

Doctor of Philosophy Engineering with a Concentration in Biomedical Engineering (PhD)

Biomedical Engineering Program

Michel Audette, Graduate Program Director

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www.odu.edu/eng/programs/biomedical/

The Biomedical Engineering graduate degree programs are available to full-time and part-time students seeking to improve their research and professional skills in biomedical engineering. The programs strive to provide the highest quality engineering education at the graduate level, to engage in scholarly research at the forefront of biomedical engineering, and to serve the profession of biomedical engineering. While the biomedical engineering program is administered by the Department of Electrical & Computer Engineering, the program is highly interdisciplinary and students are admitted from broad areas of engineering, science, and healthcare. Cutting-edge research opportunities and instruction are offered in:

- Bioelectrics and Pulsed Power
- Cellular & Molecular Bioengineering
- Cardiovascular Engineering
- Musculoskeletal Biomechanics
- Plasma Medicine
- Systems Biology & Computational Bioengineering

Facilities: The Biomachina Laboratory; the Biomechanics Laboratory; Biomedical Devices and Biomanufacturing Lab; the Cardiac Electrophysiology Laboratory; the Cellular Mechanobiology Laboratory; the Machine Intelligence & HR Communications Lab; the Gene Therapy and Regenerative Medicine Laboratory; the Medical Simulations Laboratory; the Plasma Engineering and Medicine Institute (PEMI); and the Virginia Institute for Imaging and Vision Analysis (VIIVA).

The program also has strong ties to several other on- and off-campus laboratories, including the Applied Research Center at the Jefferson National Laboratory, the Center for Brain Research and Rehabilitation, the Frank Reidy Research Center for Bioelectrics, Center for Bioelectronics, and the Virginia Modeling, Analysis and Simulation Center (VMASC). Regional, national, and international clinical collaborators support the program. These unique resources position the biomedical engineering program as a leader in education and research in the Southeast and nationally.

Doctor of Philosophy Admission Requirements

Admission to the Ph.D. program in biomedical engineering is in accordance with Old Dominion University and Frank Batten College of Engineering and Technology requirements for doctoral programs as specified in this catalog. Specific additional requirements include the following:

1. Completion of a master's degree in a closely related field is expected. Accepted students from disciplines other than Biomedical Engineering will be required to complete a number of leveling courses to meet the prerequisites of the program; the Graduate Program Director will work with the admitted students to create the list of leveling courses, including calculus and differential equations.
2. A minimum GPA of 3.50 (out of 4.0) is required of most students. A student with a lower GPA meeting ODU's graduate admission requirements and with evidence of a high level of professional capability

may be eligible for admission to the program upon submission of a petition to the graduate program director.

3. Recent scores, typically, not more than five years old, on the Graduate Record Examination's (GRE) verbal, quantitative, and analytical writing sections must be submitted by all applicants.
4. Three letters of recommendation (typically at least two of which are from faculty in the highest degree program completed when the application is within five years of graduation from that degree program) are encouraged but not required.
5. The applicant must submit a resume and a statement of purpose and goals.
6. Foundation knowledge in physics, basic chemistry, physiology, computer programming, and mathematics (including differential equations and statistics) is expected. Some leveling courses may be required to complement the student's expertise, namely in physiology, statistics, and differential equations.
7. The Frank Batten College of Engineering and Technology at Old Dominion University has the Direct Bachelor-to-Ph.D. and linked Bachelor/Ph.D. programs that allow exceptionally well-qualified undergraduate students to apply for admission directly to a Ph.D. program. Typically, undergraduate students apply at the end of their junior year for admission to the linked programs.

Curriculum Requirements

The program of study will be developed with the approval of the graduate program director and the student's advisor. The program shall include a common core of 15 credits and 9 credits of technical electives.

BME Common Core *

BME 820	Modern Biomedical Instrumentation	3
BME 821	Mathematical Modeling in Physiology	3
BME 826	Biomaterials	3
BME 892	Biomechanics	3
BME 847	Responsible Conduct of Research	2
BME 830	Predoctoral Fellowship Grant Writing	1

Technical Electives **

Select 9 credits of the following:		9
BME 554	Introduction to Bioelectrics	
BME 562	Introduction to Medical Image Analysis	
BME 564	Biomedical Applications of Low Temperature Plasmas	
BME 612	Digital Signal Processing I	
BME 824	Neural Engineering	
BME 840	Regenerative Medicine	
BME 851	Computational and Statistical Methods in Biomedical Engineering	
BME 855	Biomembranes and Ion Channels	
BME 862	Applied Medical Image Analysis	
BME 883	Digital Image Processing	
BME 895	Special Topics in Biomedical Engineering	

Dissertation Research		24
BME 899	PHD Dissertation Research	

Total Credit Hours		48
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* Students who have completed any of the core courses at the 700-level as part of a previous degree or program may substitute these courses with 800-level BME electives approved by the graduate program director.

** The technical elective courses provide a basis for dissertation research and future career objectives. These courses can be selected from the biomedical engineering technical electives or a wide variety of appropriate graduate courses in engineering, biology, chemistry, psychology, computer science, modeling and

simulation, mathematics, statistics, or other programs. No more than six credits from course work satisfying foundation knowledge requirements may be included in the program of study for elective credit. At least 15 credits of non-dissertation course work must be at the 800-level. A minimum of 3 credits must be selected from the biomedical engineering technical electives list; the remaining credits can be selected from this list or other graduate courses with approval of the student's advisor and the graduate program director.

Doctor of Philosophy Degree Requirements

The Ph.D. in biomedical engineering is offered in accordance with the general requirements for doctoral degrees as specified in the Requirements for Graduate Degree Section of this catalog. Specific program of study requirements include the following:

1. Completion of a minimum of 48 hours of graduate credits to include: a minimum of 24 credits of course work beyond the master's degree and a minimum of 24 credits of dissertation research. At least 15 credits of non-dissertation course work must be at the 800-level. The Graduate Program Director in concurrence with the Chair can approve exceptions to these requirements under special circumstances.
2. Successful completion of a written diagnostic examination before the end of the first academic year.
3. Successful completion of a written and oral qualifying examination near the completion of the coursework.
4. Successful presentation of a dissertation research proposal at the beginning of the dissertation research.
5. The successful completion and public defense of a dissertation representing independent, original research worthy of publication in a peer-reviewed scholarly journal. At least one published and one submitted manuscript as first author in peer-reviewed, indexed journals are expected.