

## Descriptions of Courses

### EEW501 Introduction to Energy Science and Engineering

Current status of conventional fossil energies will be introduced. Fundamental principles and engineering technology for sustainable energy will be studied. Alternative energy for oil, solar cell, fuel cell, hydrogen energy, bio energy, CO<sub>2</sub> recovery & utilization, green car, wind power, solar energy, tidal wave power, geothermal, energy storage & harvest, artificial photosynthesis will be lectured.

### EEW502 Nature of Chemical Bond

NCB aims to provide a conceptual understanding of the chemical bond sufficient to semi-quantitatively predict the structures and properties of materials. The philosophy is similar to that of Linus Pauling, who revolutionized the teaching of chemistry by including the concepts from quantum mechanics (QM), but not its equations. We also include the new understanding that has resulted from QM calculations over the last 40 years. We develop an atomistic QM-based understanding of the structures and properties of chemical, biological, and materials systems. This course is aimed at experimentalists and theorists in chemistry, materials science, chemical engineering, applied physics, biochemistry, physics, geophysics, and mechanical engineering with an interest in characterizing and designing molecules, drugs, and materials.

### EEW503 Molecular Thermodynamics and Energy System

This course focuses on understanding the phase equilibria of gas, liquid and solid phases on the basis of molecular thermodynamics and their applications to future energies such as hydrogen energy, fuel cell and gas hydrate.

### EEW504 Advanced Quantum Mechanics

This course focuses on understanding the phase equilibria of gas, liquid and solid phases on the basis of molecular thermodynamics and their applications to future energies such as hydrogen energy, fuel cell and gas hydrate.

### EEW505 Thermodynamics and Chemical Reaction Kinetics

This course deals with the fundamentals of thermodynamics, the flow of energy in chemistry, and the theory of chemical reaction kinetics. We discuss the basic concepts of statistical mechanics that forms the basis of reaction kinetics and the link for thermodynamics.

### EEW506 Polymer Materials for Energy Devices

This course deals with structure and properties of polymer materials for energy devices typically including secondary batteries, fuel cells, and solar cells. The structure design, synthesis, and evaluation of the energy related polymer materials are thoroughly discussed.

### EEW507 Thermal Physics

The course provides an introduction to the physics of heat, from both the macroscopic and molecular viewpoints. Meaning of temperature, specific heat, and molecular scale understanding of heat transport and phase transition will be shown. The application of thermal physics in energy application will be discussed.

### EEW508 Surface Physics and Chemistry

The course treats chemical and physical phenomena taking place at the surface and interfaces. The structural, electrical, thermodynamical, and mechanical properties of surfaces will be shown. Various surface analytic techniques and topics of heterogeneous catalysis on single crystal and nanoparticles will be described.

### EEW509 Theory of Electron Microscopy and Its Experiment

The course treats chemical and physical phenomena taking place at the surface and interfaces. The structural, electrical, thermodynamical, and mechanical properties of surfaces will be shown. Various surface analytic techniques and topics of heterogeneous catalysis on single crystal and nanoparticles will be described.

### EEW510 Design of Functionalized Nanostructures

Students use first-principles simulation tools to design nanoscale materials and processing, which include new nanostructure for energy storage, Carbon Nanotubes for field emitters, STM Initiated Self-Directed Growth of Nanowires, Atomic Layer Deposition, Single Electron/Molecular Structures and Properties.

#### EEW511 Hydrogen Energy 1. Storage

Classification of Hydrogen storage system, storage in metals and intermetallic compounds in view of structure of materials and hydrogen location in materials and capacity and capacity and degradation of the metallic. Non metallic and chemical compounds as storage materials in view of the effects of structural modification on capacity and cycle life with its mechanism. Developing methods of the hydrogen storage system.

#### EEW512 Sustainable Catalysis

This course deals with sustainable catalysis related to energy, resources, water and environment securing energy supplies and resources as well as preventing green house effect.

#### EEW513 Water Treatment and Desalination

The course will discuss the science and technology of water treatment, desalination and reuse. Topics to be covered include: water chemistry, conventional treatment processes (e.g., coagulation, flocculation, media filtration and disinfection), membrane filtration (e.g., reverse osmosis, electrodialysis, nanofiltration, ultrafiltration and microfiltration), sorption, ion exchange and thermal processes. The course will also discuss emerging topics such nanotechnology applications to water treatment, desalination and reuse.

#### EEW966 Energy Technology Seminar

This course deals with state-of-the-art technology on energy conversion and storage materials used for devices such as lithium rechargeable batteries, fuel cells, solar cells etc.. Students are provided with the opportunity to discuss on this topic with experts in each field from industry, laboratory and universities.