Dept. of Integrative Biomedical Science & Engineering

The Department of Integrative Biomedical Science and Engineering offers an excellent education and interdisciplinary cutting-edge research programs to train future leaders and innovators in biomedical science and engineering. Faculties from biochemistry, epidemiology, materials, electrical and mechanical engineering, and computer science provide a broad range of courses and joint research projects in partnership with academia and industry.

❑ Biomedical Science Major

Biomedical Science Major specializes in biological or medical application of basic sciences in the context of medicine. A wide range of courses are provided by faculties from biochemistry, epidemiology, materials, and engineering. Our program trains future leaders and innovators in biomedical science by offering an excellent education and cutting-edge research projects.

❑ Biomedical Engineering Major

Biomedical Engineering Major specializes in biological or medical application of engineering principles or engineering systems to living things. A broad range of courses are provided by faculties from mechanical and electrical engineering, computer science, materials, and biochemistry. Our program trains future leaders and innovators in biomedical engineering by offering an excellent education and cutting-edge research projects.

☐ Courses

❑ Core Courses

- **Molecular and Cellular Biology (3)**

  The goal of the course is for graduate students to learn about basic concepts in molecular cell biology. Topics include chemistry of nucleic acids, DNA topology, DNA replication, repair and recombination, recombinant DNA technology, transcription, RNA processing and post-transcriptional control, translation and post-translational modification, protein structure and function, techniques for protein purification, tools for protein analysis, membrane biology, intracellular trafficking, cytoskeleton, cell cycle and division, cell signaling, and programmed cell death.

- **Introduction to Biomedical Engineering (3)**

  Designed as a freshmen course, this lecture will provide the overview of the biomedical engineering field. Faculty from various School of Engineering departments will give background lectures to introduce students to the fundamental basis for biomedical engineering and its application and impact to biomedicine. Topics include but not limited to biomaterials, biomechanics, bioelectronics and medical imaging.

· **Seminar on Modern Bioengineering (3)**
This course will examine the recent research trends in the biomedical science and engineering field. Specialists and scholars will be invited to give lectures on the new technologies and innovations. This course will focus on the currently debated areas of research in the relevant fields.

· **Independent Study1 (3)**
Under guidance of instructor, the basic procedures for thesis writing will be studied from selection of research topic in biomedical science and engineering, literature survey, methodology, analysis of results, paper writing and presentation.

· **Independent Study2 (3)**
Under guidance of instructor, the basic procedures for thesis writing will be studied from selection of research topic in biomedical science and engineering, literature survey, methodology, analysis of results, paper writing and presentation.

❑ Biomedical Science Major

· **Advanced Biology (3)**
This lecture will cover the up-to-date knowledge of biochemistry, molecular biology, molecular cell biology, microbiology, animal cell and tissue, and human physiology, which are the basis of biomedical science and biomedical engineering.

· **Current Topics in Bio Medicinal Materials (3)**
Studies and discuss on the current research trend in pharmaceutical and medical applications.

· **Advanced Biotechnology (3)**
This course covers the recent research trend and technology in the area of bio informatics, gene cloning, construction of genetically modified microorganisms, production of recombinant enzymes in microbial systems and kinetic analysis of recombinant enzymes.

❑ Biomedical Engineering Major

· **Biomaterials (3)**
The purpose of this course is to intruduce various biocompatible materials and to let students understand synthesis technology and material properties of biomaterials.

· **Biotransport Phenomena (3)**

Understanding the physical, chemical and biological processes governing the movement of mass and transmission of forces throughout an organism is important in biomedical engineering and physiology. This course will cover transport processes which influence the normal and pathological function of cells and organs and provide fundamental knowledge of transport processes which are important in the design and operation of a number of biomedical devices.

· **Biomedical Optical Imaging (3)**

This course is intended to provide the optical imaging techniques and related photonics theory in biomedical field to visualize multiscale biological processes which are highly dynamic and complex in nature.

· **Cell Mechanics (3)**

This course focuses on the mechanical aspects of the cell including mechanotransduction. To study how cell biology and biochemistry influence the mechanical properties of the cell, we will discuss how cell properties can be measured experimentally and how they can be characterized in the form of equations. We will also study how mechanical environment, such as load, pressure, stress or strain, can influence the cell's shape and integrity, and eventually its biology and biochemistry.

· **Biomechanics (3)**

The biomechanics means the research and analysis of the mechanics and the application of engineering principles to and from biological systems. This lecture deals the analysis of joints, muscles, and bones of human body. The computer software for system integration is also studied.

· **Applied Haptic System (3)**

The haptic system is a tactile feedback technology that takes advantage of a user's sense of touch by applying forces, vibrations, and/or motions to the user. This lecture is composed of the theories for the haptic analysis and system integration technology.

· **Rehabilitation Engineering (3)**

Rehabilitation engineering is the systematic application of engineering sciences to analyze, design and develop the mechanisms and devices which can help individuals with disabilities. This lecture covers the rehabilitation theory and the system application.

· **Electrochemistry (3)**

In order to get insights on fundamentals of bioelectronics and related applications, chemical reactions which take place in a solution at the interface of an electron conductor (a metal or a semiconductor) and an ionic conductor (the electrolyte), and which involve electron transfer between the electrode and the electrolyte or species in solution are studied. In detail, the scope includes the electrolysis in which a chemical reaction is driven by an external applied voltage to and the battery in which a voltage is created by a chemical reaction. Furthermore, fundamentals of semiconductor device physics will be covered for understanding the operation principles of nanoscale biosensor devices and circuits.

· **Bioinformatics (3)**

Bioinformatics is the application of techniques and theory in statistics and computer science to solve problems arising from the management and analysis of biological data such as nucleic acid(DNA/RNA) and protein sequences in the filed of molecular biology. The primary goal of this course is to understand the computation techniques to process the biological data: sequence alignment, genome assembly, protein structure alignment, analysis of gene/protein expression, DNA chip, etc. The software tools and web services implementing the techniques are also covered in this course.

· **Medical Image Processing (3)**

This course presents the fundamentals of medical image processing. Topics include digital image fundamentals, image acquisition, image enhancement, image restoration, image segmentation, and image analysis. Students will develop practical experience through projects using the MATLAB Image Processing Toolkit.

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