PHD IN MEDICAL PHYSICS

Overview

The medical physics graduate program is accredited by the Commission on Accreditation of Medical Physics Education Programs, Inc. (CAMPEP (http://www.campep.org/)). The program, serving both MS and PhD degrees, ensures that the students receive adequate didactic and clinical training to continue in education and research, enter clinical physics residencies or begin working as medical physicists in radiation therapy and diagnostic radiology departments. PhD students participate in research projects during their graduate studies and are trained to become independent researchers in the field of medical physics and conduct impactful research or develop novel technologies.

Admission Requirements

The qualifications and documentation required for admission to the PhD program in Medical Physics are the same as for the College of Engineering.

In general, the Department admits four types of students to its PhD program:

- Students with MS degrees in Medical Physics
- Students with MS degrees in Biomedical Engineering or related science and engineering fields.
- Students with MD degrees with undergraduate degrees in sciences or engineering.
- Highly qualified students with BS degrees in engineering or sciences.

Students admitted with non-engineering degrees are generally given conditional admission and required to take additional undergraduate courses in engineering, physics, and/or mathematics depending on their previous course work, as specified in the admission letter. The requisite courses will be prescribed by the Department Chair or Graduate Program Director during the first advising session.

The PhD program in biomedical engineering is also a degree-granting program of the University of Miami's MD-PhD program.

Internal M.S. students (thesis or non-thesis) who wish to pursue a doctoral degree can transfer from the MS program to the doctoral degree program under the following general requirements:

- Submission of an application for admission to the PhD program.
- Submission of a letter of support by a faculty member who agrees to serve as the student's Ph.D. dissertation advisor.
- Approval of the application by the Department's Graduate Admissions Committee.

Curriculum Requirements

The PhD program in Medical Physics is accredited by CAMPEP. The objective of the Medical Physics program is to provide advanced knowledge in the field of therapeutic medical physics, and to provide the training required for students to become licensed medical physicists. This program is coordinated by the Department of Biomedical Engineering and the Department of Radiation Oncology at the School of Medicine.

Candidates are required to have completed the course work of a physics minor, that must include Modern Physics (PHY 360 or equivalent), before they start their course work in the Medical Physics program.

Students enrolled in the Medical Physics program must complete their PhD dissertation project on a topic related to medical physics. In general, the project is co-supervised by Faculty from the Department of Biomedical Engineering and the Department of Radiation Oncology.

Credit Requirements

The credit requirements are summarized below. Students admitted with non-engineering degrees are generally accepted conditionally, with the requirement to complete a set of undergraduate courses in engineering and/or mathematics before gaining full admission into the PhD program. The list of pre-requisite courses is defined before the start of the first semester of study by the Graduate Program Director and Department Chairperson, in consultation with the student mentor. Course pre-requisites are not counted towards the degree requirements.

PhD in Medical Physics Curriculum Requirements
Total of 72 Course & Dissertation Credits

Code	Title	Credit Hours
Required Courses [1]		
BME 601	Biochemistry and Cellular Physiology for Engineers	3
BME 602	Human Physiology for Engineers	3
BME 603	Neurophysiology for Engineers	3
BME 620	Medical Imaging Systems: X-ray and CT	3
BME 621	Medical Imaging Systems: MRI, NMI and Ultrasound	3
BME 681	Radiation Biology and Physics	3

BME 682	Radiation Therapy Physics	3
BME 683	Radiation Protection	3
BME 729	Applications of Medical Physics and Imaging	3
BME 780	Graduate Scholarship in Biomedical Engineering	3
BME 781	Radiation Dosimetry and Physics	3
BME 783	Radiation Therapy Physics Clinical Rotation	3
BME 784	Medical Physics Journal Club	1
A graduate biostatistics course		**3**
A minimum of 12 credits of additional courses [2]		**12**
Seminar Series		**6**
BME 703	Biomedical Engineering Seminar Series	
Teaching Requirement		**3**
BME 704	Mentored Teaching Experience	
Responsible Conduct of Research Training [3]		
Responsible Conduct of Research		0
BME 701	Professionalism and Ethics for Engineers and Medical Physicists	1
Dissertation Credits [4]		**12**
BME 830	Pre-candidacy Doctoral Dissertation	
BME 840	Post-Candidacy Doctoral Dissertation	
Total Credit Hours		**74**

1 Students with a biomedical background only need to take 2 of the physiology courses that must include BME 602.

2 A minimum of 12 credits of additional courses to be selected by the student in consultation with his/her mentor and the supervisory committee. Students with an M.S. degree in engineering will be able to waive up to 12 credits of coursework. Students in the MD/PhD program can count up to 6 credits of PIB 731 towards this coursework requirement.

3 More information about these courses can be found on the CoE website (http://www.coe.miami.edu/) and the UM RCR website (https://bioethics.miami.edu/clinical-and-research-ethics/responsible-conduct-of-research/).

4 A minimum of 12 credits of dissertation work must be completed. Students should enroll into BME 830 before admission to candidacy and BME 840 after admission to candidacy.

Research in Residence

Once a student has completed all required course and dissertation credits, he or she must enroll in Research in Residence status (BME 850, 0 credit) until the degree has been granted. Research in Residence status is considered full time enrollment. Credit is not granted for research in residence, but a fee is charged for each enrollment.

BME Qualifying Examination

Since the Medical Physics program is hosted by the Department of Biomedical Engineering, students enrolled in the program will satisfy all requirements by the BME qualifying examination (see PhD in Biomedical Engineering (https://bulletin.miami.edu/graduate-academic-programs/engineering/biomedical-engineering/biomedical-engineering-phd/#curriculumtext)).

Medical Physics Qualifying Examination

Format

Students enrolled in the Medical Physics program must pass an additional written examination focused on topics covered in the Medical Physics curriculum. The examination is typically scheduled after the regular BME qualifying examination, and consists of 6 separate written tests on the following topics, corresponding to courses in the curriculum: Human Anatomy/Physiology/Radiobiology BME 602/BME 681); Medical Imaging (BME 620/BME 621); Radiation Therapy Physics (BME 682); Radiation Protection (BME 683); Radiation Dosimetry (BME 781); Medical Physics Clinical Rotation (BME 783). The entire examination is scheduled in a single day, with each test lasting 55 minutes (total of 6 hours).

Schedule

The examination will be administered in the fourth semester that a student is enrolled in the PhD program.

Qualifying Examination Evaluation and Repeat Rule

The tests in the medical physics qualifying examination will be prepared by medical physics course instructors. All questions in the tests will be discussed and approved by the medical physics faculty, and graded by the corresponding instructor. The minimum passing score for each test is 70%. Students who fail one or more of the tests must retake the test(s) before the end of the following semester. Students who fail the same test twice will be dropped from the Medical Physics program.

Supervisory Committee

Following the successful completion of the BME and Medical Physics qualifying examinations, a Ph.D. Supervisory Committee is appointed by the Chairperson of the Department of Biomedical Engineering. Usually, the student consults with his/her research mentor and with the Chairperson to select the Committee members. In the Department of Biomedical Engineering, the members of the Supervisory Committee usually also eventually serve on the Dissertation Committee. The role of the Supervisory Committee is to administer the dissertation proposal, and to make up any additional written or oral examination deemed necessary to complete the qualifying examination.

In the Department of Biomedical Engineering, the Supervisory Committee must be comprised of at least five members. The minimum requirements of the committee composition are given below:

- At least three primary BME faculty members
- At least one external member. The external member is either a University of Miami faculty member who holds a primary appointment outside of BME, a faculty member from another University or from outside of academia. If the external member is from outside of academia, he/she must be a recognized expert in the field holding a leadership position.

The five members include the committee chair, who is a Graduate Faculty member of the Department of Biomedical Engineering. If the committee chair is not a Primary Faculty member of the Department of Biomedical Engineering, a second Co-Chair who is a Primary Faculty of the Department of Biomedical Engineering is required.

For more information about the Supervisory Committee, please also see the Graduate Student Handbook, which can be found on the Graduate Student Handbook, which can be found on the Graduate School website (www.grad.miami.edu (https://www.grad.miami.edu/)). The Graduate School website also provides a list of Faculty who are members of the University of Miami Graduate Faculty.

Dissertation Proposal

Format

Each student must submit an original written proposal describing the goals of the dissertation research project, the significance of the work, preliminary studies, and the research plan. The proposal must be submitted to the Supervisory Committee and orally defended before the end of the fourth semester for students admitted with an MS degree and before the end of the first semester of the third year for students admitted with a BS degree. The student's knowledge of the proposed research topic will be tested during the oral defense. If any deficiencies are discovered during the defense of the proposal, an additional written or oral examination may be required by the Ph.D. Supervisory Committee.

Evaluation Forms

The candidate is responsible for distributing dissertation proposal evaluation forms (http://bulletin.miami.edu/graduate-academic-programs/engineering/biomedical-engineering/medical-physics-phd/SACS_Graduate_Rating_Grid_Rubric_2016.pdf) to the members of the Supervisory Committee. The evaluation forms are used to assess the overall quality of the graduate program at the Department, College, and University level. The evaluation forms are available on the Graduate School and Department of Biomedical Engineering websites. The forms must be completed by the Committee members after the dissertation defense. The completed forms must be collected by the Dissertation mentor and forwarded to the Office Manager at the Department of Biomedical Engineering.

Admission to Candidacy

A student who has passed the written qualifying examination, and successfully defended the dissertation proposal must:

- submit a signed "Approval of the Dissertation Proposal (http://bulletin.miami.edu/graduate-academic-programs/engineering/biomedical-engineering/medical-physics-phd/Department_Dissertation_Proposal_Approval.pdf)" form to the Graduate Program Director of the Department of Biomedical Engineering.
- form a Dissertation Committee (see below)
- submit an Application for Admission to Candidacy (https://grad.miami.edu/policies-and-forms/forms/) for the Ph.D./Ed.D./D.M.A. to the Graduate School to be granted admission to candidacy.

Admission to candidacy recognizes the fact that a student enrolled in the PhD program has completed all doctoral degree requirements except completion of an acceptable dissertation project and defense of the dissertation. Completion of the required course credits and dissertation credits (BME 830 and/or BME 840) is not a requirement for admission to candidacy in the Department of Biomedical Engineering.

No student may receive the degree in the same semester or summer session in which he or she is admitted to candidacy. The student must be admitted to candidacy before the dissertation defense is scheduled.

Dissertation Committee

In the Department of Biomedical Engineering, the Dissertation Committee is generally the same as the Supervisory Committee, but it may also be a committee formed anew to undertake the duties of advising and passing upon the dissertation. The Dissertation Committee is nominated by the Department, and is approved and appointed by the Dean of the Graduate School.

As with the Supervisory Committee, the Dissertation Committee must be comprised of at least five members, including the committee chair. The minimum requirements of the committee composition are given below:

- At least three primary BME faculty members
- At least one external member. The external member is either a University of Miami faculty member who holds a primary appointment outside of BME, a faculty member from another University or from outside of academia. If the external member is from outside of academia, he/she must be a recognized expert in the field holding a leadership position.

The five members include the committee chair, who is a Graduate Faculty member of the Department of Biomedical Engineering. If the committee chair is not a Primary Faculty member of the Department of Biomedical Engineering, a second Co-Chair who is a Primary Faculty member of the Department of Biomedical Engineering is required.

If a student and his/her mentor decide to change the members of the Dissertation Committee after being admitted to candidacy, a Committee Composition Change Request Form must be completed. This form can be completed electronically via Dynamic Forms on the Graduate School's website.

Bi-Annual Progress Review

The student must schedule a bi-annual meeting with the dissertation committee. The purpose of the meeting is to give the student an opportunity to present his/her doctoral research progress to the committee and to receive the committee's feedback and recommendations. The student must submit a brief progress report to the dissertation committee at least seven days before the meeting. During the meeting, the student will present his/her doctoral research progress to the committee. The presentation will be followed by a discussion session. At the end of the discussion session, the committee will meet alone to discuss the student's progress and provide recommendations to the mentor. The mentor will provide a written summary of the discussion and committee recommendations to the student and to the Graduate Program Director. Students who are not making adequate progress may be terminated from the program.

Doctoral Dissertation

General Description

The doctoral dissertation is a monograph which describes the significance of the research and summarizes the research activities completed as part of the doctoral degree requirements. The objective of the dissertation is to evaluate the candidate's competence in the area of the Ph.D. research. The dissertation must demonstrate that the research is original and that it makes a significant contribution to the field of study.

A final public oral defense of the dissertation is required. However, none but the members of the dissertation committee may interrogate the candidate. The defense must be held before the deadline published on the Graduate School website (https://grad.miami.edu/), generally at least two weeks prior to the last day of class in the semester the student wishes to graduate. The student must submit the Defense Notice Form (https://grad.miami.edu/policies-and-forms/forms/) available on the Graduate School website (https://grad.miami.edu/) and provide a copy to the Department of Biomedical Engineering.

The candidate is well advised to have a final, acceptable typescript of the dissertation in the hands of each member of his/her committee at a time reasonably in advance of the final defense of the work a minimum of two weeks prior to the defense.

Dissertation Format and Deadlines

It is the duty of the student to ensure that the dissertation defense is scheduled and that a final version of the dissertation approved by the Dissertation Editor is submitted to the Dissertation Editor by the required deadlines set by the Graduate School. All information pertaining to the formatting and electronic guidelines for electronic thesis and dissertation submission can be found on the Graduate School website (https://grad.miami.edu/). The Graduate School also encourages students to contact the Dissertation Editor at the Graduate School when they start preparing their dissertation.

Students must inform the Department of Biomedical Engineering of their intent to defend at least 2 weeks in advance of the defense date, by email to the Department staff. The email must include the dissertation title and the date, time and location of the defense. The information will be posted in the Department's physical and online bulletin boards.

Each dissertation must be accompanied by Certificate of Defense Approval for Doctoral Dissertation signed by all members of the Committee. Forms can be downloaded from the Graduate School website (https://www.grad.miami.edu/).

Evaluation Forms

The candidate is responsible for distributing dissertation evaluation forms (http://bulletin.miami.edu/graduate-academic-programs/engineering/biomedical-engineering/medical-physics-phd/SACS_Graduate_Rating_Grid_Rubric_2016.pdf) to the members of the Dissertation Committee. The evaluation forms are used to assess the overall quality of the graduate program at the Department, College, and University level. The evaluation forms are available on the Graduate School and Department of Biomedical Engineering websites. The forms must be completed by the Committee members after the dissertation defense. The completed forms must be collected by the Dissertation mentor and forwarded to the Office Manager at the Department of Biomedical Engineering.

Publication Requirements

As a requirement for graduation, all PhD Candidates at the University of Miami Department of Biomedical Engineering are expected to have published, or have in press (i.e., the manuscript must have received final acceptance), in high quality peer-reviewed journals, a minimum of 2 publications describing work related to the dissertation. The candidate must be the first author on at least one of these two publications. In addition, the candidate

must have been the presenting author of at least 2 oral or poster presentations describing the dissertation work at major peer-reviewed international conferences.

Teaching Requirements

Students enrolled in the PhD program in Medical Physics who passed their qualifying examination are required to complete two semesters as a teaching assistant. Teaching assistants assist faculty by holding office hours for undergraduate courses, prepare laboratory sessions, and/or cover lectures for the faculty. Fulfilment of this requirement will be tracked by a 1-credit course taken two different semesters (BME 704, Mentored Teaching Experience). Students will also take a 1-credit teaching training workshop the semester before starting the teaching assistant responsibility.

Suggested Plan of Study

Year One		
Fall		**Credit Hours**
Responsible Conduct of Research		0
BME 703	Biomedical Engineering Seminar Series	1
BME 701	Professionalism and Ethics for Engineers and Medical Physicists	1
BME 620	Medical Imaging Systems: X-ray and CT	3
BME 681	Radiation Biology and Physics	3
BME 682	Radiation Therapy Physics	3
	Credit Hours	**11**
Spring		
BME 703	Biomedical Engineering Seminar Series	1
BME 621	Medical Imaging Systems: MRI, NMI and Ultrasound	3
BME 683	Radiation Protection	3
BME 781	Radiation Dosimetry and Physics	3
BME 784	Medical Physics Journal Club	1
	Credit Hours	**11**
Summer		
BME Qualifying Examination (August)		
	Credit Hours	**0**
Year Two		
Fall		
BME 703	Biomedical Engineering Seminar Series	1
BME 780	Graduate Scholarship in Biomedical Engineering	3
BME 602	Human Physiology for Engineers	3
BME 783	Radiation Therapy Physics Clinical Rotation	3
	Credit Hours	**10**
Spring		
BME 703	Biomedical Engineering Seminar Series	1
BME 704	Mentored Teaching Experience	1
Graduate Statistics Course		3
BME 830	Pre-candidacy Doctoral Dissertation	2
Medical Physics Qualifying Examination		
	Credit Hours	**7**
Summer		
Research		
	Credit Hours	**0**
Year Three		
Fall		
BME 703	Biomedical Engineering Seminar Series	1
BME 704	Mentored Teaching Experience	1
BME 603	Neurophysiology for Engineers	3
BME 729	Applications of Medical Physics and Imaging	3
BME 830	Pre-candidacy Doctoral Dissertation	1

Dissertation Proposal (Admission to Candidacy)		
	Credit Hours	**9**
Spring		
BME 703	Biomedical Engineering Seminar Series	1
BME 704	Mentored Teaching Experience	1
BME 840	Post-Candidacy Doctoral Dissertation	4
	Credit Hours	**6**
Summer		
Research		
	Credit Hours	**0**
Year Four		
Fall		
BME 840	Post-Candidacy Doctoral Dissertation	6
	Credit Hours	**6**
Spring		
BME 840	Post-Candidacy Doctoral Dissertation	6
	Credit Hours	**6**
Summer		
Research		
	Credit Hours	**0**
Year Five		
Fall		
BME 840	Post-Candidacy Doctoral Dissertation	6
Dissertation Defense		
	Credit Hours	**6**
	Total Credit Hours	**72**

Goal

The goal of the Medical Physics Graduate Program at the University of Miami is to train students to develop the necessary academic framework as well as a thorough practical understanding in medical physics, including areas of diagnostic radiologic physics, health physics, nuclear medicine, and a designated focus on radiation therapy.

Student Learning Outcomes

- Ability to conduct independent research in one or more areas of medical physics.
- Ability to apply knowledge of mathematics, science and engineering to formulate and solve relevant medical physics problems.
- Ability to communicate scientific and technical research effectively in writing and oral presentations.
- Ability to work with physicians and technicians in conducting diagnostic radiology or radiation therapy.