Bioengineering

Program Description

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Bioengineering is a thriving area of research involved with the development of new technologies for the study, characterization and manipulation of biological systems from the molecular to the organismal levels. The Bioengineering graduate group at UC Merced offers a vibrant research and training program for students who want to explore cutting-edge solutions to a variety of life sciences problems ranging from fundamental biological processes and mechanisms to biotechnological, clinical and healthcare applications in which the overarching principle is the application of the newest methods and approaches for scientific inquiry.

The Bioengineering Graduate Program at UCM offers a multidisciplinary research and training program for students who want to learn advanced methods for solving biological and biomedical problems at the molecular and cellular levels. Research projects are available on topics ranging from theoretical methods and computational modeling, instrument design and method development in biological imaging to a panoply of experimental approaches in the life sciences including molecular biophysics, protein engineering and design, genetic engineering, electrophysiology, structural biology, synthetic biology, colloidal and interfacial chemistry, and mechanobiology.

Master's Program Requirements

The recipient of an M.S. Bioengineering degree will possess knowledge of a broad field of learning that extends well beyond that attained at the undergraduate level, but is not necessarily expected to have made a significant original contribution to knowledge in that field. The Bioengineering M.S. student will complete the required courses of the program:

- BIOE 210: Advanced Bio-thermodynamics, Bio-kinetics, and Bio-transport
- BIOE 215: Biological Imaging and Spectroscopy
- BIOE 291: Research Seminar

Each M.S. student must have a faculty advisor responsible for designing and approving a plan of study detailing all classes to be taken. Students should work with their advisors to determine which, if any, additional courses are best suited for their degree. Research and publication efforts are not required, but could be an important aspect of the individual M.S. training program depending on the chosen track.

Master's Program Learning Outcomes

1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3) An ability to communicate effectively with a range of audiences.
4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
8) Experience in solving bio/biomedical engineering problems, including those associated with the interaction between living and non-living systems.
9) Experience in analyzing, modeling, designing, and realizing bio/biomedical engineering devices, systems, components, or processes.

Ph.D. Program Requirements

The Doctor of Philosophy degree is granted to students who demonstrate a thorough knowledge of a broad field of learning and have given evidence of distinguished accomplishment in that field. The degree also signifies that the recipient has critical ability

and powers of imaginative synthesis as demonstrated by a doctoral dissertation containing an original contribution to knowledge in his or her chosen field of study. The Bioengineering doctoral student will complete the required courses of the program:

- BIOE 210: Advanced Bio-thermodynamics, Bio-kinetics, and Bio-transport
- BIOE 215: Biological Imaging and Spectroscopy
- BIOE 291: Research Seminar

Each doctoral student must have a faculty advisor responsible for designing and approving a plan of study and a suitable research project. Students should work with their advisors to determine which additional courses are best suited for their research areas, and to satisfy the total unit requirements of the program. Research and publication efforts will also be a primary focus of the individual doctoral training program. Funding is usually provided for doctoral students in the form of fellowships, training grants, teaching assistantships or research assistantships.

Ph.D. Program Learning Outcomes

1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3) An ability to communicate effectively with a range of audiences.
4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
8) Experience in solving bio/biomedical engineering problems, including those associated with the interaction between living and non-living systems.
9) Experience in analyzing, modeling, designing, and realizing bio/biomedical engineering devices, systems, components, or processes.

BIOE Research Themes Include:

The Bioengineering Graduate Program at UC Merced has its emphasis on Biomolecular and Cellular Science and Engineering and offers research opportunities, high level training and graduate courses in the following interrelated foci:

MOLECULAR AND CELL BIOPHYSICS focuses on the structural, quantitative and functional characterization of biomolecules, including proteins, nucleic acids, and lipids, and their complex interactions, in vitro and in their cellular, tissular and/or organismal context with the final goal of elucidating the fundamental mechanisms of life.

SYNTHETIC MOLECULAR AND CELL BIOLOGY focuses on the design and engineering of custom biomolecules, assemblies, cellular structures, and biological devices with applications in biomedical research, drug design, healthcare, sustainable energy production, and bioremediation.

BIOLOGICAL IMAGING AND SPECTROSCOPY utilizes or develops advanced technologies to obtain, analyze and display images and/or structural and mechanistic information of biological systems at the molecular, cellular, tissue, and organismal levels.

BIOLOGICAL MODELING AND SIMULATION involves the development and application of mathematical models, computational methods and simulations to describe complex biological phenomena with the goals of understanding the dynamics of biological systems and harnessing the capability of designing them.

Individual faculty and research groups work on the following areas: protein biophysics and synthetic biology: folding, binding and function; control of gene expression; biosensor design and engineering; biomolecular mechanisms of inflammation and programmed cell death; colloidal, polymeric, and biologically active interfaces for synthetic biology; physics and engineering of biopolymer networks; mechanobiology and motility of organelles, cells and multi-cell aggregates; optical, spectroscopic and electrophysiological methods for striated muscle physiology; mechanical and genetic aspects of cardiovascular diseases, vascular

development, remodeling and angiogenesis; biomedical imaging methods for cancer and drug delivery; novel techniques for in vivo imaging of tissue regeneration, transplantation and cancer.