Descriptions of Courses

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

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.

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.

MS415 Introduction to Semiconductor Devices

Concerning present and projected needs, this course provides a strong intuitive and analytical foundation for dealing with solid state devices. Emphasis is placed on developing a fundamental understanding of the internal working of the most basic solid state device structures, such as silicon based, metal-semiconductor contact, PN junction, MOS capacitor, bipolar transistor, and MOSFET.

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.

MS635 Semiconductor Integrated Process Design

Since unit processes for VLSI manufacturing are related to each others, it is necessary that semiconductor engineers have a deep understanding about issues between the VLSI process integration and device operation. This course provides basic science underlying unit process steps, particular engineering in achieving required device performances, and the tradeoffs in optimizing device performance and enabling manufacturing. It assumes that the student has already acquired an introductory understanding of the semiconductor device physic.

MS670 Sol-Gel Nano Materials and Process

In this course, fundamentals of sol-gel process and fabrication of ceramics and glasses by sol-gel process are studied. Also, synthesis and application of nano materials such as nano composites, nano hybrids, nano structured materials, mesoporous materials, and biomaterials prepares by sol-gel nano process are introduced.

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.

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.

CBE556 Structure and Properties of Macromolecules

The effects of the polymer structure (chemical structure, molecular weight, intermolecular structure and morphology) on physical, mechanical and electrical properties are studied. The property estimation scheme originating from the structure-property correlation is also studied.

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.

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.

MAE510 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.

MAE512 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.

MAE521 Viscous Fluid Flow

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.

MAE611 Convective Heat Transfer

This course deals with various fundamental aspects of convective heat transfer. The mechanism of convective heat transfer and the methods of analytical approach are going to be discussed in depth. The major topics included in this course are the laminar/turbulent heat transfer in internal/external flows and the forced/natural convections. The students are assumed to have taken the introductory courses on fluid mechanics and heat transfer.

MAE613 Computational Fluid Mechanics and Heat Transfer

The purpose of this course is to familiarize the students with numerical methods of treating differential equations in fluid and thermal engineering fields. In this course, participants get abilities for predicting and analyzing the diverse physical phenomena by using a program. Through various contents of home works and term projects, students can analyze the physical model numerically.

PH960 M.S. Thesis Research

PH980 Ph.D. Thesis Research