

Description of Courses(Graduate School of Medical Science and Engineering)

□ 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 is 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 covers various experimental technique and the theoretical backgrounds.

MSE503 Biomedical Cell Biology I

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 trends 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.

MSE506 Current Topics of Biomedical Research

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

MSE507 General Clinical Medicine

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

MSE508 Cell Therapy

The purpose of this course is to make students who took the courses of Cell Biology or Immunology learn comprehensive techniques to treat diseases using therapeutic cells. It is composed of lectures by a faculty and experimental practice. Topics include immunity to tumors, allergy, autoimmunity, and infection.

MSE509 Introduction to Global Medicine: Biosciences, Technologies, Disparities, Strategies

This course explores the concept and basic themes of global medicine. The course will address classic themes of social medicine such as social inequalities and health disparity. It will also address issues of patenting, development, and delivery of vaccines, pharmaceuticals or biotechnologies in international context. New paradigms, challenges and solutions for global health will be identified and discussed through the course.

MSE510 Pathology of Laboratory Animals

The purpose of this class is to increase the capabilities of reading the histopathological findings and understanding a variety of diagnostic tools to scientists. To achieve this goal, learn the normal microstructure of each organ and understand the pathogenesis of diseases in laboratory animals.

MSE512 Cancer Genomics

Recent development of genome technologies (Next Generation Sequencing; NGS) and bioinformatics enabled us to explore whole-genomes of cancer and normal cells in an unprecedented scale. To interpret the big dataset

correctly, knowledges on 'cancer biology', including the history, fundamental questions previous scientists raised, current technologies and recent advances, are crucial. In the lecture series, we will read and discuss the classical and cutting-edge articles in the field.

MSE513 Therapeutic Protein Engineering

This lecture series will introduce the basic knowledge of protein 3D structure and structure determination as well as several cases of structure-based protein engineering. Furthermore, we will understand the mode of action of FDA-approved therapeutics with their 3D structure and develop new ideas for a novel therapeutics from recent cutting-edge articles.

MSE514 RNA Biology

This course introduces diverse noncoding RNAs and their biological roles as well as RNA metabolism. By understanding features of diverse RNAs and RNA experimental techniques, we will discuss how RNAs can be used as biomarkers, therapeutic targets and/or therapeutic molecules in diseases.

MSE524 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.

MSE530 Molecular & Cellular Biology of Cancer

Cancer is one of the most common causes of death. This course aims to comprehensively understand cancers in molecular and cellular aspects. We will discuss about the oncogenic mutations initiating various solid and blood cancers and DNA repair system, the regulation of cell cycle and apoptosis related to tumor growth and the regulatory roles by immune cells and tumor vasculatures, and cell-cell interaction and cancer stem cells involved in tumor invasion and metastasis.

MSE545 Stem Cell Biology

To improve the fundamental knowledge of regenerative medicine, this subject is focusing on understanding the molecular and cellular mechanisms of stem cells, including pluripotency of stem cells, stem cell niche and epigenetic mechanism.

MSE546 Genomic Medicine

This lecture will introduce the genomic medicine to (under)graduate students. Recently, advance in sequencing technology has revolutionized the medicine as well as the molecular biology in many ways. In addition, major countries just started to invest the big money for the genomic medicine and precision medicine. In this lecture, I will provide the recent findings about the human genome consisting of 3 billion letters. Regarding human diseases, I will provide the new insight of how the genomic medicine makes a huge impact on the diagnosis and treatment in Neurological disorders, Cancers, Metabolic disorders, and etc. I will discuss with students about the future medicine based on the genomics.

MSE552 Cognitive Neuroscience

Human cognitive functions are understood and their mathematical models are developed. We first study measurement techniques for brain signals such as EEG and fMRI. Then, cognitive models are developed for learning, memory, language, emotion, and behavior.

MSE553 Advanced Cellular and Molecular Immunology

The purpose of this course is to make students who took the courses of Cell Biology or Immunology understand advanced and comprehensive concepts of immunology. It is composed of lectures by a faculty and discussion of recent articles. Topics include innate immunity, recognition of antigen, activation and regulation of lymphocytes, effector mechanism of cell-mediated or humoral immunity, immunity to microbes, transplantation, immunity to tumors, allergy, autoimmunity, and immune deficiency.

MSE601 Medical Science Experimental Techniques

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

MSE602 Contemporary Seminar of Modern Medical I

Contemporary Seminar of Modern Medical I provides the students with new paradigm of viewpoints by reviewing "cutting-edge" technologies and theories in the field of medical sciences. We will especially focus on neuro-psychiatric disorders, metabolic and circulatory disorders and neoplastic disorders.

MSE603 Contemporary Seminar of Modern Medical II

Contemporary Seminar of Modern Medical II provides the students with new paradigm of viewpoints by reviewing "cutting-edge" technologies and theories in the field of medical sciences. We will especially focus on neuro-psychiatric disorders, metabolic and circulatory disorders and neoplastic disorders.

MSE605 Experiment for Translation Research

This course aims for graduate students who have ample clinical experience to enhance their research power by performing numerous related experiments as well as the acquisition of their underlying principles. This would lead to activate the translation research.

MSE606 Molecular endocrinology

This class will provide basic understanding of endocrine systems that control homeostasis of body. This class will focus on molecular aspect of endocrinology; the molecular mechanisms by which steroid hormones activate nuclear receptors to provoke their biological effects; the molecular mechanisms by which peptide hormones activate cell surface receptors to provoke their biological effects; the mechanism how the actions of peptide hormones (e.g. insulin) are involved in diseases (e.g. diabetes); the pathways of the endocrine systems that link control and production of hormones in specific tissues with the actions of these hormones in their respective target organs. Topics include the molecular biology and endocrinology of sexual differentiation, hypothalamic and pituitary regulation, ovarian follicular development, steroidogenesis, breast and prostate cancer, steroid and thyroid hormone action, diabetes and insulin action, G-protein coupled receptors and hormonal regulation of gene expression.

MSE607 Clinical Functional Neuroimaging

This course covers clinical application of functional neuroimaging in clinical neuroscience, especially normal brain development and neuropsychiatric disorder.

MSE610 Techniques of Laboratory Animal

Based on the animal anatomy and pathologic characteristics, animal treatment methods (anaesthesia of animals, sacrifice, injection, etc) are generally introduced for the research of students.

MSE611 Cellular and Molecular Immunology

Clinical Aspects of Immunology provides the students with basic and comprehensive concepts of modern immunology in cellular and molecular level. Topics include development of immune system, innate and adaptive immunity, recognition of antigen, lymphocyte development and activation, and immune system in health and disease.

MSE612 Pathophysiology of Chronic Infectious Diseases

Viruses and bacteria which induce chronic infectious diseases in human will be discussed, especially in the aspect of molecular and cellular biology. Immune responses, inflammation, oncogenesis and mechanisms of other complications in chronic infectious diseases will be also discussed.

MSE614 Vascular Biology

Proper vasculature function is essential for normal metabolism in every cells and abnormal vasculatures are causatively involved in various diseases. The central goal of this course is to provide both developmental and pathologic aspects of vascular biology. Throughout the whole course, students would comprehensively understand the process to form new vessels and the vascular functions in both molecular and cellular aspects.

MSE622 Biochemistry of Carcinogenesis

This course is 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.

MSE700 Clinical and Biomedical Communication

Effective communication skill is one of the crucial abilities that a competent researcher should master. This course aims to support how to prepare and present materials effectively in clinical and biomedical fields. Then, students have presentation focusing on their research results and get feedback from colleagues. Furthermore, students learn how to listen and respond well, leading to a good collaboration.

MSE722 Cell Signaling Networks

'Cell Signaling Network' provide students with fundamental understanding of intracellular signaling and intercellular communication. It also provide them with new concept of drug development targeting cell signaling.

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.

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.

BM526 Applied Clinical Science

The course intends to introduce the recently advanced medical treatment including imaging and radiation therapy which have been developed thanks to the state-of-the art technology, vascular engineering and genetic analysis and furthermore to present how to apply technological progress for advanced clinical treatment. Accordingly, this aims at helping non-medical students to understand the clinical medicine and to appreciate the contribution of biomedical science in clinical medicine.

BM529 Biology of Disease

This lecture course helps students to understand the nature and pathogenesis of various diseases in the aspect of molecular and cellular biology, genetics, immunology and physiology.

BM531 Bioanalytical Technology

During the first half of the course, the lectures will focus to introduce the chemical/physical properties of bio-macromolecules, and detection/structural determination of bio-macromolecules, mainly proteins, by using immunodetection, recent nanobiosensors, fluorescence detection, and X-ray crystallography.

In the later part, massive identification of biomarkers by Omics and Bioinformatics technologies and neuronal diseases based on cell biology will be introduced. At the end of the course, technology and facility related to experimental animals will be introduced.

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)

BS571 Advanced Animal Cell Engineering

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 the production of therapeutic proteins from animal cells. Discussions will be also held on recent trends concerning the tissue engineering of human bone marrow, epidermal, and liver cells.

BS611 Advanced 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 Advanced 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.

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.

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 Genome 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.

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 Advanced MRI Techniques

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

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 Structural Biochemistry

In this class we will discuss theoretical background and practical application of NMR and x-ray crystallographic techniques used for structural studies of biological macromolecules.

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.

ME510 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.

ME521 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.

ME530 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.

ME561 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

ME564 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.

ME604 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 electromagnetic wave interference are explained with emphasis on monochromatic interferometry, white light scanning interferometry, holography, and speckle and moire interferometry.

ME642 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.

ME655 Advanced 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.

CBE462 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 Materials

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.

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 Medical Imaging Technology

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 M.S. Thesis Research

MSE966 M.S. Seminar

MSE980 Ph.D. Thesis Research

MSE986 Ph.D. Seminar

MSE987 Graduate Student Seminar

This course aims to help students prepare and present materials effectively. Students will present research results and receive feedback from colleagues.