Biomedical Engineering

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Academic Programs

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Biomedical Engineering

Biomedical engineering is an interdisciplinary field in which the principles and tools of traditional engineering fields, such as mechanical, materials, electrical, and chemical engineering, are applied to biomedical problems. Engineering plays an increasingly important role in medicine in projects that range from basic research in physiology to advances in biotechnology and the improvement of health care delivery. By its very nature, biomedical engineering is broad and requires a foundation in the engineering sciences as well as in physiology and other biological sciences.

The BS degree program in Biomedical Engineering is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org/.

Undergraduate Program

BS Biomedical Engineering

Program Mission and Goals

The mission of the Biomedical Engineering program is to maintain an effective learning environment that enables and empowers graduates for careers of service, leadership and distinction in engineering or other fields. Our approach is to use a participatory, learn-by-doing, "hands-on" laboratory, projects and design centered approach to achieve this end.

To succeed in this mission, the educational objectives of the program are to facilitate graduates to:

1. Utilize a knowledge base with a core foundation in engineering, physical and biological sciences, which will enable them to apply their skills to a variety of challenges in their chosen field. Our graduates will demonstrate innovation, creativity, adaptability, and critical thinking to solve problems in disciplines related to biomedical engineering that are relevant to industry, academia, or medicine, and health related fields.

2. Demonstrate leadership in their chosen fields, and make decisions that are socially and ethically responsible. Our graduates will function effectively in multidisciplinary team environments and communicate effectively to a variety of audiences.

3. Engage in opportunities to extend their undergraduate education throughout their careers, as demonstrated by such things as pursuing graduate study, taking short courses, or attending conferences.

The program offers a four-year curriculum leading to a B.S. degree. The main educational objectives of the program are to prepare graduates who will excel in the biomedical engineering profession, understand that their education is a continuous enterprise, and seek graduate degrees for increased flexibility and mobility. The curriculum provides a sound theoretical background, practical engineering knowledge and solid laboratory exposure. It highlights an immediate introduction to the major, strong personal interaction with faculty, strong partnerships with industrial participants and a signature laboratory emphasis.

The application of engineering to medicine and biology underpins a strong and growing segment of the industrial sector, and continues to be an area of inherent interest to students. The need for well educated professionals in this interdisciplinary area has become more acute as the technology being applied has become more sophisticated. Evolution in computing, electronics, signal analysis and mechatronic systems have resulted in dramatic improvements in diagnostic efforts, therapeutic approaches and bioindustrial applications. Studies of biological materials, physiological mechanisms, biochemical kinetics and heat and mass transport in biological systems require engineering expertise. With the advent of research into artificial organs, prosthetic devices and tissue engineering, applied medical research and applied biological research has taken on a distinct engineering aspect.

Biomedical engineering combines engineering expertise with medical needs for the enhancement of health care. It is a branch of engineering in which knowledge and skills are developed and applied to define and solve problems in biology and medicine. Students choose the biomedical engineering field to be of service to people; for the excitement of working with living systems; and to apply advanced technology to the complex problems of medical care.

Some well established specialty areas exist within the field of biomedical engineering: bioinstrumentation, biomechanics, biomaterials, systems physiology, tissue engineering, clinical engineering, and rehabilitation engineering.

Bioinstrumentation is the application of electronics and measurement principles and techniques to develop devices used in diagnosis and treatment of disease. Computers are becoming increasingly important in bioinstrumentation, from the microprocessor used to do a variety of small tasks in a single purpose instrument to the extensive computing power needed to process the large amount of information in a medical imaging system. Biomechanics is mechanics applied to biological or medical problems. It includes the study of motion, of material deformation, of flow within the body and in devices, and transport of chemical constituents across biological and synthetic media and membranes. Biomaterials describes both living tissue and materials used for implantation. Understanding the properties of the living material is vital in the design of implant materials. Systems physiology is the term used to describe that aspect of biomedical engineering in which engineering strategies, techniques and tools are used to gain a comprehensive and integrated understanding of the function of living organisms ranging from bacteria to humans. Tissue engineering is a rapidly developing field that combines engineered materials with living cells to restore or replace lost organ function. Clinical engineering is the application of technology for health care in hospitals. The clinical engineer is a member of the health care team along with physicians, nurses and other hospital staff. Rehabilitation engineering is a new and growing specialty area of biomedical engineering. Rehabilitation engineers expand capabilities and improve the quality of life for individuals with physical impairments.

In addition to the objectives for all engineering programs, the goal of the BS program in Biomedical Engineering is the preparation of engineering professionals who have: (1) an understanding of biology...
and physiology; (2) an ability to apply advanced mathematics to problems at the interface of engineering and biology; (3) an ability to measure and interpret data from living systems; and (4) an ability to address the problems associated with the interaction between living and nonliving systems.

Concentrations

Bioinstrumentation

The bioinstrumentation concentration prepares students for entry level jobs in the biomedical devices industry where a deeper understanding of electrical engineering skills are necessary.

Mechanical Design

The mechanical design concentration prepares students for employment in the product development, design, or manufacturing fields in the biomedical device industry.

General Curriculum in Biomedical Engineering

A General Curriculum in Biomedical Engineering is also an option. It is not a formal concentration. Students are encouraged to select from one of the concentrations listed above, but those who do not declare a concentration will default to the General Curriculum.

Graduate Programs

MS Biomedical Engineering

General Characteristics

The Master of Science degree program in Biomedical Engineering is well-suited for those individuals who desire depth in engineering application to living systems, with a strong pragmatic and rigorous, hands-on educational experience. Graduates will be well-equipped to make significant contributions to the biomedical field. The MS in Biomedical Engineering program objectives are to:

• Provide graduates with a rigorous, broad-based advanced education in engineering coupled with applied biology that will prepare graduates for the many diverse career opportunities of biomedical engineering.
• Provide an empowering professional degree for students who intend to become practicing engineers
• Provide job-entry education for the more complex and evolving interdisciplinary area of biomedical engineering.
• Provide a base that enables graduates to maintain currency in their fields.
• Provide preparation for further study in engineering and/or medicine, leading to the Doctor of Engineering, MD, Ph.D, or MD/Ph.D. degrees.

Prerequisites

For admission as a classified graduate student, an applicant must possess a bachelor’s degree in engineering or a closely related physical science with a minimum grade point average of 3.0 in the last 90 quarter units (60 semester units) attempted. Applicants for graduate engineering programs are required to submit scores for the General Test of the Graduate Record Examination. Applicants are also required to submit 3 letters of reference in support of their application. A college level biology course, with laboratory, for biology majors is highly recommended. Applicants who meet these standards but lack prerequisite coursework may be admitted as conditionally classified students and must make up any deficiencies before advancement to candidacy. Applicants from other academic disciplines, such as biology or chemistry are encouraged to apply and may be admitted to the program conditionally in order to make up deficiencies in prerequisite coursework. Information regarding specific admission requirements and classification as a graduate student may be obtained from the Graduate Coordinator, Biomedical Engineering.

Program of Study

Graduate students must file formal study plans with their advisor, department, college, and university graduate studies office as well as fulfill the Graduation Writing Requirement no later than the end of the quarter in which the 12th unit of approved graduate course work is completed. The formal program of study must include a minimum of 45 units with:

1. At least 23 units of the 45 unit program at the 500 level.
2. A thesis or project as the mandatory culminating experience.

MS Biomedical Engineering, Specialization in Regenerative Medicine

Characteristics

Prepares students for careers in regenerative medicine and related fields. Specifically, our graduates are prepared for immediate employment in regenerative medicine, biotechnology, or medical technology companies, as well as research specialists/laboratory managers at universities or research institutes. Program graduates are also well-prepared to matriculate into bioengineering doctoral programs or graduate programs in the health professions.

Culminating Experience

Students who obtain a degree in the Master of Science in Biomedical Engineering with a specialization in Regenerative Medicine are not required to complete a “thesis” through BMED 599. In place of the thesis as a culminating experience, students are required to complete a non-traditional Comprehensive Exam. This non-traditional Comprehensive Exam includes a 9-month internship at a company or research laboratory1 (ASCI/BIO/BMED 593), a quarter-long project course at Cal Poly (ASCI/BIO/BMED 594), a written report and oral presentation of the internship project, and a written report and oral presentation of the quarter-long project course. Through the completion of these components, students demonstrate their “ability to integrate the knowledge of the area, show critical and independent thinking, and demonstrate mastery of the subject matter.”

1Students will complete their internship at one of our partner institutions. An updated list of our current partners can be found on our program website.