- **Course Description (Medical IT Convergence Engineering)**

Biosensor
In this course, basic concepts of biosensors are studied. Various methods (fluorescence, electrochemical, and potentiometric method) have been used for biosensors. Study the principles of operation of each method and analyze the strengths and weaknesses.
Carbon Nanomaterials
We will learn basic contents related to typical carbon nanomaterials such as graphene, carbon nanotube, and nanocrystal diamond. Also learn about applications of carbon nanomaterials.
Semiconductor Engineering
The basic principles of field-effect transistors (FETs) are studied in terms of manufacturing process, operating principles and application of biosensors.
Surface modification Engineering
Surface functionalization methods using plasma treatment, chemical treatment and polymer materials will be studied. The surface functionalization mechanism and analysis method are also studied.
Seminar in Biosensor
Learn sensing methods about basic theory and devices of medical biosensor. Present and discuss theory and application of each biosensor and biomaterial which can evaluate medical diagnostic in the seminar.
Advanced Biochemistry
Metabolic and biosynthetic pathways will be emphasized and the biochemical description of immunology will be introduced. We will be constructing a detailed description of the metabolic pathways of the cell. You will be tested not only on your ability to recall this description, but also on your ability to apply it to different circumstances, ie metabolic requirements, vitamin deficiencies, genetic disorders, etc. We will attempt to elucidate why biochemical reactions occur as they do, and what happens when they don't work correctly. Our goal is not so much to prepare you for working with these pathways on a regular basis, but to prepare you to think about these reactions in a holistic way.
Protein Chemistry

To acquire basic knowledge related to structure and properties of proteins and their most important functions To understand different analytical techniques used in protein chemistry Concepts related to: Proteins, enzymes, structure, kinetics, protein interactions, function of proteins, modifications, analyses methods
Medicinal Chemistry
This course will provide an in-depth look at how novel, pharmacologically active molecules are designed to treat human diseases. Topics will include selected chapters in the Silverman text, and additional examples and applications will be drawn from the published literature. Selected case histories throughout the course will serve to illustrate the concepts. The course will include guest lecturers from practicing medicinal chemists.
Special Topics in Biochemistry
THE GOALS OF THE COURSE; is to understand the relationship between Cell Biology and Biochemistry, which are two sides of the same topic. The chemistry is the evolutionary stress for the development of cellular organelles. It is important to not only understand the chemistry but also to understand the relationship of the chemistry to the organelles of eukaryotic organisms and how this relates to ancestral prokaryotic organisms.
Seminar in Applied Chemistry
Acquisition of fundamental knowledge of general, inorganic and organic chemistry is necessary for understanding of plant and animal physiology and biochemistry. Structure of course includes acquisition of knowledge of the system, structure and properties of chemical compounds with emphasis on application in each field of study.
Radiation based Medical Imaging Instrumentation
In this course, we study the construction and operation principle (radiation detector, circuit, image reconstruction and application) of medical imaging diagnostic equipment (X-ray CT, PET, SPECT, gamma camera etc.) using the radiation effect.
Radiation Detection and Measurement
In this course, we study the basic principles of digital X-ray detector and X-ray tube. Various types of image sensors (CMOS, CCD, TFT panel) are used in digital X-ray detectors. We learn about each method.
Technical Paper Writing
Studying how to write technical articles and submit them to international journals, and how to review others' articles, through which discussing how to increase readability and clarity.
Biomedical Instrumentation

Learn the operation principles of various medical devices used in hospitals and discuss problems and improvement methods.
Seminar in Medical Imaging
Present and discuss various research trends of medical imaging in the field of graduate level research in the seminar.
Pharmaceutical Engineering
Flow of fluids: Introduction, mechanism of fluid flow, Reynolds number and its significance, Bernoulli's theorem, manometers and friction losses in pipes, measurement of flow rate using direct weighing or measuring, hydrodynamic methods, displacement meters and dilution methods. Regulation of flow using plug cocks, globe valves, gate valves, unidirectional valves, automatic regulating valve, butterfly valve and diaphragm valve, and water hammer Heat Transfer: Modes of heat transfer, Fourier's law, overall heat transfer coefficient, Stefan-Boltzman's law, single pass heater, multi-pass heater, liquid-liquid heat interchanger and finned tubes Evaporation: Factors affecting evaporation, natural circulation evaporators e.g. evaporating pan, evaporating still, horizontal and vertical tube evaporators, forced circulation evaporators, film evaporators, multiple effect evaporation, material and energy balance of evaporators. Drying: Theory, behavior of solids during drying, static bed dryers, moving bed dryers, fluidized bed dryer and pneumatic bed dryers. Centrifugation: theory, industrial centrifugal filters and industrial centrifugal sedimenters.
Hemodynamics
Learn the theoretical basics of measuring blood flow, blood pressure, elevation of arterial pressure, veins, pulse rate, blood flow, etc. in a blood vessel.
Intermediate Fluid Mechanics
To learn basic knowledge of fluid mechanics and differential analysis of flow
Powder Technology
Students will become familiar with the different methods to characterize, measure, and compare distributions of powders. Students will be able to recognize and quantify the forces between particles for a variety of situations. Students will be familiar with various unit operations used to process powders and particles, e.g., mixing, agglomeration, filtration, etc. Students will have developed an appreciation for the complexity of powder processing and developed the skills necessary to design equipment used to process powders and particles.
Heart Physiology
Study physiology and pathology of cardiovascular system. Study cardiac physiology from electrophysiological and mechanical point of view.
Bio-simulation

Learn how to formulate mathematical phenomena. Learn how to interpret biomechanics by calculating formulated differential equations.
Biomechanics
Study the mechanical properties of living tissue from the viewpoint of material mechanics.
Artificial Organs
Learn about trends in artificial organs research in the domestic and international markets and market conditions. Learn human physiological knowledge and system engineering knowledge for artificial organ development.
Numerical Analysis
Develop general understanding of numerical analysis and its applications. Students use computers to learn mathematical knowledge, which is the basis of numerical analysis of engineering problems.
Special Topics in Bioengineering
Students will learn recent research trends in biomedical field through lectures. We invite experts who have new technology of new field or have experience.
Theory and Application of Medical Images
This course focuses on highly demanding medical diagnostic tool in medical areas. Learn about the physical mechanisms of imaging systems, such as x-ray imaging, tomography, ultrasound, magnetic resonance imaging, and so on. This course will allow students to study the application range and development possibility of medical devices to be actively participated in research.
Topics in Medical Image Processing
Introduction to theories, algorithms, and practical solutions of digital image/video perception, acquisition,color representation, quantization, transform, enhancement, filtering, multi-spectral processing, restoration,analysis, feature extraction, segmentation, morphological transform, and compression. Students will gain understanding of algorithm design, mathematical tools, and practical implementations of various digital image applications. Considerations of practical system requirements (e.g., medical, satellite, consumer) will be discussed. Related standards such as JPEG and MPEG will be reviewed.
Biomedical Signal Processing
This course introduces two fundamental concepts of signal processing: linear systems and stochastic processes. Various estimation, detection and filtering methods are developed and demonstrated on biomedical signals. The methods include harmonic analysis, autoregressive model, Wiener and Matched filters, linear discriminants, and independent components. All methods will be developed to answer concrete question on specific data sets in modalities such as ECG, EEG, MEG, Ultrasound. The lectures will

be accompanied by data analysis assignments using MATLAB.
Imaging Modalities Integrated Circuits
Understand the fundamental knowledge of analog/digital integrated circuits used in medical imaging modalities. Present and discuss recent technology and industry trend about semiconductor integrated circuit design used in medical imaging modalities.
Medical Ultrasound Transducers
Learn fundamental knowledge of medical ultrasound transducers used in medical ultrasound instruments. Present and discuss application areas with recent trend about the high frequency ultrasound transducers.
Medical Ultrasound System Seminar
Learn design methods about basic theory and important devices of medical ultrasound systems. Present and discuss theory and application of each equipment and component which can evaluate medical ultrasound systems in the seminar.
Photoacoustic System Seminar
Learn fundamental principles of photoacoustics and important components and systems used in photoacoustic instruments. Present and discuss the technology trends of the latest research fields of photoacoustics in the seminar.
Cell Biology
Introduction to the biology, diagnosis, and therapy of cancer. Examples of topics to be covered include tumor initiation and progression to the malignant state, metastatic cascade, tumor hypoxia and molecular oxygen sensing, tumor angiogenesis and aberrant microvasculature, cancer screening and imaging, screening test evaluation including 2x2 tables and receiver-operator characteristic curves, radiation therapy, chemotherapy, hyperthermia, photodynamic therapy. Quantitative mathematical modeling and analysis will be used as appropriate.
Laser-Tissue Interaction
Comprehensive introduction to the theory and modelinig of light and laser-tissue interactions. Tissue optical properties, radiative transport theory, and Monte Carlo modeling of photon propagation in tissue; tissue thermal theory, and Monte Carlo modeling of photon propagation equation, and finite differential modeling of heat transfer in tissue; tissue thermal damage and Arrhenius damage integral. The objective of this course is to provide the student with the fundamentals of light and laser tissue interaction to facilitate advanced study in the field of biomedical optics. Both theory and computation modeling will be

covered.
Neural Signal Analysis
Understanding of various neural signals, such as electroencephalography (EEG), electromyography (EMG), electrooculography (EOG), and studying their analysis methods.
Advanced Biomedical Statistics
Studying various statistical methods for medical data. In particular, multi-variable statistical methods are focused, and they are applied to real medical data.
Introduction to Biomedical Machine Learning
Understanding of machine learning principles based on probability and statistical theories, and studying their examples in medical fields.
Internship 5
Master and Ph.D. students are expected to learn the practical field skills through the industry work and apply the contents of the theoretical classes to the practical environment.
Biomedical Artificial Intelligent
This course focused on the artificial intelligence of Biomedical engineering. The theory and application of Deep Learning will be studied on the Biomedical artificial intelligence field.
Biomedical Control System
Understanding various control theory and application on the area of biomedical engineering. The Basic and intelligent control theory and robotics are studied for medical applications.
Seminar in Medical Artificial Intelligent
Learn fundamental principles of artificial intelligent including deep learning used in medical equipment and medical application. Present and discuss the technology trends of the latest research fields of medical artificial intelligent in the seminar.
Introduction to Brain-Computer Interface
To study decoding technologies of human thoughts based on neural signal, and to study principles and methods to apply decoding results into various applications, such as external device control (e.g., robot arm, wheelchair, computer, etc) and neurorehabilitation.
Study for Master's Thesis
Master's thesis paper.

Study for Doctor's Thesis1
Doctoral student's paper guidance (analysis level).
Study for Doctor's Thesis2
Doctoral student's paper guidance (advanced level).