

## BIOENGINEERING DOCTORAL PROGRAM

The Bioengineering Doctoral Program of the University of Puerto Rico – Mayagüez (UPRM) trains students to become researchers in bioengineering by integrating the skills and competences of engineering, computational sciences, natural sciences, and medicine, while establishing an entrepreneurial culture within the students to focus on product-oriented research for future commercialization. Another program objective is to prepare graduates that are aware of the ethical and social responsibilities associated to the solution of technical problems in bioengineering.

The program draws on internal areas of emphasis in order to guide students in their curriculum and research and to maintain a flexible structure that will allow the program to adapt itself to technological evolutions. The bioengineering program focuses on

**computational bioengineering** and **biomedical engineering** research, and consists of a total of **forty nine (49) credit-hours** for students entering the program with a **B.S. degree**, and **thirty-four (34) credit-hours** for students entering the program with an **M.S. or M.E. degree**. Of the forty-nine credit-hours, nine credit-hours will be in bioengineering core courses, six credit-hours in bioengineering courses, nine credit-hours in courses outside of bioengineering, six credit hours in elective courses, one credit-hour in graduate seminar, and eighteen credit-hours in doctoral dissertation. For students entering with an M.S. degree, 34 credit-hours will be required in the following manner: nine credit-hours in core courses, three credit-hours in bioengineering courses, three credit-hours in courses outside of bioengineering, one credit-hour in graduate seminar, and eighteen credit-hours in doctoral dissertation. Each doctoral student will be required to participate in the graduate seminar each semester and will receive one credit at the conclusion of his dissertation. Students will also be required to pass a qualifying exam, prepare a dissertation proposal and complete a dissertation research project that will demonstrate the scope of acquired knowledge and the student's creativity and scientific rigor. The dissertation must be an original contribution to the existing scientific and/or technical body of knowledge in the field of bioengineering.

### Admission Requirements

General academic requirements for admission to the Ph.D. are included in Certification 09-09 issued by the UPRM Academic Senate. Additional specific program requirements are:

#### Students entering the program with a B.S. degree

- A baccalaureate degree in engineering with a minimum grade point average (GPA) of 3.20 on a scale of 4.00, from an accredited institution of higher learning. Depending on the applicant's academic background,

admission may be granted with deficiency courses. Applicants will be encouraged, but not required, to have approved undergraduate courses in human anatomy and physiology, human cellular and molecular biology, or both.

- A baccalaureate degree in physics, chemistry, biology or related areas with a minimum grade point average (GPA) of 3.20 on a scale of 4.00, from an accredited institution of higher learning, and with a mathematical background at the level of differential equations. Depending on the applicant's academic background, admission may be granted with deficiency courses. Applicants will be encouraged, but not required, to have approved undergraduate courses in human anatomy and physiology, human cellular and molecular biology, or both.
- International students for whom English is not the first language are required submit a Test of English as a Second Language (TOEFL) exam score.

#### Student entering the program with an M.S. or M.E. degree

- A master's degree in engineering from an accredited institution of higher learning. Depending on the applicant's academic background, admission may be granted with deficiency courses. Applicants will be encouraged, but not required, to have approved undergraduate or graduate courses in human anatomy and physiology, human cellular and molecular biology, or both.
- A master's degree in physics, chemistry, biology or related areas from an accredited institution of higher learning, and with a mathematical background at the level of differential equations. Depending on the applicant's academic background, admission may be granted with deficiency courses. Applicants will be encouraged, but not required, to have approved undergraduate or graduate courses in human anatomy and physiology, human cellular and molecular biology, or both.
- International students for whom English is not the first language are required submit a Test of English as a Second Language (TOEFL) exam score.

The same norms established by the UPRM's Academic Senate as well as all previously described admission guidelines to the doctoral program are applicable to transfer students. The program's graduate committee will consider transfers from the doctoral program into the master's program, with previous recommendation from the student's thesis committee and from the program's executive director.

### Graduation Requirements

The general academic requirements for conferring the doctoral degree are stated in Certification 09-09 of the

UPRM's Academic Senate. Specific requirements for the Doctoral Program in Bioengineering are described below.

Students entering the program with a **B.S. degree** are required to approve a minimum of **forty-nine (49) credit-hours** distributed in the following manner:

- 9 credit-hours in core courses
  - Principles of Biomedical Engineering (INME6065)
  - Principles of Computational Bioengineering (BING 6004)
  - Molecular and Cellular Biology for Engineers (BING 6002)
- 6 credit-hours in bioengineering courses
- 9 credit-hours in courses outside of bioengineering
- 6 credit-hours in elective courses (either in bioengineering or outside)
- 1 credit-hour in seminar (BING 8998)
  - The topics covered in the seminar will include:
    - Scientific issues
    - Social and ethical issues
    - Entrepreneurship
- 18 credit-hours in doctoral dissertation (BING 8999)

Students entering the program with an **M.S. or M.E. degree** are required to approve a minimum of **thirty-four (34) credit-hours** distributed in the following manner:

- 9 credit-hours in core courses
  - Principles of Biomedical Engineering (INME6065)
  - Principles of Computational Bioengineering (BING 6004)
  - Molecular and Cellular Biology for Engineers (BING 6002)
- 3 credit-hours in bioengineering courses
- 3 credit-hours in courses outside of bioengineering
- 1 credit-hour in seminar (BING 8998)
  - The topics covered in the seminar will include:
    - Scientific issues
    - Social and ethical issues
    - Entrepreneurship
- 18 credit-hours in doctoral dissertation (BING 8999)

Students will prepare a plan of study before the second month of their second semester of studies, and under the guidance of the student's graduate committee. The plan of study will be prepared taking into consideration: the student's academic and research interests, suitability of courses to prepare students for their research work, and academic offer. No more than 9 credit-hours of advanced undergraduate level courses can be used to complete doctoral degree requirements.

### ***Minimum Academic Index Requirements***

In order to complete the doctoral degree, each student must approve a minimum of 49 credit-hours with a GPA of 3.0 or higher. Students enrolled in the doctoral program may repeat a course with an earned grade of C or lower only once. Courses with a final grade of A or B cannot be repeated.

### ***Maximum Number of Transfer Credits to be Allowed***

Courses taken at UPRM in fulfillment of requirements of another graduate program may be utilized to fulfill the requirements of the proposed program. Courses taken at other institutions of higher learning may be utilized to fulfill doctoral program requirements, but are subject to residency requirements as specified in Certification 09-09 which establishes that 60% of the courses in a student's plan of study must have been taken at UPRM. The program's graduate committee will determine which courses could be transferred. All transfer courses must be approved with a minimum grade of B. Under no conditions may thesis credits be transferred.

### ***Residency***

The "Norms that Regulate Graduate Studies at UPRM" stipulate the residency requirements as follows:

*"Residency requirements at the Doctoral level: a minimum of four semesters for students entering with a Bachelors degree, and a minimum of two semesters for students entering with a Master's degree. In both cases the student will complete sixty (60) percent of the course work for the program at UPRM."*

### ***Graduate Seminar***

Doctoral students will be required to register for the Graduate Seminar in Bioengineering course for the duration of their doctoral studies and will be awarded one credit-hour the semester the dissertation is turned in. Besides scientific and technical topics, the graduate seminar will also cover topics related to entrepreneurship, intellectual property, and social and ethical issues related to the field of bioengineering.

### ***Qualifying Exam***

All doctoral students will be required to take a doctoral qualifying examination in order to evaluate the candidate's competency in bioengineering core areas. The examination consists of three written parts, which will be prepared, supervised and evaluated by the program's Graduate Studies Committee in coordination with its faculty.

A student who has passed the examination will be allowed to register in BING 8999 – Doctoral Dissertation.

This student is henceforth regarded as a doctoral degree candidate in the Bioengineering Program at UPRM.

A student who has failed the qualifying examination the first time may retake it a second and final time within one semester of the first attempt. According to UPRM regulations, a second failure will result in the student's dismissal from the graduate program. If the student does not hold a Master's degree in Bioengineering, the student will be given the opportunity to transfer to the Bioengineering's Master of Science or Master of Engineering programs. If none of these options is selected, the student will be suspended from the Bioengineering graduate program. After one year of suspension, the student may apply for a second and final admission to the same program or to another UPRM graduate program.

### ***Dissertation Proposal***

After successfully passing the qualifying examination, the doctoral student is required to submit a research proposal regarding his/her project of interest. Following the acceptance of the research proposal, the student is given a comprehensive examination to determine initiative, originality, breadth, and high level of professional commitment to the problem selected for investigation. This dissertation proposal exam consists of a written part (the proposal) and an oral defense of the proposal.

### ***Dissertation***

All Ph.D. candidates must undertake an independent research project that becomes a significant contribution to the advancement of knowledge in a particular area of bioengineering. All doctoral candidates must pass the oral exam in defense of his/her dissertation. Students must have passed the qualifying examination in order to register for the doctoral dissertation course, and have passed the preliminary exam before defending his/her thesis.

### ***Publication in Peer-Reviewed Journals***

All students should have at least one (1) scientific article related to the dissertation submitted in a peer-reviewed journal before the thesis defense.