

#### **4. Descriptions of Course**

##### **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.

##### **BM503 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.

##### **BM504 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.

##### **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.

##### **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.

##### **BM527 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.

#### BM528 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.

#### 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.

#### BM530 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.

#### 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.

#### BM545 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.

#### BM553 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.

#### BM610 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.

#### 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.

#### BM711 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.

#### BiS525 Brain Dynamics

This course describes various brain functions with a dynamical point of view and briefly reviews the theoretical aspects of brain functions using nonlinear dynamics and information theory.

#### 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, 3-D visualization, and virtual reality for medical operations are discussed.

#### BS516 Advanced Genetics

Genes of the higher eucaryote are characterized by complex structures and their activation is restricted by various methods. This course examines the biological significance of such structures and functions and helps students create insight into the activation of genes through post-transcriptional modification by methylation. Moreover, it will cover specific examples of medical applications concerning the unique regulation mechanism of sex chromosomes.

#### BS524 Advanced 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.

#### BS525 Gene Expression

This course provides students with an understanding of the 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.

#### BS536 Environmental Toxicology

This course covers absorption, distribution, metabolism and excretion of toxic substances. Topics include: Target organ toxicity and toxic mechanisms of drugs, pesticides, food additives and air pollutants; Regulation and risk assessment.

#### BS624 Protein Chemistry and Engineering

This course provides seniors with an ability to understand modern protein folding and protein structure analysis. Topics include methods for determining protein structure, biological and biochemical methods in protein design, purposely modified proteins and their properties. Design of mutant proteins, structural analysis of mutant protein by NMR and X-ray crystallography, and applications to science medicine and industry are also included.

#### BS626 Nucleic Acid Biochemistry

This graduate course provides students with the current advances 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.

#### BS628 Biological Membranes

The course focuses on the relationship between the structure and function of biological membranes. The lectures will also provide insight to the characteristics of the liposome, the mutual relationship between liposomes and proteins, the transport of molecules through the membrane, the electrical phenomenon in organisms, the effect of hormones, and the mechanism of energy transduction and membrane fusion.

#### BS671 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.

#### BS711 Bioinformatics

The course provides graduate students with an overview of the characteristics of biological information, organization, and processing mechanism, and introduces various approaches to simulate those systems.

#### BS722 Biochemistry of Carcinogenesis

This listing 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.

#### BS742 Molecular Cell Biology

Details of the cell's delicate structure, functions and their interrelationships are presented. Topics include: plasma membrane, cell nucleus, cytoskeleton, cell signalling, cell growth and division, cell adhesion, cell junctions and the extracellular matrix.

#### 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. A 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.

#### CH581 Advanced Biochemistry

This course covers advanced description of biosynthesis of macromolecules including such topics as replication gene expression, protein synthesis as well as 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. 8

#### EE535 Digital Image Processing

This course deals with the fundamental concepts 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.

#### 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.

#### ME510 Advanced Fluid Mechanics

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

#### ME521 Viscous Fluid Flow

This course covers the following topics: 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 analyse a given linear system in terms of stability, controllability and observability, and to design a linear controller by using eigen-structure assignment.

#### ME642 Medical Biomechanics

This course studies the structure, function and its behavior of human musculoskeletal system, and identifies the physical problem of musculoskeletal 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.

#### MS514 Mechanical Behavior of Materials

This course is designed to introduce the fundamental phenomena and theories on 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

This course 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.

**MSE601 Medical Science Experimental Techniques**

Medical Science Experimental Techniques is designed to give students basic understanding of the latest experimental technique 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.

**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.

**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 systems.

**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.

**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.

**BM960 M.S. Thesis Research**

**BM966 M.S. Seminar**

**BM980 Ph.D. Thesis Research**

**BM986 Ph.D. Seminar**

**BM987 Graduate Student Seminar**

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