number of credit hours, exceptions include courses numbered 6971, 7979, and 7980. No more than five credits each of 6910 (Supervised Research) and 6940 (Supervised Teaching) may be taken by a graduate student at the University of Florida. Course numbers 6971 (Masters Research), 7979 (Advanced Research), and 7980 (Doctoral Research) cannot count towards the Masters Non-Thesis degree.

It is crucial that BME students have an overall comprehensive understanding of the curriculum and be able to master it well. If a student lacks education in a particular area, the Graduate Coordinator can suggest courses to enhance this student(s) education to the benefit of that student and his/her matriculation and experience through the Graduate Program in BME. For these select cases, a course not considered graduate level but 3000+ may be credited towards the graduate degree, but the course may not be a BME course and it must be approved.

### **1.6.1. Professional Work**

Graduate students may receive credit toward their degrees for courses in professional programs (e.g., J.D., D.V.M., or M.D.) when their advisors and graduate coordinators certify that the course work is appropriate for their programs and when the students receive permission from the academic units and colleges offering the courses. A list of such courses for each student must be filed with the Graduate Student Records (106 Grinter) and is limited to a maximum of 9 credits toward the master's degree and 30 credits toward the doctorate. (Graduate Catalog - Courses and Credits).

## **1.7. Grades**

The only passing grades for graduate students are A, A-, B+, B, B-, C+, C, and S. An overall GPA of at least 3.0 must be maintained to stay in good academic standing. Grade points are not designated for S and U grades and are not used in calculating the grade point average. All letter graded courses taken as a graduate student are used in calculating the cumulative grade point average. Letter grades of C-, D+, D, D- or E are not considered passing at the graduate level, although the grade points associated with these letter grades are included in grade point average calculations.

## **1.8. Unsatisfactory Progress or Unsatisfactory Scholarship**

Any graduate student may be denied further registration if progress toward completing the program becomes unsatisfactory to BME, the College, or Dean of the Graduate School. Unsatisfactory scholarship is defined as failure to maintain a B average (3.00) in all work attempted. Graduate students need an overall GPA of 3.00 truncated and a 3.00 truncated GPA in their major (and in the minor, if a minor is declared) at graduation. Students with less than a 3.00 GPA may not hold an assistantship or fellowship.

## **1.9. Correspondence and Forms**

Students must correspond and comply with outlined policies via electronic or hardcopy means. For electronic communications, all students are provided with a University of Florida email account (ufl.edu) upon entrance to the program. GSO will use this UF accounts for all official communications. Students are responsible for promptly and thoroughly reading emails and are expected to communicate in a professional manner. For hardcopy correspondence, all documents, including forms, should be fully completed and submitted directly to the GSO office. Most forms have clear deadlines and students are expected to comply with these deadlines.

## **1.10. Preparation for Final Semester**

**It is the student's responsibility to ascertain that all requirements have been met and that every deadline is observed.** Deadline dates are set forth in the University Calendar and by the BME department. These dates can be found online at the Graduate School and BME websites.

Students must notify the BME GSO of graduation plans no later than the Graduate School registration deadline for their program. At the beginning of the final term, students must also file a degree application online through ISIS and must meet minimum registration requirements. Non-thesis Master's students must complete be registered for or have already taken BME 6907. Master's Thesis and PhD students should obtain the Checklist for their relevant degrees from the Graduate School website to ensure compliance with BME and Graduate School requirements: <http://graduateschool.ufl.edu/graduation/thesis-and-dissertation>.

For deadline information regarding submissions to the Graduate Editorial Office, please visit: <http://helpdesk.ufl.edu/application-support-center/graduate-editorial-office/> When the dissertation or thesis is ready to be put in final form, the following website offers formatting information: <https://asc.helpdesk.ufl.edu/>.

**It is solely each student's responsibility to ensure that all required forms are submitted in accordance with Department and Graduate School deadlines.**

## **1.11. Student Responsibility**

The student is responsible for becoming informed and observing all program regulations and procedures. The student must be familiar with Graduate Catalog general regulations and requirements, specific degree program requirements, and offerings and requirements of the major academic unit. *Rules are not waived for ignorance.* It is also the student's responsibility to check their UFL email on a regular basis. Failure to do so will not be a valid excuse for missing deadlines. Under no circumstances will a faculty advisor be responsible for meeting student deadlines.

## 2. MASTER'S DEGREE

### 2.1. General

The Department of BME offers both a Masters of Engineering (M.E.) or Masters of Science (M.S) degree. The Master's degree may be thesis or non-thesis. For all options, standard admission requirements of the Graduate School must be met. To be eligible for admission to the M.E. program, students must have earned a bachelor's degree from an ABET-accredited college or they must complete articulation work for equivalence. Students who do not meet the ABET requirement may be admitted to the Master of Science program. Note that the Medical Physics Concentration is only a Master of Science program.

The non-thesis M.E. degree is a 30-credit course-work degree. A capstone project (BME 6907) must be included in the 30 credits. The Thesis option requires 29 credits of course work and at least 3 credits of BME 6971. The Medical Physics concentration requires 38 credits of course work and at least 3 credits of Thesis (BME 6971) or Non-Thesis (BME 6907) Research. All Master's students (thesis and non-thesis) are required to pass a Final Examination.

### 2.2. BME M.E. or M.S. Degree Requirements

The general minimum requirements for completion of the BME M.E. or M.S. program includes:

- Completion of course requirements
- Good academic standing with an overall GPA of 3.00 truncated and a 3.00 truncated GPA in their major (and in the minor, if a minor is declared) at graduation
- Assignment of Supervisory Chair and/or Committee
- Completion of Final Examination (capstone or Thesis)

### 2.3. Course Requirements

The required courses for the Master's programs are outlined on pages 17-19. Unless otherwise specified, for any master's degree, the student must earn a minimum of 30 credits as a graduate student at the University of Florida. Graduate credit is awarded for courses numbered 5000 and above (unless approved 3000-4999 level courses for up to 6 credits) and at least 15 credits must be in BME (excluding BME 6971). All work, including transferred credit, counted toward the master's degree must be completed during the seven years immediately preceding the date on which the degree is awarded.

#### 2.3.1. Transfer of Credit

If appropriate, a Transfer Petition request may be submitted to the BME Graduate Affairs Committee to request transfer of credits to apply towards the BME Master's degree. Only graduate-level (5000 and above) coursework, earned with a grade of B or better, are eligible for transfer of credit. S/U coursework is **not eligible** for transfer credit. These can include no more than 9 credits from outside institution/s approved by UF and up to 6 credits from postbaccalaureate work at the University of Florida, for a maximum of 15 transfer credits allowed. To apply towards the MS or MS degree, all transferred courses must be designated within course classifications (e.g. engineering requirements, engineering electives, Department requirements). These credits are applied only after written approval from the Dean of the Graduate School.

## **2.4. Supervisory Chair and/or Committee**

All Master's degree candidates should appoint their Supervisory Chair and/or Committee as soon as possible after admission to the Graduate School, **but no later than the second semester of graduate study.**

### **2.4.1. Thesis Master's Degree**

For a Master's degree with a thesis, a Supervisory Chair and Committee are required. The supervisory committee must consist of at least two members selected from the Graduate Faculty. The Chair must be a member of the BME Graduate Faculty. The Chair will serve as the student's advisor.

The supervisory committee's duties are to advise the student, to check on the student's qualifications and progress, to supervise the preparation of the thesis, and to conduct the final exam. The student is responsible for forming a Supervisory Committee and providing the names of the committee members to the Department of Biomedical Engineering Graduate Student Office. The function of the committee is to guide the student through his/her thesis research and to administer the final examination. Students should complete a Master's Thesis Supervisory Committee selection form (see GSO or website for form), signed by their full committee, to finalize their selection.

### **2.4.2. Non-Thesis Master's Degree**

For a Master's degree without a thesis, only a Supervisory Chair is required. The Chair must be a member of the BME Graduate Faculty. The Chair will serve as the student's advisor. The Chair will also administer and grade the Final Examination Project (BME 6907). Students should complete a Master's Non-Thesis Supervisory Chair selection form (see GSO or website for form), signed by their Chair, to finalize their selection.

## **2.5. Master's Thesis**

In addition to the required outlined coursework, all candidates for the Master's degree with thesis must prepare and present a thesis that shows independent investigation and is acceptable to their Supervisory Committees and the Graduate School. The candidate should consult the Graduate School Editorial Office for instructions concerning the format of the thesis. The University Calendar specifies final dates for submitting the original thesis to the Graduate School.

### **2.5.1. Research and Course Credit**

Students should coordinate research work with their Supervisory Committee. Students are expected to conduct independent research, under the guidance of their Committee Chair and with input from their Supervisory Committee. Thesis students are required to enroll in and satisfactorily complete 3 credits of BME 6971 in their final term. Students in the general program (not Medical Physics concentration) may elect to enroll in an additional 3 credits of BME 6971 (up to 6 credits total) during their research experience, which can be applied towards their Specialization elective course requirement. Elected credit is proportional to the amount of time students are expected to devote to the research project and all research credit must be approved, supervised, and graded by the student's designated Supervisory Chair.

### 2.5.2. Final Examination Procedures

The goal is to present a thesis that shows independent investigation, is of publishable quality, in a form suitable for publication, and satisfies the expectations outlined by the student's Supervisory Committee. Each student should work closely with their Supervisor Committee in preparing the written and oral components of this examination.

### 2.5.3. Timing:

M.S. Thesis students can take their Final Examination no earlier than the semester preceding their anticipated graduation. The student should let the GSO know of their graduation intentions the semester prior to graduation. This will allow time for course requirement checks. The student is expected to be in charge of scheduling of their examination with their Supervisory Committee. The student should coordinate with the BME office for room reservations. The examination should be scheduled 1 month in advance and the BME Graduate office must be notified. The Department of BME must receive date, time, title, location, and abstract two weeks prior to the examination date. Graduation may be delayed for those who do not adhere to this rule. It is solely each student's responsibility to ensure that all required forms are submitted in accordance with Department and Graduate School deadlines.

The written portion of the thesis must be submitted to the Supervisory Committee and the Graduate Coordinator (for retention in student's records) two weeks prior to the scheduled oral examination. Electronic format is permitted, but paper format must be provided if requested.

### 2.5.4. Format:

The format for the final examination is a thesis consisting of both written and oral components.

The written thesis should be of publishable quality and in a form suitable for publication. The style and content should be succinct and clear. The final format for the document is guided by the Graduate School requirements (see <http://graduateschool.ufl.edu/files/etd-guide.pdf> for format requirements and example pages; <http://graduateschool.ufl.edu/files/checklist-thesis.pdf> for checklist; <https://asc.helpdesk.ufl.edu/> for the Application Support Center/Electronic Theses and Dissertation Lab; and <http://graduateschool.ufl.edu/graduation/thesis-and-dissertation> for Graduate School Editorial Office Information) and the Supervisory Committee, but the minimum recommended standards are:

- Title/Abstract/Summary – Abstract should be ~ 200 words.
- Introduction/Background/Significance –to provide context for the central hypothesis and ensure that the work outlined is independent and of relevance
- Materials and Methods – summary of materials and methods performed following the style of standard journals in the field
- Results – summarizing results collected with figures/tables in publication quality format
- Discussion – Discussion of interpretation and impact of results collected, as well as potential challenges and pitfalls of the work, as well as alternatives.
- Literature Cited - list references using a standard citation format that also includes all authors and the full title of the cited reference (use of citation software *strongly* encouraged)

The oral report is expected to provide an appropriate summary of the thesis. Handout of the slides is suggested to facilitate discussion. This formal presentation is public, should be 30-45 mins long and cover the key aspects of the thesis, including Background and Significance, Methods, Results, and Discussion. Following the formal open presentation, a question and answer session is expected, wherein the first section is for the general audience and the second section is closed to the Supervisory Committee. Students are expected to address questions directly and to demonstrate their capacity to rigorously defend all aspects of his/her research. Further, the supervisory committee is free to ask additional questions on general BME and selected minor subjects, as well as matters pertaining to the student's field of study.

The entire Supervisory Committee are required to participate in the final examination in compliance with Graduate Council policies, i.e. the Chair or co-Chair must be in the same physical location as the student and the other members are permitted to participate from remote sites via technological means.

#### **2.5.5. Examination Results:**

Following completion of the examination, the student will be asked to leave the room and the supervisory committee may then engage in discussion regarding the student's exam performance. In concert, the supervisory committee will complete the Master's Thesis Final Examination rubric (see GSO for form), which is based on both the written and oral components of the examination. Appropriate and detailed comments for each section should be provided, with the Committee Chair serving to condense all comments in the Master's Thesis Final Examination Results form. Comments should be tailored to provide constructive and specific feedback of identified weakness or deficiencies (if any).

Following completion of the discussion, the committee will make collective PASS / NO PASS recommendation. The recommendation must be unanimous and take place at the conclusion of the examination prior to the committee's adjournment. The final vote is binding and recorded in the Master's Thesis Final Examination Results form.

If PASS, all committee members must the Master's Thesis Final Examination Results. In addition, they should sign the Thesis Approval signature page<sup>1</sup>.

If NO PASS, the committee members should specifically outline deficiencies the student must address prior to reexamination and sign the Final Examination Report.

Note that the Master's Thesis Final Examination Results will be released in their entirety to the student.

#### **2.5.6. Reports and Records of Examination:**

The Committee Chair is responsible for submitting the formal examination rubric and Final Examination Report with recommendation (PASS or NO PASS) to the Graduate Coordinator on the day of the examination. The Graduate Coordinator then will certify the report and

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<sup>1</sup> In cases where the thesis committee has identified issues with the written report that the student must address prior to final approval, the committee must specifically outline these outstanding issues and may elect to not sign the Thesis Approval signature page at the time of the oral examination. In this case, the student is responsible for collecting all signatures once the issues have been addressed.

recommendation. The Graduate Coordinator will then email the official rubric and recommendation to the student, with copy also sent to his/her Committee Chair, within 7 days after the examination.

If a successful PASS, the student is responsible for submitting the signed Thesis Approval signature page and final version of the written thesis to the GSO. Requirements of the final examination will not be met until all items are on file with the GSO.

#### **2.5.7. Examination Retakes:**

Only one retake is permitted. All retakes should be scheduled as soon as possible, depending on the recommendations and conditions outlined in the NO PASS vote. This is typically within 2-3 months and must be no later than 6 months after the original examination. If a second NO PASS is given, the student will be released from the program.

### **2.6. Non-Thesis**

In addition to the required outlined coursework, all candidates for the non-thesis Master's degree must prepare a capstone project, directed by a Supervisory Chair, to fulfil their final examination requirements.

#### **2.6.1. Final Project and Course Credit**

Students are required to complete a capstone project and should coordinate the format and expectations for this project with their Supervisory Chair. Non-thesis Master's students in the general program are required to enroll in and satisfactorily complete 1 credit of BME 6907 as their capstone project, which can be taken no earlier than the semester preceding their final term. Non-Thesis Master's students in the Medical Physics Concentration are required to enroll in and satisfactorily complete 3 credits of BME 6907 (2 towards the general requirement and 1 towards the Final Examination credit) in their final term to meet concentration guidelines.

Students in the general program may elect to enroll in an additional 3 credits of BME 6907 (up to 4 credits total) during their research experience, which can be applied towards their Specialization elective course requirement. Elected credit is proportional to the amount of time students are expected to devote to the project and all research credit must be approved, supervised, and graded by the student's designated Supervisory Chair. Note, the overall restriction of no more than 6 credits derived from S/U courses for non-thesis Master's students must still apply.

#### **2.6.2. Final Examination Procedures**

For the non-thesis Master's degree, the Final Examination consists of the successful completion of a capstone project designated by a BME faculty member. Credit for this project is recorded via satisfactory completion of 1 credit of BME 6907 as a Final Examination Credit. This credit is designated as the Final Examination Credit by completing and filing the Master's Non-Thesis Final Project enrollment form (see GSO or website for form) with the GSO prior to registration. The Master's Non-Thesis Final Project form is filled out by the student and designated Committee Chair, and serves to outline the expectations for successful completion of the project for credit towards the Final Examination.

Non-thesis students can take their Final Examination via enrollment in BME 6907 as a Final Examination Credit no earlier than the semester preceding their anticipated graduation.

In order to provide the student a measure of performance mid-semester, the Committee Chair is expected to complete a mid-term evaluation of the student (see GSO or website for form), accompanied by recommendations for improvement for the remainder of the term. The mid-term evaluation of the student should be accompanied by a one-on-one meeting between the Committee Chair and the student. This form should be a part of the documentation retained by the Committee Chair for grade assignment.

For grade assignment of BME 6907 for Final Examination credit, the Committee Chair must submit a Final Examination Completion form (see GSO or website for form), which outlines the manner in which the student completed the outlined project and assign a grade (S or U). A grade of S should be assigned if the student achieves at least 70% of the expectations set out by the research advisor and the student at the beginning of the semester, as well as a Final Report. The Committee Chair is expected to retain records of the student's Final Examination Project Report for future reference, if needed.

If the student receiving a U grade (i.e. fails the final examination), he/she must retake the examination in the next semester. The exam may be retaken only once.

## **2.7. Transfers to Ph.D. Program**

If a student in the general Master's program applies to the PhD program and is accepted, the student may elect to take the PhD Oral & Written Qualifying Examination and, upon successful completion, satisfy the Master's Non-Thesis and the PhD Oral & Written Qualifying Examination simultaneously. It is solely each student's responsibility to ensure that all required forms are submitted in accordance with Department and Graduate School deadlines.

# **CURRICULUM FOR MASTERS DEGREES**

## **DEPARTMENT OF BIOMEDICAL ENGINEERING**

### **General BME: Graduate Curriculum**

<b><u>BME Core Required Courses (Total of 11 Credit Hours)</u></b>		<b>Credits</b>
BME 5401	Biomedical Engineering & Physiology I	3
BME 6010	Clinical Preceptorship	3
BME 6936	BME Seminar (Fall and Spring)	2
<b><u>BME Core Math requirement (choose 1 of 2):</u></b>		
BME 5703	Statistical Methods for BME	3
<b>OR</b> BME 5704	Advanced Computational Methods for BME	3

### **BME Electives (9 Credit Hours)**

A BME Core Elective is any graduate course (5000+) having a BME prefix (excluding BME 6905, BME 6910, BME 6940, BME 6971, BME 7979, BME 7980).

### **Specialization Electives (9 Credit Hours)**

BME elective courses require approval from the student's Supervisory Chair. Allowable courses are all graduate courses (5000+) offered by the COE or COM.

### **Master's Final Examination**

The thesis final examination research is conducted under the BME 6971 (Research for Master's Thesis) for 3 credits in the final graduating term.

The non-thesis final examination capstone project is conducted under BME 6907 (Non-Thesis Master's Project) for at least 1 credit in either the semester preceding or the semester of the final graduating term.

### **BME Graduate Seminar**

MS Students are required to enroll in BME 6936 Fall and Spring semester of their first year.

### **Program Credit Totals**

MS/ME: 30 credits (non-thesis); 32 credits (thesis)

# GENERAL BME MASTER'S GRADUATE PROGRAM PLAN

BME Core Requirements (8 credits total):

Course			Semester completed	Grade earned
BME5401	Biomedical Engineering & Physiology	3		
BME6010	Clinical Preceptorship	3		
BME6936	BME Seminar (Fall)	1		
BME6936	BME Seminar (Spring)	1		

BME Math Requirement (3 credits total):

Course			Semester completed	Grade earned
BME5703	Statistical Methods for BME	3		
BME5704	Advanced Computational Methods	3		

BME Electives (9 credits total)<sup>a</sup>:

Course			Semester completed	Grade earned

<sup>a</sup>Any graduate-level BME-prefix course (excluding BME 6905, BME 6910, BME 6940, BME 6971, BME 7979, BME 7980).

Specialization Electives (9 credits)<sup>b</sup>:

Course			Semester completed	Grade earned

<sup>b</sup>Any graduate-level course in the College of Engineering or College of Medicine

**Thesis** students (2-3 credits, depending on the semester)<sup>c</sup>

Course			Semester completed	Grade earned
BME 6971	Master's Thesis			

<sup>c</sup>The Graduate School requires MS Thesis students to complete 3 credits of BME 6971 in Fall/Spring during their final term of registration. If graduating in the summer, the Graduate School requires registration for 2 credits of BME 6971.

**Non-thesis** students (1 credit)<sup>d</sup>

Course			Semester completed	Grade earned
BME 6907	Master's Non-Thesis Project	1		

<sup>d</sup>MS non-thesis students are **required** to register for 1 credit of BME6907 Non-thesis project to fulfill their Final Examination Requirement no earlier than the semester preceding their final term.

## MEDICAL PHYSICS CONCENTRATION BME MASTER'S GRADUATE PROGRAM PLAN

<b>FIRST FALL SEMESTER</b>		<b>CREDITS</b>
BME 6535	Radiological Physics, Measurements and Dosimetry	3
BME 6590	Medical Physics	3
<u>BME 6533</u>	<u>Radiological Anatomy</u>	<u>3</u>
<b>Total:</b>		<b>9</b>
<b>FIRST SPRING SEMESTER</b>		
BME 6591	Therapeutic Radiological Physics I	3
ENU 6657	Diagnostic Radiological Physics I	3
<u>ENU 5626</u>	<u>Radiation Biology</u>	<u>3</u>
<b>Total:</b>		<b>9</b>
<b>FIRST SUMMER SEMESTER</b>		
BME 6592	Therapeutic Radiological Physics II	3
<b>Elective Course Offerings**</b>		
<u>ENU 6652</u>	<u>Diagnostic Radiological Physics III</u>	<u>3</u>
<b>Total:</b>		<b>3-6</b>
<b>SECOND FALL SEMESTER</b>		
ENU 5658	Imaging System Analysis	3
BME 6936	Biomedical Engineering Seminar	1
BME 6505	Diagnostic Radiological Physics II	3
<b>Elective Course Offerings**</b>		
<u>BME 6593</u>	<u>Therapeutic Radiological Physics III</u>	<u>3</u>
<b>Total:</b>		<b>7-10</b>
<b>SECOND SPRING SEMESTER</b>		
ENU 6636	Medical Radiation Shielding and Protection	3
ENU 6659	Nuclear Medicine Physics	3
BME 6936	Biomedical Engineering Seminar	1
BME 6971 or	Masters Research*	3
BME 6907	Non-thesis Research Projects*	
<b>Elective Course Offerings**</b>		
<u>ENU 6623</u>	<u>Radiation Dosimetry</u>	<u>3</u>
<b>Total:</b>		<b>10-13</b>
<b>Total Hours</b>		<b>41 min</b>

\* A minimum of 3 hours of either Masters Research or Non-Thesis Research must be completed as part of the graduate program. It is suggested that students begin their research in the first summer, but may be varied at the discretion of the student's research advisor and supervisory committee. It is anticipated that most students will register for additional research credits throughout their academic program. Thesis students must take 3 credits of BME6971 in their final term.

\*\* Students must complete one of the Elective Course Offerings

### 3. DOCTOR OF PHILOSOPHY DEGREE

The University of Florida Biomedical Engineering Ph.D Program seeks to provide students with a fundamental understanding the application of engineering principles to biomedical research in a highly translational manner. The goal of this program is to graduate high independent, creative, and innovative global ambassadors to the field of biomedical engineering.

#### 3.1. Degree Timeline and Deadlines

The recommended deadlines\* for Ph.D. students are:

Time from Start of Program	Milestone	Section
Within 1 month	Submit selection of Research Area	3.3
Within 1 <sup>st</sup> semester	Selection of a permanent Doctoral Advisor	3.5
By 2 <sup>nd</sup> semester	Finalization of Ph.D. Supervisory Committee	3.6.1
End of 2 <sup>nd</sup> semester	Pass Departmental Comprehensive Examination	3.6.2
2.0 years	Pass Graduate Qualifying Examination	3.6.3
2.0 years	Admission to Ph.D. Candidacy	3.6
2.0+ Annually	Annual Research Update with Supervisory Committee	3.4.4 & 3.6.1.3
No earlier than 6 months prior to defense	Sufficiency Meeting with Supervisory Committee – <i>Recommended Only</i>	3.7.1
4.0-5.0	Thesis Defense	3.7

\*Academic holds may be placed when a student is out of compliance with recommended deadlines.

#### 3.2.BME Ph.D. Requirements

The general minimum requirements for completion of the BME Ph.D. program include<sup>2</sup>:

- Completion of all required courses (or equivalent subject coverage) with appropriate GPA (minimum 3.0)
- Completion of Supervised Teaching requirement (4 credit hours)
- Complete requirements for admission to Ph.D. Candidacy
- Research credits (BME7979 before candidacy, BME7980 after candidacy)
- Additional coursework as specified by the supervisory committee
- A minimum of 90 credits
- Demonstration of scholarly dissemination of scientific contributions through peer reviewed publication(s)
- Successful Ph.D. Dissertation Defense

#### 3.3. Research Area

All Ph.D. students are required to select a Research Area, which follows their specific research interests within the field of BME. This Research Area should assist in guiding advisor and coursework selection. While many projects may cross into several research areas, students should pick one area in which they feel they are more closely aligned. Student are expected to submit their official Research Area selection to the BME Graduate Assistant

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<sup>2</sup> Note: Requirements outlined are for the general BME Ph.D. program. The Medical Physics concentration has additional requirements.

within the first month of admission (see office for form). This designation will also dictate the faculty composition for the Departmental Qualifying Examination. While this designation is commonly retained throughout the student's tenure, students may elect to change their research area if their research focus is modified due to faculty assignment, project focus change, etc. A sound reason must be provided for this change and this change must be made using the Research Area change form (see office for form). Note that students admitted into the Medical Physics concentration are automatically placed within this research area.

**The Department of Biomedical Engineering Research Areas are:**

- Neural Engineering
- Imaging & Medical Physics
- Biomaterials & Regenerative Medicine
- Biomedical Informatics & Modeling

### **3.4. Courses**

#### **3.4.1. Course Requirements**

All students must complete the minimum course requirements for doctoral degrees, as specified on Page 34. Electives provide flexibility to the student to tailor their coursework to support their research. A minimum of 90 credits beyond the bachelor's degree is required for the Ph.D. degree in all fields. All master's degrees counted in the minimum must have been earned in the last seven years.

#### **3.4.2. Transfer of Credit**

See the Graduate Catalog for transfer of credit policy. Students should contact the GSO to begin the process of transferring credits from a previous degree. Once departmental approval is received a petition to the Graduate School is submitted by the department. This petition cannot be submitted until final transcripts have been received in the Office of Admissions. All such transfer requests must be made by petition of the BME academic committee no later than the third semester of Ph.D. study.

#### **3.4.3. Registration in Research Courses**

Advanced Research (7979) is open to doctoral students who have not yet been admitted into candidacy. Research for Doctoral Dissertation (7980) is reserved for doctoral students who have been admitted to candidacy. Students enrolled in 7979 during the term they qualify for candidacy will stay in this registration unless the GSO elects to change their enrollment to Research for Doctoral Dissertation (7980).

#### **3.4.4 Annual Evaluation for PhD Students**

The Supervisory Committee Chair, in consultation with the other committee members, will give each PhD student a yearly written evaluation of his/her progress towards his/her degree. The student is given an opportunity to discuss the evaluation with his/her Supervisory Committee Chair. Copies of this evaluation and of student comments are placed in the student's academic file.

### **3.5. Selection of Ph.D. Advisor**

Upon acceptance into the PhD program, students are expected to identify a Doctoral Advisor. This advisor will serve to as their primary mentor for their dissertation research

and the Chair of the Supervisory Committee. The Doctoral Advisor must have Graduate Faculty status within the Department of Biomedical Engineering. If the desired research advisor is not a member of the BME Graduate Faculty, they can only serve as the Co-Chair of the student and a faculty who is a member of *Primary* BME Graduate Faculty must be named as the Chair of the student's committee. This named Chair will formally serve as the student's Doctoral advisor.

Selection of a Doctoral advisor is encouraged as early into the Ph.D program as possible to enhance efficiency of progress through the program; however, students are strongly encouraged to meet with multiple faculty within their research area of interest to ensure a strong advisor-advisee match. The selection of a Doctoral Advisor is an important decision, thus both the advisor and advisee should enter into this agreement in a judicious manner. Both the student and the advisor should consider research goals, mutual interests, compatibility of work habits and personalities, and the student's career goals when making this decision.

During their 1<sup>st</sup> semester, the graduate office will request that all incoming Ph.D students submit an ordered list of their preferred Doctoral Advisors. Faculty will also be requested to submit an ordered list of their preferred advisees. The Graduate Affairs Committee will match up students with advisors. The matching process uses the following criteria: student preference, faculty preference, faculty appointment (Primary BME faculty have priority), and current distribution of students among advisors.

If a student cannot be matched with a Doctoral Advisor within the 1<sup>st</sup> semester, the student will be closely monitored to facilitate matching during the 2<sup>nd</sup> semester of study. If an advisor-student match cannot be made by the 2<sup>nd</sup> semester, the student may elect to move to transfer to the MS program or leave the program.

### **3.6. Ph.D. Candidacy**

The general minimum requirements for Admission to Ph.D. Candidacy

- Appointment of Ph.D. Supervisory Committee Members
- Successful Pass of Departmental Comprehensive Examination
- Successful Pass of Graduate Qualifying Examination
- Good academic standing (e.g. maintenance of minimum GPA)

#### **3.6.1. Appointment of Ph.D. Supervisory Committee**

The Ph.D. Supervisory Committee provides guidance about the student's research project and academic progress through the duration of the student's graduate tenure. The student should personally meet with potential faculty candidates for their Supervisory Committee to clarify the roles and responsibilities of these members (see below for details) and to begin establishing a relationship with the faculty members. The student must set up their supervisory committees by the time they have completed their second semester.

##### **3.6.1.1. Membership**

Supervisory committees are designated by the student and faculty advisor. The supervisory committee for a candidate for the doctoral degree shall consist of no fewer than 4 members. All faculty must be members of the Graduate Faculty to be eligible. The make-up of the committee must be as follows:

1. at least 2 members, including the chair, from the *BME Graduate Faculty*, whereby at least 1 is a *Primary* BME Faculty member.
2. at least 1 member from a different educational discipline, *unaffiliated* with the Department of BME (designed as the External Member)

It is *strongly suggested* that 1 member of the committee is from the College of Medicine or other health-related college. The dean of the Graduate School is an exofficio member of all supervisory committees. Medical Physics Concentration students have additional requirements and should contact the Medical Physics Coordinator for advice on Committee members.

Once the committee has been selected, all committee members must sign the duties and responsibility form (see GSO or website for form). A signed copy of the Supervisory Committee form must be certified by BME Graduate Office. Modifications in the committee make-up must be recorded via submission of modification form (see GSO or website for form).

### **3.6.1.2. Duties and Responsibilities**

Duties of the supervisory committee are as follows:

1. To inform the student of all regulations governing the degree sought. It should be noted, however, that this does not absolve the student from the responsibility of informing himself/herself concerning these regulations.
2. To conduct the Graduate Qualifying Examination to discuss and approve the proposed dissertation project and the plans for carrying it out. The entire supervisory committee must participate in the oral portion of the examination in compliance with Graduate Council policies, whereby the Chair or co-Chair must be physically present and the other members are permitted to participate from remote sites via technological means. This examination must be given on campus. (See Graduate Qualifying Examination section)
3. To provide annual feedback to the student via a yearly letter of evaluation and S/U grades awarded for the research courses 7979 and 7980. The Chair should complete the Ph.D. Annual Review form (see GSO or website for form) in consultation with the Supervisory Committee and submit to the student and the graduate office for retention in the student's confidential departmental file.
4. To formally meet when the work on the dissertation is at least 50% completed to review procedure, progress, and expected results and to make suggestions for completion
5. To meet when the dissertation is completed and conduct the final oral examination to assure that the dissertation is a piece of original research and a contribution to knowledge. The entire supervisory committee must participate in the final examination in compliance with Graduate Council policies, whereby the Chair or co-Chair must be physically present and the other members are permitted to participate from remote sites via technological means. Only members of the official supervisory committee may sign the dissertation and they must approve the dissertation unanimously (see Graduate Catalog).

### **3.6.1.3. Meetings**

The student must schedule annual meetings (or even semi-annual as the student advances into their 3-5<sup>th</sup> year) with their Supervisory Committee. These meetings can be one-on-

one or collective. These meetings serve as a forum for feedback and are collectively documented in the Ph.D. Annual Review form (see GSO or website for form). Meeting with your Supervisory Committee is a critical and required component in progression towards your Dissertation. As such, regular communication is important to ensure adequate time for feedback prior to defending.

### **3.6.2. Departmental Comprehensive Examination**

There are two formats of the Departmental Comprehensive Examination: 1) General; and 2) Medical Physics Concentration. The following text outlines the format for the general examination. Students in the Medical Physics program should refer to the BME website or the Medical Physics Coordinator for detailed information regarding their Departmental Comprehensive Examination.

#### **3.6.2.1. Exam Philosophy**

The goal of the Departmental Comprehensive Examination is not to evaluate the student's competency of coursework, but rather to assess a proficiency and potential for a successful career in original biomedical engineering research at the doctoral level. As such, this exam is designed to assess the student's:

- breadth and depth of knowledge of their field of interest in BME
- capacity for critical analysis of literature
- independent thinking and decision making ability
- aptitude for application of knowledge to push new boundaries in BME

#### **3.6.2.2. Eligibility, Timing, and Requirements**

All Ph.D. students must take the Departmental Comprehensive Examination as a part of the requirements for admission to Ph.D. candidacy. Only students in good academic standing are permitted to take the examination.

Ph.D. student must take the exam during the examination period offered at the end of the Spring semester of their 1<sup>st</sup> year of study. Students that enter the Ph.D. program in the Spring term may petition to defer this examination for 1 year (must be requested).

The GSO will notify each student of their eligibility for examination during the Spring semester. Examination selections (see below) will be sent 5 weeks prior to the examination date. Finalization of selection must be made by 4 weeks prior to the exam date. The student will be notified of the assigned date, time, and location of the examination 2 weeks prior to the examination. The written report is due 5 days prior to the date of the examination.

#### **3.6.2.3. Format of Departmental Comprehensive Examination**

The format for the examination consists of both a written and oral component. To account for the high variability in the field of biomedical engineering and to provide the appropriate format for meeting the exam philosophy, the examination of each student will be tailored according their selected research area (see Section 3.3). Specifically, these research areas are:

- Neural Engineering
- Imaging & Medical Physics
- Biomaterials & Regenerative Medicine

- Biomedical Informatics & Modeling

The examination will be conducted by three committee members designated to be within the same research focus as the student under examination (see Section 3.6.2.4 for more details).

At 5 weeks prior to the examination period, students will be provided with their examination selections, which consist of 3 seminal research articles, to consider. The students will have 1 week to select 1 of the articles to evaluate. During the subsequent weeks, they will work on their written and oral reports on the publication. Students are expected to work independently on their actual reports; however, discussion of concepts with other students or faculty are welcome.

The written report should address the following key 5 points:

1. What is the problem being addressed?
2. What is the hypothesis of the study?
3. Describe and summarize the key methodologies.
4. Describe and summarize the key results.
5. Describe and summarize the advancement(s) in the field made by this manuscript

The write up should be grammatically correct, with appropriate brevity, clarity, context, and analysis with a maximum of 2 pages (single spaced, Ariel/Times New Roman, 11-12 pt, 1" margins). This report is due 5 days prior to the scheduled oral examination.

The oral report is expected to provide an appropriate summary of the publication. This formal presentation should be 20-30 mins long and cover the key aspects of the manuscript, including Background, Methods, Results, and Conclusions, addressing the key questions asked in the written portion. All presentations should also include a final Interpretation section that outlines the student's prospective on the publication, including topics such as future directions, additional controls, and pitfalls/weakness. Following the formal presentation, a 30-50 min question and answer session will be conducted. The total duration of the examination should be no less than 1 hr and no more than 1.5 hrs.

During this session, it is expected that the student demonstrates the capacity to:

- Demonstrate an understanding and communicate the appropriate background and context on the problem addressed in the manuscript
- Describe any and all methods employed in the study
- Characterize the results of the data
- Rigorously defend his/her positions on the interpretation of the study

#### **3.6.2.4. Departmental Comprehensive Committee**

The Departmental Comprehensive Examination is administered by a faculty committee consisting of 3 professors, with 1 member designated as the Chair. The Graduate Coordinator will appoint the Departmental Comprehensive Examination Committee and the respective Chair, seeking to match faculty within the research area selected by the student.

The primary research advisor of the student under examination may not serve on the examination committee. He/she may attend the exam as an observer, but may not make

comments during the exam, unless requested to do so by a committee member. The advisor may not be present while the committee is making its final decision.

To be eligible to serve on the Departmental Comprehensive Examination Committee, a faculty must hold:

- A faculty appointment as Professor, Associate Professor, or Assistant Professor in the Biomedical Engineering department.
- Exceptions. The Graduate Coordinator may elect a committee member not meeting the above criteria to ensure adequate representation of faculty within the student's elected field of research. To be considered for approval, the Coordinator must:
  - Review the curriculum vita of the potential committee member to ensure adequate expertise in the targeted research field
  - Meet with the potential committee member to review the philosophy and policies of the examination to ensure consistency

The Chair of the Departmental Comprehensive Examination Committee must be a primary faculty member of the BME department. The Chair serves to ensure uniformity and parity to the examination and that the questions are fair and appropriate. The Chair will also serve to ensure the examination proceeds on time and within scope. Further, the Chair will be responsible for directing the discussion at the termination of the examination, recording the final votes, writing up the final examination report, and submitting these results to the Graduate Coordinator.

#### ***3.6.2.5. Departmental Comprehensive Examination Results***

Following completion of the examination, the student (and advisor if present) will be asked to leave the room and the committee may then engage in discussion regarding the student's exam performance. Members will follow the Departmental Comprehensive Examination Rubric (see GSO or website for form) for guidance on examination standards. Discussion will be based on both the written and oral components of the examination. Appropriate and detailed comments for each examination metric should be provided, with the Chair serving to condense all comments in the Department Comprehensive Examination Result form. Comments should be tailored to provide constructive and specific feedback of identified strengths, weakness, and/or deficiencies.

Following completion of the discussion, the committee will take a PASS / NO PASS vote. Voting must be finalized prior to the committee's adjournment. The final binding vote is recorded on the internal rubric form. The final recommendation is that of the majority votes and the vote does not have to be unanimous. The final majority recommendation PASS / NO PASS must be recorded on the Department Comprehensive Examination Result form.

Vote options:

- PASS
  - With Recommendations –
    - Only *Weaknesses* are identified during the course of the examinations
    - Recommendations are not strictly enforced and only serve to assist in promoting further improvements to the student's training
  - With Conditions

- These are *Weakness* and a *Deficiency* (no more than 1) identified during the course of the examination
- Conditions are strictly enforced and must be addressed within one year of the examination
- Conditions are clearly outlined and enforceable (e.g. taking and achieving a B grade or better on a specific course)
- NO PASS
  - Student has demonstrated *Deficiencies* in 2 or more areas of the examination
  - If this is the first time the student has taken the examination, strong recommendations and conditions should be provide to assist in guiding the student to address these deficiencies

Note that the Department Comprehensive Examination Result form will be released in their entirety to the student.

#### **3.6.2.6. *Reports and Records of Departmental Comprehensive Examination***

The Chair of the examination committee is responsible for submitting the internal voting form and Department Comprehensive Examination Result form to the Graduate Coordinator on the day of the examination. The Graduate Coordinator will certify the report and recommendations. The Graduate Coordinator will email the official result and recommendations to the student, with copy also sent to his/her research advisor, within 7 days after the examination. A copy of the results will also be retained within the student's file.

#### **3.6.2.7. *Departmental Comprehensive Exam Retakes***

Only one retake is permitted. All retakes should be scheduled as soon as possible, depending on the recommendations and conditions outlined in the NO PASS vote This is typically within 2-3 months, but no longer than 6 months, after the original examination. The same committee members are expected to serve on the retake examination, unless requested and approved by the Graduate Coordinator. If a second NO PASS is given, the student may elect to pursue an MS or withdraw from the program.

### **3.6.3. Graduate Qualifying Examination**

#### **3.6.3.1. *Exam Philosophy***

The Graduate Qualifying Examination is the final milestone to qualify the student for Ph.D. candidacy. The examination seeks to review the qualifications outlined in the Departmental Qualifying Examination, as well as to provide rigorous review of the student's selected research proposal and breadth of knowledge in the student's research area. As such, it consists of a written research proposal, which is defended orally. Of critical importance in the examination is ensuring that the student's research project:

- seeks to encompass a single unified concept with sufficient focus and structure
- applies both engineering and biomedical components
- possesses the major characteristics of scientific method, specifically objectivity and reproducibility.
- is feasible within a reasonable graduate student tenure
- seeks to provide an original and significant contribution to the field of biomedical engineering.

### **3.6.3.2. Eligibility, Timing, and Requirements**

All Ph.D. students must take the Graduate Qualifying Examination as a part of the requirements for admission to Ph.D. candidacy and only *after* successfully passing the Departmental Qualifying Examination (PASS with Recommendations or PASS with Conditions). Only students in good academic standing are permitted to take the examination.

Ph.D. students may take the examination as early as their third semester of graduate study and are expected to pass the examination prior to the start of their 3<sup>rd</sup> year of study.

The student is expected to be in charge of the scheduling of their examination, reaching out to their Supervisory Committee to coordinate schedule. The student should coordinate with the BME office for room reservations. The examination should be scheduled 1 month in advance and the BME Graduate office must be notified.

### **3.6.3.3. Graduate Examination Committee**

The Graduate Qualifying Examination is administered by the student's Ph.D. Supervisory Committee (see Appointment of Supervisory Committee section for details). The entire Supervisory Committee are required to participate in the final examination in compliance with Graduate Council policies, i.e. the Chair or co-Chair must be in the same physical location as the student and other members are permitted to participate from remote sites via technological means.

### **3.6.3.4. Format of Graduate Qualifying Examination**

The format for the Graduate Qualifying Examination is a dissertation proposal consisting of both written and oral components. The goals are to outline a cohesive research plan with a central hypothesis and specific aims seeking to rigorously test this hypothesis. Each student should work closely with their Supervisor Committee in preparing the written and oral components of this proposal

The proposal represents a starting template for how the central hypothesis will be tested. While the aims and experimental plans may evolve as the project progresses, the proposal should seek to clearly outline the scope of the research and the plan for carrying out the proposed study. It also provides a formal means for the Supervisory Committee to provide input in the direction and implementation of the research strategy. It should, however, be reexamined, by your committee, at least annually.

The written format should follow the style and content of an NIH R01 proposal. The proposal should be succinct and clear. The final format for the document is guided by your Doctoral Advisor, but the minimum recommended standards are outlined below. Note the indicated number of pages per section are recommendations only. Students should seek advice from their Doctoral Advisor for specific guidance.

- 10-15 pages, single spaced, Times New Roman or Ariel, 11/12pt, 1" margins
- Title/Abstract/Summary (1 page) – Abstract should be ~ 200 words.
- Central Hypothesis and Specific Aims (1 page) – hypothesis should be written in the correct form and aims should seek to rigorously test this hypothesis

- Background and Significance (3-4 pages) - to provide context for the central hypothesis and ensure that the work outlined is original and of relevance
- Preliminary Results (1-3 pages) – to establish the feasibility of the aims
- Research Plan (4-6 pages) – to outline the proposed plan for how the aims will be rigorously tested. Descriptions as to how the data will be collected, analyzed, and interpreted should be included. Special emphasis should be given to experimental design in order to test specific hypotheses and inclusion of adequate experimental and control groups. Discuss potential challenges and pitfalls of the approach, as well as alternatives.
- Literature Cited (not counted towards overall length) – list references using a standard citation format that also includes all authors and the full title of the cited reference (use of citation software *strongly* encouraged)
- NIH Style Biosketch of the student (see GSO or website for example)

The written portion of the proposal must be submitted to the Supervisory Committee and the Graduate Coordinator (for retention in student's records) 2 weeks prior to the scheduled oral examination. Electronic format is permitted, but paper format must be provided upon request. If the student does not submit this on time, the examination may be rescheduled (up to the discretion of the committee).

The oral report is expected to provide an appropriate summary of the proposal. Handout of the slides is suggested to facilitate discussion. This formal presentation should be 30 min long and cover the key aspects of the proposal, including Central Hypothesis, Specific Aims, Background and Significance, Preliminary Results and Research Plan. Following the formal presentation, a 30-50 min question and answer session is expected. Students are expected to address questions directly and to demonstrate their capacity to rigorously defend all aspects of his/her research plan. While the Doctoral Advisor may ask questions and provide input when requested, the primary responder to questioning should be the student.

#### **3.6.3.5. Examination Results**

Following completion of the examination, the student will be asked to leave the room and the Supervisory Committee will engage in discussion regarding the student's exam performance. Members will follow the Graduate Qualifying Examination Rubric (see GSO or website for form) for guidance on examination standards. Discussion will be based on both the written and oral components of the examination. Appropriate and detailed comments for each examination metric should be provided, with the Chair (Doctoral Advisor) serving to condense all comments in the Graduate Qualifying Examination Result form. Comments should be tailored to provide constructive and specific feedback of identified strengths, weakness, and/or deficiencies.

Following completion of the discussion, the committee will make a collective PASS / NO PASS recommendation. The vote must be unanimous and take place at the conclusion of the examination prior to the committee's adjournment. The final vote is binding and recorded on the Graduate Qualifying Examination Result form.

Vote options:

- PASS
  - With Recommendations –
    - Only *Weaknesses* are identified during the course of the examinations
    - Recommendations are not strictly enforced and only serve to assist in promoting further improvements to the student's training
  - With Conditions
    - These are *Weakness* and a *Deficiency* (no more than 1) identified during the course of the examination
    - Conditions are strictly enforced and must be addressed within one year of the examination
    - Conditions are clearly outlined and enforceable (e.g. modification of aims, review of concepts in biomaterials)
- NO PASS
  - Student has demonstrated *Deficiencies* in 2 or more areas of the examination
  - If this is the first time the student has taken the examination, strong recommendations and conditions should be provide to assist in guiding the student to address these deficiencies

Note that the examination rubric and results will be released in their entirety to the student.

#### **3.6.3.6. Reports and Records of Examination**

The Chair (Doctoral Advisor) is responsible for submitting the Graduate Qualifying Examination Result form with recommendations to the Graduate Coordinator on the day of the examination. The Graduate Coordinator will certify the report and recommendations. The Graduate Coordinator will then email the official report and recommendations to the student, with copy also sent to his/her research advisor, within 7 days after the examination. A copy of the results will also be submitted to the Academic Office for reporting to the Graduate School and retained within the student's file. The Doctoral Advisor should not share the report with the student prior to certification by the Graduate Coordinator.

#### **3.6.3.7. Exam Retakes**

Only one retake is permitted. All retakes should be scheduled as soon as possible, depending on the recommendations and conditions outlined in the NO PASS vote This is typically within 2-3 months, but no longer than 6 months, after the original examination. If a second NO PASS is given, the student may elect to pursue an MS or withdraw from the program.

### **3.7. Final Examination and Doctoral Dissertation Defense**

#### **3.7.1. Dissertation Sufficiency**

It is *strongly* recommended that the student hold a Dissertation Sufficiency meeting with the entire Supervisory Committee, either as a group or individually, 6-4 months prior the anticipated Doctoral Dissertation Defense date. This meeting should include formal presentation of the research progress made to date. While not required, this meeting serves to identify any potential deficiencies that the committee may identify in the research *prior* to the formal defense. A Dissertation Sufficiency can be extremely helpful in maximizing

progress by identifying and addressing these potential issues earlier than the final defense meeting.

### **3.7.2. Eligibility, Timing, and Requirements**

Within six months prior to graduation and after completion of all other prescribed work for the degree, the doctoral candidate should schedule the Doctoral Defense (Final Examination) by his/her Supervisory Committee. The student is expected to be in charge of the scheduling of their examination, reaching out to their Supervisory Committee to coordinate schedule. The student should coordinate with the BME office for room reservations. The examination should be scheduled 1 month in advance and the BME Graduate office must be notified. The Department of BME must be provided with the title and abstract of the dissertation, as well as the date, time, and location of the oral defense at least 2 weeks prior to the oral defense time for public announcement.

### **3.7.3. Ph.D. Dissertation Defense Committee**

The Graduate Dissertation Defense Examination is administered by the student's Ph.D. Supervisory Committee. The entire Supervisory Committee are required to participate in the final examination in compliance with Graduate Council policies, i.e. the Chair or co-Chair must be in the same physical location as the student and the other members are permitted to participate from remote sites via technological means.

### **3.7.4. Format of Graduate Qualifying Examination**

The PhD final examination consists of a written doctoral dissertation and oral defense of the research results that are described the written document. The goals are to outline the completion of a cohesive research plan with a central hypothesis and specific aims that rigorously test this hypothesis. Each student should work closely with their Supervisory Committee in preparing the written and oral components of their final dissertation. Specific formatting requirements for the written portion of the examination are defined by the Graduate School, so students are required to following the formatting requirements defined therein, see website for requirements and Checklist for Doctoral Dissertations: <http://gradschool.rgp.ufl.edu/editorial/introduction.html>.

Dissemination of research findings is a critical component of the education and training leading to a PhD degree. As such, it is expected that a student's original, scientific contributions will be submitted for scholarly publication in archival refereed journals. Given that the field of BME is highly diverse, the number and nature of the publications resulting from a dissertation will vary. As such, students should work closely with their Doctoral Advisor and Supervisory Committee to ensure that they are meeting these expectations The supervisory committee will take progress towards this goal as one of the key elements in evaluating if and when a student is ready for defense of his/her dissertation.

The written portion of the dissertation must be submitted to the Supervisory Committee 2 weeks prior to the scheduled oral examination. Electronic format is permitted, but paper format must be provided upon request. If the student does not submit this on time, the examination must be rescheduled.

The oral report is expected to provide an appropriate summary of the dissertation. Handout of the slides is suggested to facilitate discussion. This formal presentation should be approximately 45 min long and cover the key aspects of the proposal, including Central Hypothesis, Specific Aims, Background and Significance, Results, Discussion, and Future Directions. Following the formal presentation, an extensive question and answer session is expected. Students are expected to address questions directly and to demonstrate their capacity to rigorously defend all aspects of his/her research plan. While the Doctoral Advisor may ask questions and provide input when requested, the primary responder to questioning should be the student.

### **3.7.5. Examination Results**

Following completion of the examination, the student will be asked to leave the room and the Supervisory Committee will engage in discussion regarding the student's exam performance. Members will follow the Doctoral Final Examination Rubric (see GSO or website for form) for guidance on examination standards. The discussion will be based on both the written and oral components of the dissertation. Appropriate and detailed comments for each examination metric should be provided, with the Chair (Doctoral Advisor) serving to condense all comments in the Doctoral Final Examination Result form. Comments should be tailored to provide constructive and specific feedback of identified strengths, weakness, and/or deficiencies.

Following completion of the discussion, the committee will make a collective PASS / NO PASS recommendation. The vote must be unanimous and take place at the conclusion of the examination prior to the committee's adjournment. The final vote is binding and recorded on the Doctoral Final Examination Result form.

If PASS, all committee members must sign the Doctoral Final Examination Results. In addition, they should sign the Dissertation approval signature page<sup>3</sup>.

If NO PASS, the committee members should specifically outline deficiencies the student must address prior to reexamination and sign the Doctoral Final Examination Report.

Note that the Doctoral Final Examination Results will be released in their entirety to the student.

### **3.7.3. Reports and Records of Examination**

The Chair (Doctoral Advisor) is responsible for submitting the Doctoral Final Examination Results for to the Graduate Coordinator on the day of the examination. Once the signatures pages are signed and completed, these should be submitted by the student, along with a copy (hardcopy or electronic) of the final written dissertation. The Graduate Coordinator then will certify the report and recommendation. The Graduate Coordinator will then email the official results to the student, with copy also sent to his/her Doctoral Advisor, within 7 days after the examination.

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<sup>3</sup> In cases where the Supervisory Committee has identified issues with the written report that the student must address prior to final approval, the committee must specifically outline these outstanding issues and may elect to not sign the Doctoral signature page at the time of the oral examination. In this case, the student is responsible for collecting all signatures once the issues have been addressed.

If a successful PASS, the student is responsible for submitting the signed Dissertation approval signature page and final version of the written dissertation to the GSO. Requirements of the final examination will not be met until all items are on file with the GSO.

PhD Students should also review the Checklist for Doctoral Dissertations from the Graduate School website for additional Graduate School requirements: <http://gradschool.rgp.ufl.edu/editorial/introduction.html>.

#### **3.7.4. Dissertation Defense Retakes**

Only one retake is permitted. All retakes should be scheduled as soon as possible, depending on the recommendations and conditions outlined in the NO PASS vote. This is typically within 2-3 months, but no longer than 6 months, after the original examination. If a second NO PASS is given, the student may elect to pursue an MS or withdraw from the program.

# CURRICULUM FOR GENERAL PH.D. DEGREE

## DEPARTMENT OF BIOMEDICAL ENGINEERING

### General BME: Graduate Curriculum

<b><u>BME Core Required Courses (Total of 11 Credit Hours)</u></b>		<b>Credits</b>
BME 5401	Biomedical Engineering & Physiology I	3
BME 6010	Clinical Preceptorship	3
BME 6936	BME Seminar (Fall and Spring)	2
<b><u>BME Core Math requirement (choose 1 of 2):</u></b>		
BME 5703	Statistical Methods for BME	3
<b>OR</b> BME 5704	Advanced Computational Methods for BME	3

### **BME Electives (9 Credit Hours)**

A BME Core Elective is any graduate course (5000+) having a BME prefix (excluding BME 6905, BME 6910, BME 6940, BME 6971, BME 7979, BME 7980).

### **Specialization Electives (9 Credit Hours)**

BME elective courses require approval from the student's Supervisory Chair. Allowable courses are all graduate courses (5000+) offered by the COE or COM.

### **BME Research**

Advanced Research (7979) is open to doctoral students who have not yet been admitted into candidacy. Research for Doctoral Dissertation (7980) is reserved for doctoral students who have been admitted to candidacy. Students enrolled in 7979 during the term they qualify for candidacy will stay in this registration unless the academic unit elects to change their enrollment to Research for Doctoral Dissertation (7980).

### **BME Graduate Seminar**

PhD students may defer the required enrollment in BME 6936 to later years, but must enroll in a Fall and Spring offering.

### **BME Supervised Teaching**

PhD students are required to enroll for BME 6940 Supervised Teaching for a total of 4 credit hours (typically over 2 semesters). Enrollment is not recommended for first year students.

### **Program Credit Totals**

90 credits