

## Descriptions of Courses

### **NST510 Introduction to Modern Physics**

The goal of this course is to help students understand the physical concepts necessary to understand physical phenomena at the nanoscale.

### **NST520 Introduction to Nano-chemistry**

The goal of this course is to understand the general chemistry for students who don't have chemistry background.

### **NST530 Introduction to Physiology**

Understanding toward co-ordinations and integrations of physiologic processes in the body at the level of nano-molecular-cellular-tissue-organ levels.

### **NST535 Introduction to Nanobiology**

The goal of this course is to understand the biophysical properties and principles of biological processes.

### **NST540 Nanoscience and Technology Laboratory**

Nanoscale physics/chemistry/biology laboratory course operated in a lab-rotation style.

### **NST550 Nanofabrication Laboratory**

This course aims to provide knowledge and hands-on practice on top-down and bottom-up nanofabrication technologies and analytical tools at nanometer scale. The course will be composed of teaching and experimental sessions, and students will operate a number of nanofabrication and analytical equipments in the experimental sessions to conducting carefully designed experiments.

### **NST551 Computational Nanoscience: Electronic Structure theory**

Computational simulation is considered as a third means in modern research sciences, in addition to traditional experiment and theory. Last 20 years, predicting power of computational nanomaterials science has been improved significantly owing to rapid development of supercomputing multiprocessors. In this class, we will learn modern methodologies of computational materials science and electronic structure theories, and perform a term project using VASP or PWscf on selected topics such as molecules, nanoclusters, nanotubes, and proteins to acquire basic computational skills.

### **NST552 Biomedical Optics**

This course provides an introduction to optical principles, technologies, and instruments that are being used in a variety of scientific and engineering fields including biomedical research. The intended audience is the undergraduate and graduate students in the Department of nanoscience and technology as well as other departments (eg. biological sciences, chemistry, bioengineering, mechanical engineering), who wish to learn multidisciplinary optics in real-world applications as well as cutting-edge research.

### **NST553 Electrochemistry and Nanoscience**

Key topic areas of electrochemistry: 1. Electrostatics and Electrokinetics: The basics of Electrode potentials, Electrical Double Layers, Structure, Diffusion, Migration, and Reaction of the interfacial region. 2. Applications: Chemical Sensors. 3. Current hot topics related with electrochemistry in nanoscience.

### **NST554 In Vivo Imaging System**

This course will discuss the principle of modern biophotonic technologies to implement various in vivo imaging system with its current and future application for biomedical research by integrating nanotechnology.

### **NST555 Theoretical biophysics**

This course provides physical understanding of various biological functions, based on statistical mechanics and stochastic process. The main goal is to demonstrate how quantitative theoretical models explain current issues of cellular biology. In particular, non-equilibrium dynamics and fluctuations of biological processes will be emphasized.

### **NST556 Introduction to Imaging Techniques**

This course will introduce various techniques in optics and engineering for the implementation of imaging system. Principles of imaging optics, electrical circuit, signal and image processing and their practical applications for imaging system will be introduced.

### **NST557 Introduction to Soft Nanomaterials**

This is a course about the science of soft nanomaterials such as liquid crystals, biopolymers, biological membranes, polymers, block copolymers, molecular monolayers, colloids, nano-particles, and other soft nanomaterials.

### **NST559 Cell Signaling**

This course explores advanced topics in cell signal signaling related to cell proliferation, cell death, cell cycle, and so on. Some topics covered include the following: protein kinases and their function, phosphatases and their role in regulation, growth factor receptors and G-proteins, calcium and other second messengers, cell cycle and immune system signal transduction events, etc. A basic review of overall related researches will be provided, and current findings from the scientific literature will be discussed.

### **NST560 Introduction to BioMEMS**

BioMEMS can deliver selective, sensitive, fast, and low cost diagnostic and point-of-care methods. This course will introduce microfabrication, microfluidics, and MEMS/NEMS sensors. Students will learn principles of control of fluid and sensing at small scale, and also practice actual device fabrication.

### **NST561 Nanoscience of Solids**

Nanoscience of solid state materials emerges as important field of study to date. This is a descriptive course designed to introduce the students to recent developments in this important area of science as well as the fundamentals of solid state nanoscience.

### **NST562 Introduction to NanoPolymer Science**

This course aims to help students better understand contemporary polymer science focusing on syntheses and materials properties of polymers. In addition to considerations of fundamental topics, the course will cover relevant recent research such as controlled radical polymerization in depth.

### **NST563 Introduction to Crystallography**

Crystallography is essential to understand crystal structure of (nano)solids and its close relationship with important physical properties. This class will cover the basics of crystallographic science and provide students with theoretical understanding of how atoms and molecules are found in crystal space from diffraction data. Students will also learn the symmetry-related, physical properties

### **NST564 Special Topics in Block Polymers**

This course aims to provide basic and comprehensive knowledge of block polymer self-assembly. We will discuss fundamental physics of microphase separation of block polymers as well as essential chemistries for synthesis of block polymers in conjunction with related recent publications.

### **NST565 Introduction to Optical and Optoelectronic Components**

This course introduces basic concepts, internal physics, design issues, and practical applications of essential optical and opto-electronic components which are widely used from scientific experiments in labs to commercialized optical systems in industry. The main goal of this course is to provide deep understanding on physics and practically useful information which can be directly applied to the researches and experiments with optical and opto-electronic components.

### **NST566 Nanobiomedicine**

The course covers fundamental knowledge in medicine and biomedical science as well as their applications in the field of nanomedicine.

### **NST570 Special Topics in Nanoscience**

Nanoscience not only covers diverse areas from multiple discipline but also is quickly expanding its realm. This course will cover topics of cutting-edge nanoscience and technology, aiming for understanding fundamentals and applications of the technology.

**NST571 Nonequilibrium Statistical Mechanics**

The course is aimed to provide some understanding of non-equilibrium statistical mechanics by acquainting students with theoretical foundation of the theory and its applications to various physical phenomena. For instance, kinetic theory, linear response theory, the fluctuation-dissipation theorem, stochastic theory including Pokker-Planck equation, and fundamental aspects of nonequilibrium statistical thermodynamics will be covered.

**NST572 Soft Matter Nanostructure Analysis**

This is a course about the nano-structural analysis of soft matters such as liquid crystals, polymers, biopolymers, block copolymers, molecular monolayers, colloids, nano-particles, and other soft matters.

**NST635 Cancer Biology**

This course is a broad based overview of modern molecular and cellular cancer biology, including basic and clinic aspects. The course highlights multiple areas including signaling in tumor cells, oncogenes, viruses, tumor suppressors, apoptosis, metastasis, angiogenesis, epigenetics, epidemiology, hormones in cancer, immunology, prevention, molecular markers used in diagnosis and prognosis and therapeutic applications, including nanotechnology specific examples.

**NST717 Topics in Nanoscience and Technology**

This course is a survey of many different methods for depositing, and analyzing, thin films, in particular for semiconductor applications. Designed for graduate students who are starting work on thin-film related research, elementary knowledge of quantum mechanics, thermodynamics, and solid state physics is recommended

**NST960 M.S. Thesis****NST980 Ph.D. Thesis****NST966 M.S. Seminar****NST986 Ph.D. Seminar**