Blue Marble University

Doctor of Science (D.Sc.) in Biomedical Engineering

(3 Year Program You Can Complete Entirely Online)

Pre-requisite: A minimum of a Bachelor Degree (or equivalent in education and training) with demonstrated competency in science, engineering, computer science, and math.

This is a broad and exciting field which combines applied engineering with current rapid advances in Biology and Medicine. The major goal of this interdisciplinary field is to use design and problem solving engineering skills to improve health care. Examples of biomedical applications include the development of biocompatible prostheses, medical devices, imaging equipment, and regenerative tissue growth.

We believe that the most important medical observation of our time is that repair stem cells taken from a patient's blood can heal damaged tissue and can repair bodily functions. Stem cell science has opened a whole new and exciting area for biomedical engineers. New designs of equipment and processes are needed in the areas of batch preparation of stem cells, labeling and sorting of cells, cell preservation techniques, clinical diagnostic imaging devices to find such cells, scaffolding and other techniques for tissue creation, nanotechnology, as well as cellular delivery devices.

Consequently, we have pointed our program in the direction of cellular and tissue engineering, and our standing research project is to design a batch human stem cell processor the size of a large coffee pot that every physician can have in their office to produce patient treatment regimens.

Yet, even though cellular and tissue engineering are our focus, our program is rock solid in all the hot new fields of nanotechnology, imaging systems, fiber optics and bio-sensors, biophotonic instrumentation, bioinformatics, robotics, medical devices and implants.

It is intended that a graduate of our program will be equally at home in an academic or industrial/pharmaceutical research lab, teaching setting, medical device manufacturer, medical imaging developer, clinical stem cell treatment clinic, clinical engineering environment, or in hospital administration.

We have an exciting program, and it is not as difficult as you think!! Dissertation topics are always open to the student to select what he/she would like to research (with faculty guidance and approval). We are currently encouraging dissertations that relate to the batch processing of human stem cells, growth media, and nanotechnology for labeling and sorting of cells, but this topic in biomedical processes is not a requirement.

We operate on a trimester schedule, which means that our academic year is divided into 3 segments of 4 months each. In each 4 month period, students take three courses. For some terms, or as determined by the University, students may be assigned courses in sequence, lasting about 1 month each. In that event, for any approximate one month period, a student will be studying one course.

TOTAL: 72 TRIMESTER CREDITS
(Equivalent to the USA Minimum Requirement for a Doctoral Degree)

Year 1
Term 1
Anatomy and Physiology for Engineers: This course provides an introduction to anatomy and human physiology for engineers and other non-life-scientists. Topics include nervous system, muscle and cardiac function, digestive system, and immune system
Human Cell and Molecular Biology for Engineers: Advanced examination of the organization and function of the cell with emphasis on the biophysical and quantitative aspects of cellular function. Emphasis will be on the biomedical engineering applications of regulation of cell division, protein transcription and translation within the cell, cellular energetics, and intracellular networks for cell signaling and cell function.
Human Adult Stem Cell Biology: The course examines blood and blood components, identification of adult stem cells, biological and medical properties of adult stem cells, and tissue sources. Lab created embryonic stem cells are also studied.
Term 2
Immunofluorescence Labeling Techniques: One of the most important imaging systems in modern medicine, we cover this course from the standpoint of cell labeling and imaging of cells and cell components.
Tissue Engineering: Creation of artificial organs and tissue from biological materials, including an investigation of bio-artificial organs which use synthetic and biological components. Use of case studies to explore pathologies of tissue, current clinical treatment, and the role of engineers in developing new technologies to diagnose and treat these pathologies.
Genetic Engineering: We cover recombinant DNA technology, genetic modification and manipulation and gene splicing. The production of human synthetic insulin from modified bacteria is studied.
Term 3
Batch Preparation of Human Cells: The current status of bioreactors, current status of batch processes as related to human cells, and in particular to human stem cells, is studied within the historical back-drop of the batch processing of bacterial cells. Equipment, growth media, control processes will be investigated.
Cell Labeling and Separation: Biochemical, immunological, nano-particle, and optical cellular labeling and separation techniques are presented.
Bio-nanotechnology: Preparation and use of nanometer size particles in biological systems, with emphasis on cellular labeling, and cell separation via nano-particle recognition

Year 2
Term 1
Biophotonics: Manipulation of light with emphasis on use of the laser for sensing and imaging of cells and tissue. Also covered is the thermal response of random media in interaction with laser irradiation; calculation of the rate of heat production caused by direct absorption of the laser light, thermal damage, and ablation.
Fiber Optic Applications: Using fiber optics for biomedical sensing of pressure, differential pressure, acoustics, substance and cellular detection.
Biosensors: Biosensors represent a newly arising frontier in biomedical engineering. The course offers a solid preparation on sensors (theory, physical principles, and applications) so valuable in industry and R&D.
Term 2
Signal Processing: Merging biomedical engineering with advanced signal processing skills can create professional competencies that most companies are looking for, and most engineers are not able to give. We look at sensing principles and algorithms taken from neural networks, radar, and space communication as made relevant to biological systems.
Medical Devices and Regulations: Many categories of devices are covered, with emphasis on devices for people with disabilities.
Medical and Biological Imaging: Physical principles and signal processing techniques used in thermographic, ultrasonic, and radiographic imaging, including image reconstruction from projections such as CT scanning, MRI, and millimeter wave determination of temperature profiles
Term 3
Implants and Biomaterials: Overview of biomaterials, including prosthetics, ceramics, metal implants, and polymers, with specific emphasis on properties and applications. The immunology of material-tissue interactions and the issues of biocompatibility are also covered.
Pharmaceutical Materials: Introduction to pharmaceutical materials and its application to designing and manufacturing drug products. Focus is on materials encountered in the pharmaceutical industry and how the materials affect processes they are used in.
Bioinformatics and Robotics: Developing and using computer tools for data collection and analysis, with emphasis on robotics.

Year 3
Term 1
Research Methodology and Writing: We include creation of the student's Online Portfolio and introduction to blogging. The Online Portfolio is the student's digital presentation of accomplishments, education, research, and other interests published to the internet
Select and Outline Thesis Topic
Dissertation Preparation I
Term 2
Dissertation Preparation II
Term 3
Final Dissertation Presentation and Completion of Online Portfolio

Credits: Each of the above courses (with the exception of Final Dissertation Presentation and Completion of Online Portfolio which is 6 credits) consists of 3 trimester credits each.The program comprises 72 trimester credits, and consequently is equivalent to the minimum 60 semester credits for a USA regionally accredited college or university. Upon completion, and for a nominal fee, graduates will be able to obtain a Certificate of Equivalency from a foreign education credentials evaluation service approved by the USA Department of Education for employment purposes in the USA.