

Description of Courses

□ Graduate Program

MSE501 Biomedical Biochemistry

This course covers advanced description of biosynthesis of macromolecules including such topics as replication gene expression, protein synthesis as well as a discussion of nature and functional aspects of protein and nucleic acid structures.

MSE502 Biomedical Molecular Biology

This course designed to give students a basic understanding and history of molecular biology. Topics include ; structure and function of nucleic acids, enzymes involved in DNA replication, in vivo DNA replication, transcription and translation in general. This course also cover various experimental technique and the theoretical backgrounds.

MSE503 Biomedical Cell Biology

BioMedical Cell Biology covers the recent advances in most areas of modern life sciences which graduate students should be acquainted with for their own thesis researches. The course will place a particular emphasis on basic processes of cell biology.

MSE504 Biomedical Cell Biology II

BioMedical Cell Biology II is the continuation of Molecular Cell Biology I, which will cover the recent advances in several fundamental biological phenomena occurring at the level of cells with a particular emphasis on their molecular and mechanistic aspects.

MSE505 Biomedical Bioinformatics

This course discusses recent research trend of interdisciplinary research area among biology, medical, information, electronic and mechanical engineering. By providing the newest research method and application of bioelectroinformatic systems, this course serves design, analysis and development ability for bioelectroinformatic systems.

MSE551 Experimental Techniques of Biomedical Molecular Biology

This course is designed to give students basic understanding of the latest experimental technique of biomedical molecular biology.

BM501 Current Topics of Biomedical Research

Current research topics in the biomedical science and biomedical engineering area and prospective future topics are covered.

BM502 General Clinical Medicine

Structure and function of the human body and systems, disease development mechanism and treatments, prevention strategies are introduced.

BM521 Human Anatomy and Physiology

To understand the human body, primary target of biomedical research, structure and function of human body are studied in the aspects of histology and physiology.

BM522 Human Pathology

Mechanism of development, symptoms, diagnosis, progress, prognosis of human diseases are covered. Also,

diseases classified according to parts of human body are discussed.

BM523 Neurobiology

The neurobiology of brain, the highest hierarchy of all human organs and tissues are studied. Five major subjects including cellular signal transduction, cognitive science, systemization, development, higher level mental functioning are covered.

BM524 Experimental Animals

Animals used in biomedical research are studied for their anatomy and physiological characteristics. Basic animal treatment methods, anaesthesia of animals, toxicity testing using animals are covered as well as animal model research topics.

BM525 Genetics of Cancer

Cancer inducing genes that are regulated in cancer cells and tissues, their influence in cell growth, inherited and acquired mechanism of tumor suppressing genes are introduced. Cause of genetic modifications or mutations causing cancers and specific action mechanisms are studied.

BM701 Special Topics in Biomedical Sciences

Common areas of medicine and science, their most recent hot topics are introduced. This course may be taken more than once if the sub-title is different.

BM702 Special Topics in Biomedical Engineering

Common and inter-related areas of medicine and engineering and the most recent hot topics are introduced. Applications such as human tissue replacement technology and development of new diagnostic instruments are selected and introduced. This course may be taken more than once if the sub-title is different.

BS524 Advanced Molecular Biology

Designed to give students a basic understanding and history of molecular biology. Topics include ; structure and function of nucleic acids, enzymes involved in DNA replication, *in vivo* DNA replication, transcription and translation in general.

BS525 Gene Expression

This course provides students with an understanding of fundamental principles underlying various steps of gene expression with an emphasis on molecular mechanism of transcription regulation. Topics include mechanistic steps of transcription, roles of transcription factors, regulation of gene transcription, RNA processing and editing, translational control, and post-translational control.

BS526 Molecular Virology

This course deals with the structure, replication and functions of viral genes in molecular level and emphasizes the understanding of the molecular characteristics of animal viruses

BS543 Advanced Neurobiology

This course will study basic aspects of neurons (development, synaptic transmission and synaptic plasticity) and molecular mechanisms underlying various brain functions (i.e. sensorymotor system, sleep and memory) and dysfunctions (i.e. schizophrenia)

BS611 Molecular Cell Biology I

Molecular Cell Biology I covers the recent advances in most areas of modern life sciences which graduate students should be acquainted with for their own thesis researches. The course will place a particular emphasis on basic processes of cell biology

BS612 Molecular Cell Biology II

Molecular Cell Biology II is the continuation of Molecular Cell Biology I, which will cover the recent advances in several fundamental biological phenomena occurring at the level of cells with a particular emphasis on their molecular and mechanistic aspects

BS626 Nucleic Acid Biochemistry

This graduate course provides students with the current advancements in nucleic acid research. Focus is given on new unusual structures of DNA and RNA, and newly discovered functions of RNA ribozymes, telomerase RNA, guide RNA and anti-sense RNA, etc.

BS672 Animal Cell Biotechnology

The course will provide the students with basic knowledge on cell functions needed for cultivation of animal cells. In addition, the students will be informed about monoclonal antibodies of these cells, as well as about vaccines and the production of other useful proteins. Discussions will be held on recent trends concerning the tissue engineering of creating human bone marrow, epidermal, and liver cells.

BS685 Advanced Developmental Biology

The primary goal of the course is to present a comparative view of cellular and molecular mechanisms of animal development. This includes induction mechanisms, cell adhesion and migration, cell-matrix interactions and protein-protein interactions (i.e. interactions between Hox and transcriptional cofactors) during body axis formation, neurulation, and organogenesis. The development of complex systems, such as the nervous system and limbs is emphasized. Model organisms and evolutionary aspects are especially emphasized. Another important aim of the course is to teach the students how actual developmental research is carried out. Various state-of-art research techniques used in modern developmental biological researches are introduced

BS722 Biochemistry of Carcinogenesis

Designed for graduate students to understand the basic biochemistry of chemical carcinogens. These include metabolism of chemical carcinogen, interactions between the carcinogens and oncogenes, inhibition of chemical carcinogenesis, chemoprevention and reduction of cancer risks, and finally influence of dietary constituents in chemical carcinogenesis.

BS750 Selected Topics in Biotechnology

The purpose of this course is to give graduate students the most up-to-date information about biotechnology. Topics are decided by instructors. Covered topics are as follows : molecular biology, industrial microbiology, biochemical engineering biomedical technology, and cell cultures.

BS782 Cell Signal Transduction

This course explores advanced topics in signal transduction related to cell proliferation and differentiation. Some topics covered include the following: protein kinases and their function, phosphatases and their role in regulation, growth factor receptors and G-proteins, calcium and other second messengers, cell cycle and immune system signal transduction events, etc. A basic review of overall related researches will be provided, and current findings from the scientific literature will be discussed.

BiS500 Bioinformation and Bioelectronics

This course discusses recent research trend of interdisciplinary research area among biology, medical, information, electronic and mechanical engineering. By providing the newest research method and application of bioelectroinformatic systems, this course serves design, analysis and development ability for bioelectroinformatic systems.

BiS523 Information and Electronics for Scientists

This course is designed to provide basic knowledge on the information and electronics for the biosystems education and researches. The first half will be devoted to C language, while selected topics from

undergraduate Electrical Engineering courses will be taught at the second half.

BiS531 Bioinformatics

Fundamental bioinformatics techniques including sequence analysis, genomic sequencing, protein motif analysis, cDNA chip data analysis, SNP analysis, 2D PAGE and MALDI analysis, and pathway analysis, are explained for bioinformatics software developers and practitioners.

BiS551 Medical Image Processing

Processing and visualization of biomedical images are studied for medical diagnosis. Basic theories for biomedical image acquisition, processing, visualization, image fusion and registration, 3D visualization, virtual reality for medical operation are discussed.

BiS554 Neural Networks

Theory, applications, and implementations are studied. We first introduce two basic learning rules, i.e., Hebbian learning rule and error backpropagation rule, and discuss network architectures and learning algorithms for several neural network models. Major applications and neuromorphic hardware implementations are also studied.

BiS571 BioElectroMechanics

This course provides electromechanics for understanding and analysis of biomechatronic systems. Analogy between mechanical systems and electrical systems, modeling of electromechanical systems, and working principles of biomedical, diagnostic, surgery and therapeutic equipments are discussed.

BiS623 Bioelectronic Devices

This course covers advanced topics in the design and industrial application of bioelectronic devices such as biosensor and biochip. The fundamental principles in these areas have emphasized to understand the biological recognition mechanism of enzyme, antibody, microorganism, animal cell, and DNA.

BiS632 Bio-Statistics

Statistical principles and techniques such as probability distribution, hypothesis testing, regression, principal component analysis, which can be applied to various bioinformatics tasks, are introduced. Such statistical techniques are explained along with their applications to bio-sequence homology search, structure homology search, mRNA expression analysis, protein expression analysis, and so on.

BiS653 Biomedical Imaging System

Theory and applications of several biomedical imaging systems are studied. Especially, X-ray imaging, ultra-acoustic imaging, X-ray CT, MRI, PET, and PACS are discussed.

BiS672 Nano Electro Mechanical Systems

This course discusses physical phenomena and engineering problems arising from nanometric area. Topics included are analysis of the nano physical principles and design of the working principles, nano materials and its fabrication processes, and nano testing and characterization techniques. This course also provides basic knowledge of the Nano Electro Mechanical Systems (NEMS). Term projects and presentation are required.

BiS771 Nanobiotechnology

This course discusses microenergy conversion and transfer as well as properties and behaviors of micromaterials based on mechanical, material, physical, chemical and biological analysis of biomedica and their reactions. Topic included are nanoscale phenomena in cellular physiology/metabolism, micro/Nano fabrication processes with unusual materials, microfabricated tools for neuroscience, biological motors and

nanobiochips.

PH507 Advanced Electrodynamics I

This course provides graduate students in physics with an understanding of electricity and magnetism. Topics include: Electrostatics, Magnetostatics, Maxwell's equations, Wave propagation, Wave guides, Radiating systems.

CH521 Advanced Organic Chemistry I

The course surveys both classical and modern concepts using electronic interpretation of organic reactions. Topics include electrophilic reactions of Aromatic compounds, Nucleophilic reactions, Stereochemistry, Hammett linear free-energy relationships, Addition-elimination molecular rearrangements and Woodward-Hoffmann-type relationships.

CH581 Advanced Biochemistry

This course covers advanced description of biosynthesis of macromolecules including such topics as replication gene expression, protein synthesis as well as a discussion of nature and functional aspects of protein and nucleic acid structures.

CH610 NMR Spectroscopy

This course is designed for graduate students and research scientists with an interest in how nuclear magnetic resonance (NMR) techniques can be used to provide valuable information to physical and biological chemists. This course will introduce basic NMR theory, including a Quantum Mechanical description of the NMR experiment. Examples of chemical data obtained using NMR will be summarized along with other related experiments. The course will then focus on density matrix treatment of multipulse NMR sequence and include discussions of product operator formalism.

CH782 Special Topics in Biochemistry I

This course involves lectures on special topics selected from recent hot topics in nucleic acid biochemistry and discussions through seminars. Topics including the properties and structures of nucleic acids, gene structure and function, gene expression, gene recombination, and their applications will be covered.

CH783 Special Topics in Biochemistry II

This course develops selected recent "hot topics" in protein biochemistry and discussions through seminars. Topics include the physical and chemical properties of proteins, protein structure, protein purification, the formation of the protein-ligand complexes, enzyme reaction theory and enzyme reaction mechanisms.

MAE510 Advanced Fluid Mechanics

Fundamental knowledge on fluid flows is discussed. Derivation of the basic equations and several relevant approximate flow models are introduced. Both inviscid and viscous fluid models are treated.

MAE521 Viscous Fluid Flow

This course discusses equations of viscous flow; classical analytical and numerical solutions; flow regimes and approximations; laminar boundary layers - solution methods, and applications; introduction to stability theory; turbulent boundary layers - mean-flow and Reynolds stress equations, modeling, solution procedures, and applications.

MAE530 Advanced Mechanics of Solids

Fundamentals of solids mechanics are treated from the continuum mechanics view, and the content of the undergraduate solid mechanics is extended and generalized to the graduate level.

MAE561 Linear System Control

This course is designed to enable graduate students to make analysis of a given linear system in terms of stability, controllability and observability, and to design a linear controller by using eigen-structure assignment

MAE563 Microprocessor Application

This course is designed to give graduate students the ability to understand basic principles of microprocessors and their applications in modern product designs. Prerequisites by topics: basic electrical circuits, computer languages.

MAE564 Artificial Neural network : Theory and Applications

This course treats a variety of artificial neural network techniques being currently applied to many difficult-to-solve engineering problems.

MAE604 Metrology

This course deals with the subject of precision dimensional metrology which plays important roles in various fields of modern science and engineering mainly for distance and surface measurements. Principles, fundamentals of optics especially for electromagnet wave interference are explained with emphasis on monochromatic interferometry, white light scanning interferometry, holography, and speckle and moire interferometry.

MAE642 Medical Biomechanics

Study the structure, function and its behavior of human musculo-skeletal system, identify the physical problem of musculo-skeletal system to find contribution in solving those problems applying mechanical principles.

MAE655 Robotics Engineering

This course is designed to enable graduate students to understand the most updated topics in kinematics and dynamics of robotics and to apply recently introduced control techniques.

CBE662 Bioseparation Processes Engineering

This course will cover theories and practices of separating rather fragile bioproducts. Primary separation processes including cell harvest, cell disruption and removal of insolubles will be covered as centrifugation, filtration, sonication, bead milling, french pressing and other methods are discussed. Major separation processes including chromatography, adsorption, extraction, electrophoresis and ultrafiltration will be covered in relation to bioproducts of interest. Integrated bioseparation process development will also be discussed.

CBE664 Process for Recombinant Microorganisms

This course will cover topics related to the production of various bioproducts ranging from primary to secondary metabolites as well as recombinant proteins by employing genetically engineered microorganisms. Brief introduction to molecular biology, microbiology and biochemistry will be given before covering gene cloning and strain development. Biochemical engineering strategies of employing recombinant microorganisms will also be covered.

MS514 Mechanical Behavior of Solids

Designed to introduce the fundamental phenomena and theories on the mechanical behavior of materials, and to understand the relationships between mechanical properties and microstructure of materials. Main topics include : theories of elasticity and plasticity, dislocation theories, deformation mechanisms, strengthening mechanisms, fracture, fatigue, creep, high temperature deformation, superplasticity.

MS572 Composite Materials

Introduces the fundamental descriptions and theories on the fabrication processes, properties, characterization and applications of metal matrix composites(MMC), ceramic matrix composites(CMC) and polymer matrix composites(PMC). Main topics include : fabrication processes and properties of reinforcements(particles, whiskers & fibers), structure and properties of matrix materials, bonding and interfacial reactions between reinforcements and matrices, micro-mechanical and macro-mechanical behavior of composite materials, fabrication processes, design, properties and applications of composite materials.

MS622 Glass Science and Technology

Advanced topics and theories on the glass formation, glass structure, transport phenomena in the glass, physical properties, corrosion and chemical durability, crystallization, phase separation and manufacturing technology of the glass state will be studied. Also, the application of the glass and glass ceramics will be discussed.

NQE561 Radiation Measurement Systems

This course introduces the generation, amplification, transfer and measurement of the electronic signal from various radiation detectors based on the physics theory of the electronics signal and noise. Also it deals with the design methods of radiation counting, spectroscopy, timing and imaging system.

NQE562 Radiation Imaging Instrumentation

This course deals with the analysis and design methods of various radiation imaging devices used in medical diagnostics and non-destructive tests. It also covers the 2-dimensional x-ray radiography and advanced gamma-ray imagers together with emission and transmission tomographies and laminography, which can be extended into 3-dimensional imaging techniques.

EE535 Digital Image Processing

This course deals with the fundamental concept of digital image processing, analysis, and understanding. Topics include sampling, linear and nonlinear operations of images, image compression, enhancement and restoration, reconstruction from projections, feature extraction, and image understanding.

EE561 Introduction to VLSI Devices

This course covers fundamental VLSI device physics for graduate students. After brief review of basic quantum mechanics and semiconductor processes, the course will teach basic principles of operation in semiconductor devices including PN junction, MOS Capacitor, MOSFET and bipolar transistors with a strong emphasis on deep submicron secondary effects of MOSFET and bipolar transistors for extensive understanding of advanced device engineering.

(prerequisite: EE461)

EE682 Intelligent Control Theory

Among the various well-known intelligent control techniques, the methods of fuzzy control and neural net-based learning control are first dealt with for their capabilities of handling ambiguous/uncertain situations and effective supervised learning, respectively. Specifically, the theory of fuzzy sets and fuzzy logic-based inference mechanism are studied and the design techniques of fuzzy control are introduced. Then, the neural net learning structure is discussed and the control system based on the artificial neural nets is studied. Fuzzy-neuro systems are also considered. In the second part of the course work, some other computational intelligence techniques such as GA and the rough set are briefly covered and then the basic machine learning techniques and the reinforcement learning method are studied in conjunction with their use in control system design.

(Prerequisite: EE581)

EE737 Imaging Systems

This course is designed to introduce several medical image systems and the related applications based on various image processing techniques. Topics include image reconstruction algorithms, X-ray CT, single photon emission CT, positron emission tomography, magnetic resonance imaging, ultrasound imaging, and related post processing techniques.

MSE960 Thesis/Dissertation Research (Master)

MSE966 Seminar (Master)

MSE980 Thesis/Dissertation Research (Doctoral)

MSE986 Seminar (Doctoral)