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

❒ **Graduate Program**

MSE101 The Human Body and Diseases
This course introduces the basic concepts of the human body and diseases to undergraduate students who are interested in the field of biohealth. Students will explore the principles of how the human body works and the mechanisms of various diseases from a biological and medical perspective. They also acquire common sense of health and medical care.

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 and 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 theometical 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 histopahtological 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 ides for a novel therapeutics from recent cutting-edge articles.

MSE514 RNA Biology

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

MSE520 Mucosal Immunology

The mucosal immune system provides the first barrier to invading pathogens and has multiple unique features compared to the systemic immune system. In this class, students will learn the detailed structure, composition, and function of the mucosal immune system.

MSE524 Experimental Animals

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

animal model research topics.

MSE529 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.

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.

MSE531 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 biomarkrers 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.

MSE540 Biomedical Imaging
This course introduces imaging technologies used for modern research in biomedical sciences. Optical microscopic techniques will be the primary topics. We will also discuss bioengineering ideas and experimental techniques that have been employed to maximize the quantity and quality of visual information in biomedical research..

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 an 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.

MSE550 In Vivo Imaging System
This course will discuss the principles in biophotonic technologies to implement in vivo imaging systems with their current and future applications in biomedical research. This course will focus on practical topics

in various optical microscopy for biomedical research with functional/molecular/structural imaging in the cellular level, not requiring deep understanding of physics, chemistry or biology.

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.

MSE560 Introduction to Basic Medical Sciences
This course will introduce various techniques in optics and engineering for the implementation of the microscopic imaging system. Principles of imaging optics, electrical circuit, image processing and their practical applications for the implementation of the laser-scanning microscopic imaging system will be introduced.

MSE580 Introductory Programming for Biologists
A practical course that encourages students with a background in biology to solve coding problems related to biology using open book style, where they are given minimal information needed to solve the problem and are required to search the internet, discuss with the professor, teaching assistants, and other students while solving the problem.

MSE591 Special Topics in Introductory Biomedical Sciences
This course provides introduction on the basic principles and current research trends in the special topics related to Biomedical Sciences. This course is offered for students who have little background knowledge in Biomedical Sciences. Students may take this course more than once if the course sub-title is different.

MSE601 Medical Science Experimental Techniques
This course 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 1 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-psychiatirc disorders, metabolic and circulatory disorders and neoplastic disorders.

MSE603 Contemporary Seminar of Modern Medical II
Contemporary Seminar of Modern Medical 1 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-psychiatirc disorders, metabolic and circulatory disorders and neoplastic disorders.

MSE605 Experiment for Translation Research

This course amis 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 (anaesthesis 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.

MSE620 Introduction to Bio-optical Imaging System Instrumentation
This course will introduce various techniques in optics and engineering for the implementation of the microscopic imaging system. Principles of imaging optics, electrical circuit, image processing and their practical applications for the implementation of the laser-scanning microscopic imaging system will be introduced.

MSE621 Computational neuroimaging
To understand issues and to deal data in human neuroimaging, this course is consisted of short lecture, small group discussion, hand-on practice, term project and presentations.

MSE622 Cancer Biochemistry
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, chemopresentaton and reduction of cancer risks, and finally influence of dietary constituents in chemical carcinogenesis.

MSE700 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 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.

MSE701/702/703 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.

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.

MSE801/802/803 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.

MSE495 Individual Research
Undergraduate students are allowed to conduct convergence research under the guidance of professors in various Medical Science fields of interest, regardless of the department.

MSE960 M.S. Thesis Research
Individual research is conducted based on a thesis research proposal approved by the supervising

professor, leading to the writing of a doctoral dissertation.

MSE966 M.S. Seminar
This course involves inviting experts from both inside and outside the field to listen to lectures and discuss topics of interest on recent research activities and future directions in all areas related to medical science, biomedical engineering, and bioengineering.

MSE980 Ph.D. Thesis Research
Individual research is conducted based on a thesis research proposal approved by the supervising professor, leading to the writing of a doctoral dissertation.

MSE986 Ph.D. Seminar
This course involves inviting experts from both inside and outside the field to listen to lectures and discuss topics of interest on recent research activities and future directions in all areas related to medical science, biomedical engineering, and bioengineering.

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.