Descriptions of Courses

MS211 Introduction to Materials Science and Engineering
This course covers atomic bonding, crystal structures, crystal defects, diffusion, phase diagrams and microstructures, mechanical and electromagnetic properties of metals, ceramics, semiconductors and polymers.

MS212 Thermodynamics of Materials
This course introduces the essential features of zeroth, first, second, and third laws of thermodynamics and their application to materials, statistical interpretation of entropy, and experimental techniques used to measure thermodynamic functions. Furthermore, this course deals with surface phenomena and considers their application not only to hydrostatic system, but also to magnetic, dielectric, piezoelectric and mechanical systems.

MS311 Phase Transformation and Microstructural Evolution
The objective of this course is to provide juniors in MS&E with the concepts and models which are required to understand the formation and evolution of microstructures in both the crystalline solids and thin films. The topics include: thermodynamics of solid solutions, phase equlibria, diffusion equations and solution, interdiffusion, surface diffusion, surface energies and thin film formation, interface structures and energies, interface energies and equilibrium shapes, grain growth and recrystallization, solidification and crystal growth; homogeneous and inhomogeneous nucleation in solids, growth and overall transformations kinetics, spinodal decomposition and coarsening, massive transformations, ordering transformations, martensitic transformations, transformation kinetics in thin films, surface kinetics processes, grain formation and evolution, thin film stresses, epitaxial growth, solid phase amorphization and crystallization, and thin film reactions.

MS321 Advanced Materials Lab I
This course is organized to give the basic theories and concepts through the introductory experiments about the phase diagrams and material characteristics. Tensile test for mechanical properties, electrical transport phenomena for electrical properties are included. Safety, technical writing, experimental design and error analysis are also introduced.

MS322 Advanced Materials Lab II
This course introduces how to tailor the properties and performance of materials by modifications in compositions and microstructures through synthesis and processing. Also, general microfabrication technologies, in which photo-lithography, diffusion of dopant, Si oxidation, and thin film deposition are included, are introduced on the basis of term projects.

MS213 Crystallography and Diffraction
This course deals with chemical bonds, atomic packing as a consequence of bond type, crystal structures by atomic packing, lattice and symmetry in crystals, reciprocal lattice and Ewald sphere. Principles and applications of optical, X-ray, and electron diffraction to crystal structure characterization, laboratory for basic techniques of optical, X-ray, and electron diffraction are covered.

MS214 Thermochemical Process in Materials Science and Engineering
This subject aims to establish an in-depth understanding of the chemical phenomena occurring at the materials exposed to the high temperature, which provides a capability to design a new materials and an optimum high temperature material-process. Especially, the knowledge obtained in this course can help to predict the equilibrium phase and composition of materials at a given state. The course involves the thermodynamic behaviors of condensed phase, gas-solid reactions and liquid-solid electrochemical reactions.

MS215 Mechanical Behavior of Materials
This course introduces to sophomores the concept of dislocations and to understand the role of dislocations on mechanical properties of materials. Topics include: application of principles of linear elastic fracture mechanics to brittle fracture and to fatigue crack propagation and reviews elasticity theory, elements of plasticity, and strengthening mechanisms.

MS216 Introduction to Electrical and Magnetic Properties of Materials
This course covers the basic principles of electrical and magnetic properties of solid materials based on band

model and defect model. Electrical conductivities, dielectric properties and magnetic properties are illustrated. The selection of ceramics for electronic device applications and a basic process of electro-ceramics are described.

MS310 Introduction to Quantum Chemistry
Understanding quantum chemistry is a necessity for materials scientists. This course covers wave-particle duality, the Schroedinger equation, the hydrogen model, molecular orbitals, symmetry of molecules, spectroscopy, and basic principle of solid formation.

MS331 Nanomaterials Science & Technology
This course covers the techniques for patterning materials at the nanometer length scale. Topics include: nanostructure, self-assembly, nanoimprint lithography, scanning probe lithography, organic semiconductors, nanopatterning, atomic layer deposition, nanoelectronics, colloidal crystals, mesostructures, circuits and programmable assembling DNA.

MS340 Polymer Materials
The course is to collect and organize understanding of the relationships between structure, properties and applications of polymer materials. The major polymer properties such as processability, mechanical, thermal, electrical, optical, acoustic, chemical and surface properties will be discussed from various aspects of polymer structures.

MS354 Corrosion and Oxidation of Metals
This course is designed to provide undergraduate students in materials science and engineering an introduction to degradation of metals and alloys at both low and high temperatures. The fundamentals of electrochemistry and electrode kinetics pertinent to metallic corrosion, corrosion control, gas-metal reactions, and mechanisms and kinetics of oxidation are presented. Topics include: Introduction to corrosion and oxidation, review on electrochemistry, pourbaix diagrams, corrosion kinetics, mixed potential theory, passivity, predicting corrosion behavior, corrosion rate measurements, galvanic corrosion, localized corrosion, stress, corrosion, hydrogen damages, corrosion prevention, mechanisms and kinetics of oxidation, alloy oxidation, other metal gas reactions.
Prerequisites : MS214 and MS215

MS360 Mechanics Materials
Basic topics of mechanics of materials are covered including: concept of stress and strain, axial loading, torsion, bending and shear. Stress and strain transformation, bending of beam and shaft, combined loading will be included. Some of current development in mechanics of materials are also discussed.

MS371 Structure and Properties of Engineering Alloys
This course presents the relationship between phase transformations, microstructures and the mechanical properties of metals and alloys. Applications to alloy design, processing, and heat-treatment are included. A consideration is made of mostly mechanical properties, structural stability, grain size, interstitial and subsitutional solutes, precipitates and second-phase particles.

MS381 Introduction to Solid State Physics
This course teaches all the physical phenomena in solids from the point of wave concepts. It covers the lattice vibrations, electromagnetic waves, and electron waves. The importance interaction between those waves are emphasized. The wave theories are applied to explain the solid-state phenomena such as specific heat, thermal conduction, electron transport and scattering, light scattering, light transmission and reflection, and ionic polarization.

MS412 Material Design and Manufacturing Process
This subject is intended to provide senior engineering students, who are interested in the materials science and engineering, with a general and practical understanding of the materials design and manufacturing process. This course deals with the topics of decision making, optimization, availability, planning, statistical approach, reliability and quality control. To understand these topics, the students are asked to practice design and manufacturing a specific system. Also, since computers are becoming very important in the design field, the role of computers in materials design will be introduced.

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.

MS421 Introduction to Ceramics
This course covers broad area of physical properties of ceramics. Topics include: crystals and crystal structure of solids, defects, interfaces, material transport, phase equilibria, sintering, thermal, mechanical, optical, and electrical properties of ceramics.

MS424 Understanding of Electronic Systems for Materials Engineers
The goal of this course is to provide a basic understanding of electronic systems for Materials Engineers who will work in the areas of Electronic Materials. It covers the MOS memories circuits, display systems, microwave components and devices, electronic packaging and their fabrication process issues.

MS425 Introduction to Biomaterials
The objective of this course is to provide basic concepts in biochemistry, structures and properties of key biological polymers, and interactions between biomolecules with environments. This course will also introduce properties and characterization methods for various biomaterials.

MS431 Nano-Biomaterials
This class introduces the systematic study of the interactions between biomolecules and synthetic materials. Topics include non-covalent biomolecular interactions, biodegradable polymers, hydrogels, biological interfaces, tissue engineering, and gene therapy.

MS481 Semiconductor Processing
Basic VLSI processing technologies such as crystal growth, doping, ion implantation, thin film deposition, lithography, etching, and interconnection and also electronic packaging technologies will be studied.

MS482 Special Topics in Materials Science and Engineering
This course is primarily designed to cover contemporary and advanced topics in materials science and engineering and introduces undergraduates to related novel theories and applications.

MS490 Research in Materials Science and Engineering
This course is an individual research in consultation with the thesis advisor for the B.S. thesis.

MS495 Individual Study
This course is an extended participation in work of a research group. This course includes independent study of literature and direct involvement in group's research.

MS496 Seminar
This course is composed of weekly seminars for undergraduate students interested in materials science and engineering. Students present seminars on current topics in materials research with discussion and critic from seminar participants.

MS511 Thermodynamics and Phase Equilibria
Topics include: thermodynamic variables, the first, second and third law of thermodynamics, chemical potential, fugacity and activity, thermodynamic stability and critical phenomena, solution-vapor, crystal equilibrium, classification of defects in crystals, defects in metals, elemental semiconductors, defects in nearly stoichiometric, nonstoichiometric compounds, metal hydrides, amorphous, diamonds.

MS513 Structure and Defects in Solids
This course covers crystallography, point defects, line defects, surface defects, and three dimensional defects.

MS514 Mechanical Behavior of Solids
This course is designed to introduce the fundamental phenomena and theories on the 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, and superplasticity.

MS521 Statistical Thermodynamics in Materials System
In this course, thermodynamical concepts are considered in statistical point of view. This course investigates how magnetic spins, dielectric polarizations, atoms contribute to total free energy and how ideal solid was described by heat capacity, Bose-Einstein condensation.

MS523 Electron Microscopy and Experiment
This course covers topics such as electron guns, electron lenses, optics, reciprocal lattice / Ewald sphere construction, structures factor, kinematical, dynamical, indexing, stereographic analysis, inelastic scattering and Kikuchi electron diffraction, origins of contrast, perfect crystals, imperfect crystals, artifacts, amplitude vs phase contrast, identification of defects.

MS524 Phase Equilibria and Phase Diagrams
This course covers the Thermodynamics and Phase Stability Relation between Phase Diagrams and Equilibria Interpretation and Analysis Practical Applications.

MS536 Thin Film Processing
This course is planned to give graduate students in Materials Science and Engineering an understanding of the process and analysis technologies of thin films

MS541 Diffusion in Solid
This course deals with an introduction of diffusional theories and their applications which appear in the design and the manufacturing of the materials-related devices. In the part of theoretical treatment, basic differential equations are explained for the solution of various kinds of diffusion problems. In addition, the diffusion phenomena are treated from micro-scale of atomic movement to the macro-scale of thermodynamic treatment. As applications, various examples occuring at metals, ceramics and semiconductors are also introduced

MS542 Nanoscale Surface Analysis
This course provides the fundamental principles of Scanning Probe Microscope (SPM) which has become a powerful technique on the science of nanoscale materials through the lecture and experimental. The applications of SPM to the nanoscale surface analysis will be also introduced.

MS543 Introduction to Dislocations
This course is designed to understand the fundamental relationships between line defects and properties of crystalline materials and introduces the structure and properties of various types of dislocations, and discusses the phenomena and theories on interactions between dislocations and other defects. Main topics include: description and movement of dislocations, stress and strain fields of dislocation, reaction and multiplication of dislocations, dislocation arrays and crystal boundaries, interactions between defects, etc.

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.

MS545 Applied Biomaterials
This course will teach recent progresses in the application of biomaterials. Major topics to be covered in this course will include bioceramic materials, materials for biosensors/chips, biomedical materials, self-assembled biomaterials, bionanomaterials, biomimetic materials, signal-responsive biomaterials.

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.

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.

MS590 Computational Modeling and Simulation of Nano Materials and Processing
In this course, students use quantum computational simulation tools to understand and design nanoscale materials and processing. Topics include Nanostructures, Surface Reconstruction, Carbon Nanotubes, STM Initiated Self-Directed Growth of Nanowire, Atomic Layer Deposition, Hydrogen Storage, Single Electron / Molecular Structures and Properties, Nanocrystal Growth in Melt.

MS591 Emerging nanofabrication technology
This lecture covers the underlying principles and applications of nanofabrication technologies. The advantages and limitations of top-down and bottom-up approaches are extensively discussed through detailed and in-depth reviews on state-of-the-art techniques. Thermodynamically-driven and kinetically-driven nanoscale self-assembly processes will be described as illustrations of synthesis and assembly mechanisms.

MS592 Inorganic Nanomaterials
There have been significant progress in the novel synthesis and various applications of one-dimensional functional nanomaterials. These nanostructures include nanowire, hollow tube, nanofibers etc. In this course, we understand various synthesis methods of inorganic (0/1/2 dimensional) nanomaterials and their potential applications in chemical sensors, energy storages, and nanoelectronics.

MS612 Phase Transformation in Solids
The objective of the course is to provide graduate students in ES & E the fundamental concepts and models which are required to understand the phase transformation in crystalline solids. Topics include Nucleation, Growth, Coarsening, Spinodal decomposition, Recrystallization, Precipitation, Eutectoid Decomposition, Discontinuous Precipitation, Massive Transformation, Ordering Transformation, and Martensitic Transformation.

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.

MS615 Structure and Properties of Interfaces
This course covers the thermodynamics and structure of interfaces in solids and related phenomena. Topics include: Interfacial segregation, equilibrium and growth shapes of crystals, strain effect on crystal shape, thermodynamic definition of interface, structure of interfaces, kinetics and mechanism of interface migration, coherency strain in thin films, Interface instability and dendritic growth, Normal and abnormal grain growth, Precipitation at grain bounderies, theories of recrystallization, chemically induced grain boundary migration, and discontinuous precipitation.

MS617 Electrochemistry of Solids for Materials Scientist
The objective of this course is for students to acquire a fundamental and practical understanding of the electrochemical equilibria and reactions in and on solids involving point defects in terms of the electrochemical potential. Topics include phase equilibria between electrons and ions, transport of electrons and ions as fundamentals; contact phenomena, topochemical reactions, transport through solid galvanic cell as applications; current research activities concerned. This course deals with the subjects from both microscopic and macroscopic viewpoints. Topics also include: basic concepts of the electrochemical system, defect structure of solids (metals, semiconducting materials), examples for the defect structure of solids, thermodynamic quantities of quasi-free electrons and defect electrons in semiconducting materials, Galvani and Volta potentials, Example for the defect structure of electrons and defect electrons, diffusion / migration of ions and electrons, application of solid Galvanic cell, and electrochemical solid state reaction.

MS619 Electronic Ceramics Materials
In this course, topics such as dipole moment, polarization mechanism, dielectric properties, breakdown mechanism, dielectric loss, ferroelectric properties, electronic components, piezoelectric properties, crystal elastic properties, thermodynamics of piezoceramics, and piezoelectric components will be illustrated.

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.

MS621 Dielectric Materials
The following topics will be discussed in this course: dipole moment, polarization phenomena, dielectric loss, thermal characteristics of dielectric, classification of dielectrics, ferro-electric polar materials, non-polar materials, microstructural effects of dielectric characteristics, fabrication process and application of dielectric materials.

MS624 Optical Waves and Periodic Media
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.

MS631 Alloy Design and Applications
This course aims to give graduate students the basic principles of metallurgy, the mechanical behaviors of materials and the ability to use them in developing new alloy. Topics include: engineering materials, deformation and strengthening mechanical, gas turbine design and materials, NI-base superalloys, advanced high temperature alloys, fast fracture, toughness, and fatigue, high strength-high toughness alloys, composite materials, shape memory alloys, electronic and magnetic alloys, and tests.

MS632 Creep and Superplasticity
This course describes the concepts of reaction theory and kinetics of plastic deformation, creep deformation mechanisms, the dependence of creep on temperature and stress, motion of dislocations for creep, introduction of the most recent creep theories and various mechanisms for superplastic deformation.
Topics include: reaction kinetics of plastic deformation, the rate theory of plastic deformation, the theory of dislocation mobility, time dependent plastic deformation, temperature, dependence of creep stress, and dependence of creep effects on metallurgical factors on creep cyclic creep superplasticity.

MS633 Solid State Chemical Sensors
This course is designed for the understanding of the surface physics of electronic materials and defect interaction with environments. Thus in the first part, device physics of the MOS is briefly introduced with an emphasis on surface phenomena. Here, students learn to understand the concepts of surface energy level, surface energy diagram, and defect level, etc. In the second parts, absorption and desorption theory of gases on electronically active solids are explained in terms of thermodynamics, and atom physics. Here, various examples are introduced, which are chosen from Journal of Sensors and Actuators and Journal of Electrochemistry. Finally, defect chemistry of ceramic solids is introduced with Kroger-Vink notation and diagram. Here the effects of environmental gases on conductivity and capacity, etc, are discussed.

MS634 Crystal Physics
The physical properties in relation to crystal structure are investigated. Especially the macroscopic properties, such as heat capacity, electric dipole moment, dielectric constant, stress and strain piezoelectric constant, elastic constant are investigated as tensor properties. Additionally, the time reversal symmetry in magnetism is presented in detail.

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 physics.

MS642 Electronic Packaging Technology
This course covers electronic packaging technologies such as electronic design, thermal consideration, mechanical design, reliability and failure mechanism, chip interconnection, chip packaging, printed board technology, soldering, ceramic packaging, and multi chip packaging.

MS643 Sintering
Sintering is the core technique of powder metallurgy as well as ceramic processing. This course treats the phenomena that occur during sintering, i.e. densification, grain growth and microstructural evolution. The basics of materials science with respect to these phenomena are presented. Analysis and interpretation of general sintering phenomena will be made. Principles of sintering will also be explained and applied to the sintering of real systems.

MS644 Advanced Polymeric Materials
Various phase transition behaviors and structural changes of polymeric systems are presented with their relation to the molecular structure and processing condition. The corresponding material properties are interpreted in terms of the underlying physics.

MS653 Microstructural Analysis in Materials Science
In this course, the following topics are studied: reciprocal lattice and diffraction conditions, diffraction phenomena and Fourier method, high resolution images, dynamical diffraction theory, defect analysis, analysis of diffraction pattern, convergent beam electron diffraction pattern and 3-D crystallographic information, and optics of transmission electron microscope and its resolution.

MS654 Surface Science
This course treats physical and chemical properties of surfaces and interfaces of material and interactions of electrons and photons with material surfaces, and describes modern scientific tools to obtain information about composition, structure and chemistry of surfaces on a microscale, such as, AES, XPS, FTIR, LEED, RBS, SIMS, EPMA, Raman spectroscopy, etc.

MS656 Corrosion & Mechanochemical Reactions on Surfaces
The course explores the theoretical basis of electrochemistry in the materials science and the reasons for the corrosion and stress-corrosion cracking of materials. Topics include: thermodynamics and kinetics of electrode (metal and semiconducting materials) process, chemistry of corrosion, physics of corrosion (mutual interactions between electrochemical reaction, stress and structural lattics defects such as vacancies, dislocations, surfaces, grain boundaries, inclusions and cracks, etc.); friction and corrosive wear processes; environmental effect of degradation; recent research activities concerned. Laboratory work accompanies the lectures.

MS657 Environmental Effects on the Degradation of Materials
This course applies thermodynamics and kinetics of electrode reactions to environmental effects on failures of metals and alloys. Specific topics comprising pitting, stress corrosion cracking, hydrogen embrittlement, corrosion fatigue and corrosion prevention are discussed. Topics include: electrochemical aspects of corrosion, review on electrochemistry, poubaix diagrams, electrode kinetics, corrosion kinetics, prediction of corrosion behavior using mixed potential theory, passivity, localized corrosion, hydrogen damage, stress corrosion cracking, corrosion fatigue, liquid metal embrittlement, corrosion control. Prerequisites: MS214 and MS215.

MS660 Fracture Mechanics
This course covers the two- and three-dimensional elastic fields around the crack developed from both a conventional elastic and a dislocational approach. Topics include: Criteria for the crack initiation and growth for elastic and elasto-plastic deformation conditions, fracture toughness theories and testing, fracture theories in terms of materials characteristic properties, damage process in the various process zones, and mechanism of ductile fracture. Prerequisite: Mechanical Behavior of Solids.

MS661 Fatigue Phenomena in Metals
The goal of this course is to cover the topics such as the monotonic and cyclic stress-strain response, various mechanisms for fatigue crack initiation and propagation (metallurgical factors are emphasized), the characteristic

behavior of dislocations under cyclic loading for the formation of damage, high cycle and low cycle fatigue, theories for the life predictions, and grain boundary cavitation for the fatigue failure at high temperature. Prerequisite: Mechanical Behavior of Materials and Structure and Defects in Solids.

MS662 Mechanical Properties of Thin Films
Thin film coatings are widely used in industry to enhance electrical and magnetic properties, but their performance depends heavily on the mechanical reliability of the film. This course focuses on the origin of thin film stress, its measurements, and mechanical properties, and discusses adhesion problems in microelectronic packaging and plastic flow in hetero-epitaxy and superlattices.

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

MS671 First-principles Modeling of Materials
Fundamental concepts of ab initio quantum chemical methods and density functional theory (DFT) methods are introduced. The strength and weakness of ab initio and density functional theory methods are discussed in light of accuracy and computational costs. In addition, we will apply first-principles simulations to design and understand nano materials and nano processes (term projects). Examples include carbon nanotubes, organic nanowires on silicon, hydrogen storage materials, fuel cells, atomic layer deposition techniques, and chemical vapor deposition processes.

MS672 Special Topics on Nano Materials Technology
A group project will be a major component of this course. The purpose of the project is to bring together students of the similar interest to explore exciting areas of nanotechnology and to practice generating new research ideas. In the beginning of the course, each student will review the fifteen areas of nanotechnology distributed at the beginning of the class. They will select the 3-5 topics that they find most interesting. The instructor will then match students with common interests into groups. Once the groups are formed, they will work together to create their own research proposal. The proposal will either be written or presented to the class, depending on student interests and the number of students who take the class. The instructor is willing to meet with the teams during the quarter to help them find the background literature that is needed for their project and to help them develop their research ideas. Some class time will be used for this purpose.

MS673 Photochemical Materials
This class introduces photochemical processes, including photosynthesis, and related nanomaterials for light absorption, exciton transfer, charge transfer and catalysis (e.g., water splitting). Particularly, molecular and semiconductor-based materials design will be compared with natural photosystems in terms of functionality of multiscale architectures.

MS684 Principles of Semiconductor Devices
This course covers the basic physics, operation principles, and processes of semiconductor devices. This course provides the thinking tools for materials scientist to develop or improve the device characteristics, which are closely related to materials science such as structures, bulk defects, interface defects, thermodynamics, and kinetics.

MS685 Physics of Magnetism and Magnetic Materials
In this course, physics of magnetism and application of magnetism will be the two major topics to be covered. Basic concepts of magnetism, magnetic units, origin of magnetism in materials and magnetization processes of magnetic materials under DC and AC magnetic fields will be lectured on. Also magnetic anisotropy, magnetostriction and magnetic domains will be intensively covered. Lastly, engineering applications of magnetic materials in electromagnetic equipment, permanent magnets and external magnetic recording devices for computer application engineering will be discussed in the course.

MS686 Photovoltaic Materials
This course covers the principles of Solar cells, Efficiency measurement, Cell fabrication, Process simulation, selection of various materials for solar cells, and solar cell characteristics. This course enhances basic understanding and deepen specialty in solar cells.

MS696 Special Topics in Advanced Materials I
This course surveys, in depth, emerging technologies and advanced fields in materials science and their 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.

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.

MS698 Special Topics in Advanced Materials III
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.

MS960 Research in Materials Science and Engineering (Master)
This course is for the master's degree thesis based on independent research work performed by the candidate in the laboratory of the advising professor.

MS980 Research in Materials Science and Engineering (Doctorate)
This course is for the doctor's degree thesis based on independent research work performed by the candidate in the laboratory of the advising professor.

MS966 Seminar (Master)
This course is a weekly seminar for graduate students currently enrolled in the MS & E program. Students present seminars on current topics in materials research with discussion and critique from seminar participants.

MS986 Seminar (Doctorate)
This course is a weekly seminar for graduate students currently enrolled in the MS & E program. Stu

dents present seminars on current topics in materials research with discussion and critique from seminar participants.