Descriptions of Courses

EE563 Display Engineering

In this course, the technology trend of the next generation information display devices will be introduced and their basic principles will be studied. In particular, LCD, PDP, OLED, and FED are mainly discussed.

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.

EE555 Optical Electronics

This course covers propagation of lightwave in isotropic and anisotropic media, Gaussian beams, interaction of matter and light, principles of lasers, modulation and switching of light, and nonlinear optical phenomena.

EE566 MEMS in EE Perspective

In this course, we will discover microelectromechanical systems (MEMS) in electrical engineering perspective, touching a complete set of design, fabrication, and applications. With respect to designing MEMS, we will explore various working principles, CAD tools including semiconductor design tools, and signal processing circuits. Also, core semiconductor processing technologies and a wide range of micro-machining techniques are studied in depth, in order to fabricate MEMS. We will address important issues in major fields of MEMS applications, including microsensors, RF / microwave, optical, and bio / microfluidic MEMS, specially in an electrical engineering viewpoint.

EE568 Introduction to Organic Electronics

In this course, students will get familiar with the fundamental principles behind electronic/ photonic properties of organic materials, and will learn how those principles can be built into real-world devices such as organic light emitting diodes (OLED), solar cells, and field-effect transistors. Upon completion, students will be able to build a solid foundation that they can later apply to real engineering problems in related areas.

EE571 Advanced Electronic Circuits

This course introduces new analysis methods for analog-circuits implemented by using bipolar and MOS transistors. Since the design of analog circuit requires both approximation and creativity, this course explains how to approximate and design complicated circuits. (Prerequisites: EE304, EE403)

EE647 Nano-Photonics

The course will cover photonic properties of nanoscale structures and devices. Basic principles and their applications are introduced.

EE666 Optoelectronic Semiconductor Devices and Their Applications

The purpose of this course is to provide the basic principles and technological developments in semiconductor optoelectronic devices and their applications. This lecture covers optical properties of semiconductor materials, operating principles of semiconductor light sources, photodetectors, and image sensing devices along with recent research trends as well as their

system applications, such as high-speed optoelectronic signal processing and passive/active optical image sensing.(Prerequisite: EE362)

EE676 Analog Integrated Circuits

This course deals with advanced level of analog circuits emphasis on CMOS. The topics include wideband operational amplifiers, comparators, Switched capacitor filters, ADC, DAC, continuous time filters, etc.

(Prerequisite: EE571)

EE766 Plasma Electronics

In this course, the basic concept and principle of plasma electronics will be studied. In particular, the basic phenomena of electronics in gas phase and the fundamental theory of plasmonics will be studied. The application of plasma electronics for plasma process and high efficiency electronic displays and energy devices will be also discussed.

EE772 Electronic Circuits for Green Energy

This course will teach students fundamental concepts and technologies for energy harvesting systems and their related circuits, as well as power management IC technologies that can minimize the power usage.

EE867 Special Topics in Physical Electronics

This course covers topics of interest in physical electronics at the graduate level students. The course content is specifically designed by the instructor.

PH441 Introduction to Plasma Physics

This course is designed to help students build their ability to understand basic plasma concepts. Topics include discharge processes and application of plasmas, motion of charged particles in electric and magnetic fields, plasmas as fluids (magnetohydrodynamics), diffusion in weakly and fully ionized plasmas, waves in fluid plasmas, and kinetic theory and nonlinear effects. Topical Prerequisite: Electromagnetism

PH503 Quantum Mechanics Ⅰ

This course introduces the mathematical foundation of quantum mechanics to the first year physics graduate students. Topics include: Hilbert space, Measurement theory, Theory of rotation and Angular momentum, Group theory and application to quantum mechanics, Wigner Eckart theorem, Clebsch Gordon coefficients, Stationary perturbation, Time dependent perturbation, Applications to atoms, molecules and solids.Topical Prerequisites: One year of undergraduate Quantum Mechanics, Mathematical Physics, Mechanics, Electromagnetism

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

PH508 Advanced Electrodynamics Ⅱ

This course gives students the knowledge of electromagnetic theory accessed in the first course to specific problems, such as relativity, plasma physics, scattering, and moving charges. Topics include: MHD and Plasma physics, Relativity, Collisions and scattering, Radiation by moving charges, and Mutipole fields.Prerequisite: PH507

PH611 Advanced Solid State Physics Ⅰ

This course is intended to provide graduate students in physics, chemistry, electrical engineering, and materials science with a graduate-level understanding of topics in solid state physics. Topics include: Brillouin zone, Crystal symmetry, Phonons, Electron energy band

theory, Electron-electron and electron-phonon interactions, Electron dynamics, and Transport properties.Prerequisites: PH503 and PH504

PH613 Semiconductor Physics

This course is designed to provide graduate students in physics, chemistry, electrical engineering, and materials science with an ability to understand the scientific and technological backgrounds of semiconductors and related devices. Topics include: electronic structure and optical properties of semiconducting materials, defects and impurities, electron transport, electron/optical devices and device structures.Topical Prerequisites: Schrödinger equation and Hamiltonian, crystal structure and lattices, Boltzman and Fermi-Dirac distributions, Bloch theorem.Prerequisites: PH611 and PH612

PH615 Introduction to Phase Transition

This course introduces both classical theories of phase transition and modern theories of critical phenomena so that students can read most experimental and theoretical papers in the field. It will cover experimental examples of Phase transition, Phase transition anomalies and critical exponents, Landau's classical theory, Critical phenomena and fluctuations, Scaling law and universality, Renormalization group theory, Experimental measurements, Random systems, and Impurity effects.Topical Prerequisites: Thermodynamics, Statistical Physics

PH621 Advanced Wave Optics

This course is designed to convey basic and advanced ideas concerning wave optics including Interference and diffraction theory, Temporal and spatial coherence, Fourier optics, Statistical optics, and the Theory of image formation. Application of electromagnetic theory on thin film technology, Laser oscillator and crystal optics are also dealt with.Recommended Prerequisites: PH391 and PH392 (Optics I, II)

PH622 Geometrical Optics

This course is designed to teach general concepts on Gaussian optics, Seidel first order aberration theory, and optical design method. Methods of optical testing are also reviewed.Recommended Topical Prerequisites: Introductory of optics, Introductory on wave optics

PH643 Applied Plasma Physics

This course is intended for graduate students in Physics and other Engineering Departments. This course will start with six chapters of background information on plasma science relevant to industrial plasmas, followed by three chapters on ion, electron, and plasma sources which are common to many industrial applications. We will cover chapters on plasma processing of materials, and on plasma related applications and devices of industrial interest.

PH721 Nonlinear Optics

Light-matter interactions, especially nonlinear optical interactions and their applications are discussed. Nonlinear susceptibility, Harmonic generation, Four-wave mixing, Raman scattering, Nonlinear propagation of light, Coherence theory and Nonclassical light are topics of interest in this course.

PH726 Semiconductor Optics

This course introduces optical processes occurring at semiconductor band edges, and their applications to various opto-electronic devices. Topics include: Band edge absorption, Non-linear absorption, Semiconductor quantum wells/dots, Semiconductor lasers , Photonic crystals and Photonic devices.Prerequisite: Solid State Physics and Quantum Mechanics.

CH542 Organometallic Chemistry

This course is designed for senior undergraduate and graduate students in teaching reaction mechanisms, and synthetic and catalytic aspects of transition metal organometallic compounds.Prerequisite Courses : CH341 and CH342rerequisite by Topics: General properties of organometallic complexes, survey of organometallic
complexes and their reactions categorized by ligands, reaction mechanisms, characterization of organometallic complexes, catalytic processes, applications to organic synthesis, and bioorganometallic Chemistry

CH607 Surface Chemistry

This course is designed to give high-level understanding to the Chemistry of solids, mainly metal and gas-solid interface structures. Thermodynamics and dynamics of the solid surface are discussed with a brief introduction to solid state dynamics. The main area of study is the absorption and deabsorption of gas molecules on metal surfaces and implications of these phenomena to the theory of catalytic behavior.Topic include : Principle of the surface analysis methods such as Auger, XPS, LEED, SEXAFS, Chemisorption on surfaces, and Catalytic reactions on surfaces.

CH671 Organic Chemistry of High Polymers

This course is designed to give graduate students in Chemistry a survey of the synthesis and reactions of organic polymers and their physical characterization including kinetics of radical species and condensation polymerization, stereochemistry of polymers, ionic polymerizations and other organic chemistry of polymers

CH674 Organic Electromic Materials

The course provides the basic principles, various organic and polymeric materials as well as their syntheses and the device fabrications of organic thin-film transistor, organic light-emitting diode and organic photovoltaic cell which are strongly connected with industrial fields

CH675 Introduction to Lithography

Lithography is applied widely to manufacturing of semiconductor microchips, displays, and MEMS devices. This course discusses the physics of lithographic process, resist processing, and emerging lithographic thechnologies such as nanoimprint lithography, interference lithography, immersion lithography, and scanning probe lithography

CBE473 Microelectronics Processes

Unit Operations in micro-electronics processing such as chemical deposition, oxidation, ion implantation, metal sputtering, Sputtering, chemical deposition process are introduced and how these unit processes are integrated to produce semiconductor chips. Especially, chemical engineering principles are focused.

CBE525 Molecular Electronics

This course covers molecular electronic in organic materials, molecular methodologies, biooptoelectronics and molecular electronic logic and architecture. Detailed topics includes molecular scale electronics in nano-science, Foundations and theories of molecular electronics, properties and ordering of materials, piezoelectric and pyroelectric materials, molecular magnets, molecular nonlinear optics, photochromism, conducting polymers, charge transfer complex, OLED, liquid crystals and devices, self-assembly, Langmuir-Blodgett films, organic molecular beam epitaxy, molecules at surface, biological membrane, biosensors, biomolecular optoelectronicsmolecular imaging, molecular electronic logic and architecture

CBE551 Polymer Rheology

Constitutive equations are needed to describe the flow behaviors of polymeric liquids. Differential and integral types of constitutive equations are derived using the continuum theory and the non-equilibrium thermodynamics. They are applied to the flow system of fluid

CBE552 Materials Engineering of Polymers

Polymers are very popular in various industries and daily life since they are light, cheap and easy to process. The relationship between structure and properties will be considered along with rheology, mixing, extrusion, injection molding, anisotropic properties during processing and related mechanical properties. In addition, functional characteristics of polymers such as electrical, optical and permeability will be included.

CBE554 Physical Principes of Polymer

This course is designed to be an introduction to the physical principles of polymers that govern the structures and properties of individual polymer chains and also physical properties and behavior of bulk polymer materials. The microstructural properties of polymer chains are crucial to determine the bulk properties of polymer materials.

CBE572 Inorganic Materials Processing

This course deals with process-property relationship while the main focus of conventional materials science and engineering is to understand structure-property relationship. Chemical synthesis of powder, fiber and monolith form of inorganic materials are discussed. Especially, gas and liquid phase chemical processes are explained

CBE631 Microfluidics

As microfluidics plays an important role in biotechnology and nanotechnology, the goals of this course can be set as; firstly, understanding of physical phenomena in fluid flow of microfluidics, and secondly, obtaining the insight

for the analysis, optimization or design of microfluidic system based on fundamental understanding. Also, various fabrication technology for microfluidic systems and applications of microfluidic system in engineering and science will be introduced

CBE682 Organic Nano-Structured Materials

This lecture includes: non-crystal, crystals, liquid crystals, imperfections in ordered media, and finally nano-structure. Because the properties of nanomaterials are structure-sensitive, numerous associations in this class will be made to establish structure-property relations for advanced organic materials using very useful experimental techniques, in particular, diffraction and microscopy. Applications to IT and BT devices using nanostrctured materials are also discussed.

MS536 Thin Film Processes

This course is planned to give graduate students in Materials Science and Engineering an understanding of the process and analysis technologies of thin films

MS544 Engineering of Soft Materials

In this course, the basic concepts for soft condensed matter, which includes polymers, colloidal dispersion, amphiphiles and liquid crystal, are presented with the particular emphasis on their structure formation and the corresponding physical properties

MS575 Non-Crystalline Materials

Thermodynamics and kinetics of glass transition and glass formation are studied in relation to amorphous structure in order to understand non-crystalline materials. Physical and chemical properties of non-crystalline materials for technological applications are introduced. Especially,

photonic applications of non-crystalline materials are emphasized.

MS613 Solid State Physics

This course is designed for beginning graduate students of materials science and engineering. It will cover crystal structure, lattice vibration, the theory of electron gas, the quantum electron theory and the concept of band theory.

MS620 Optical Materials

This course deals with physical and chemical properties of the materials used for optical devices and consists of three parts. The first part consists of nature of electromagnetic waves, light propagation, refraction, reflection, reflection, scattering and absorption, and color generation in materials. The second part consists of light course, modulation, and detection (including human eyes) of light. Third part consists of electro-optical phenomena and optical integrated circuits

MS624 Optical properties of nanostructured materials

This course includes (1) lectures on the fundamental behavior of EM waves in periodic media, (2) introductory lectures on new class of optical materials. Students will understand firmly how the developments of nano-science and technology affect the emerging new optical materials

MS697 Special Topics in Advanced Materials II

This course surveys, in depth, emerging technologies and advanced fields in materials science and its applications at graduate levels. This course offers guest lectures by staff and visiting specialists; this series forms a content that is integrated and on important aspects of the field

ME505 Measurement Instrumentation

Basic principles, concepts, and methods of measurement instrumentation of physical quantities dealt with significance in mechanical engineering are introduced. Emphasis is given to the measurements of lengths, forces, and temperature with mechanical, electromagnet, and optical instrumentation technologies.

ME512 Advanced Heat Transfer

The aims of this course are to give the students more concrete understanding of basic ideas of heat transfer and to enable them to design actually applicable devices. Brief introduction to recent research topics will be added at the end. There will be a few homework assignments.

ME537 Optimal design of Composite Structures

Introduction of anisotropic solid mechanics based on the classical plate theory (CLT). This course gives an insight on the properties of composite materials and helps to prepare computer programs for the stress and strain analyses. A brief experiment using autoclave vacuum bag molding method is offered to manufacture a sand composite structure.

ME549 Reliability in Microsystems Packaging

The importance of reliability in microsystems packaging are treated. Fatigue and creep of solder joints of advanced packaging, fracture mechanics approach for the reliability assessment in microsystem packaging are covered. Fundamental principles of reliability evaluation procedure including Micro-Moire Interferometry are provided. Student will also learn the reliability in microsystems packaging through selected experiments and projects.

ME574 Joining Engineering

This course includes the principle and application of the joining/welding technologies as well as the electronic and MEMS bonding technologies.

ME582 Introduction to Microfabrication Technology

Based on the fundamental IC process technology, basic MEMS (Micro Electro Mechanical System) technologies such as bulk-micromachining, surface micromachining, and HAR-MEMS process are introduced which are applied for microsensors, microactuators, and micro systems. It also covers recent interdisciplinary subjects such as microfluidics, piezo-MEMS, optical-MEMS, and Bio-MEMS.

ME583 MEMS Design and Experimental Microfabrication

Based on the fundamental MEMS (Micro electro Mechanical System) technology, various microfabrication processes are introduced and processed in the clean room. It covers mask design, photolithography, thin film deposition/etching, bulk microfabrication, and X-ray mask fabrication, which provide the base for independent MEMS research. It also covers recent interdisciplinary subjects such as microfluidics, piezo-MEMS, optical - MEMS, and Bio-MEMS.

ME587 Optomechatronics

This course will treat a new engineering field termed "optomechatronics" and focus on an integrated approach to effectively combine multi-disciplinary fields (optical/mechatonic). Based on the review of fundamentals optics/mechatronics, the lecture will introduce an in-dept analysis on how such multi-disciplinary fields can be combined to generate fundamental functions generated by the fused technology.

ME589 Applied Optics

This course is designed to provide mechanical engineers with fundamentals of optics by explaining basic phenomena of light with relevant theories. Basics of geometrical optics, wave optics, electromagnetic optics, and quantum optics are introduced in a condensed way of learning with necessary hands-on experiments.

ME592 Laser: Principles and Applications

It deals with the principles and applications of various lasers. The principles of laser generation and modification will be introduced. The applications of lasers in different measurement systems and materials processing including electronic fabrication will be treated. Finally laser application in information handling and communication will be explained.

ME633 Mechanical Behavior of Polymeric and Composite Materials

In this course various characteristics of the mechanical properties of polymer and composites materials such as deformation, fracture and strength of materials are introduced for the application to engineering design. The evaluation method of mechanical properties are also explained.

ME800 Special topics in Mechanical Engineering

This lecture is designed to deal with the selected theory and application in mechanical engineering part. The specific topics will be announced before the semester begins.