PHY-922 Nanophysics

Credit Hours: 3+0

Prerequisite: None

Course Objectives: Nanophysics is an introductory course for the students intending to do specialization in nanoscience and nanotechnology. The course includes brief introduction of materials at nanoscale, nature of matter at nanoscale, methods of making objects smaller, magnetization and magnetic susceptibility, quantum effects, density of states at low-dimensions, self-assembly of nanostructures, nanofabrication and microfabrication techniques, hard and soft ferromagnets, nanomagnetism and spintronics. The last section includes applications of nanomaterials in silicon nanoelectronics, quantum interference effects in Carbon nanotubes, single electron transistors, and magnetic data storage will be studied.

Core Contents: Limits of smallness, nanofabrication, nanoelectronics, nanomagnetism

Detailed Course Contents: The detailed contents are given in the table below along with week-wise breakdown.

Course Outcomes: The students shall be able to understand:

- the effect of smallness at the scale of nanometer
- the exotic nature of objects at the nanoscale
- self-assembly of nanomaterials
- physical routes of nanofabrication
- nanoelectronics and their understanding
- nanomagnetism and applications

Textbook:

1. Edward L. Wolf, Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Wiley-VCH, 2006. (referred as ELW)

2. Claire Dupas, Philippe Houdy, Marcel Lahmani, Nanoscience, Nanotechnologies and Nanophysics, Springer,2004. (referred as CD)

Reference Books: Neil W. Ashcroft, N. David Mermin, Solid State Physics, Harcourt College Publishers 1976.

Weekly Breakdown		
Week	***Section***	***Topics***
1.	ELW 1.1-1.8	Introduction
2.	ELW 2.1-2.6	Systematics of Making Things Smaller, Pre-quantum
3.	ELW 3.1-3.3.6	What are Limits to Smallness
4.	ELW 4.6.5-4.8	Quantum Nature of the Nanoworld
5.	ELW 5.1-5.6	Quantum Consequences for the Macroworld I
6.	ELW 5.7-5.10	Quantum Consequences for the Macroworld II
7.	ELW 6.1-6.9	Self-assembled Nanostructures in Nature and Industry
8.	ELW 7.1-7.7	Physics-based Experimental Approaches to Nanofabrication and Nanotechnology
9.	ELW 8.1-8.8	Quantum Technologies Based on Magnetism, Electron and Nuclear Spin, and Superconductivity I
10.	ELW 8.8-8.13	Quantum Technologies Based on Magnetism, Electron and Nuclear Spin, and Superconductivity II
11.	ELW 9.1-9.4.1	Silicon Nanoelectronics and Beyond
12.	ELW 9.5-9.9	Silicon Nanoelectronics and Beyond
13.	CD 14.1.1-	Nanomagnetism and Spin Electronics I

	14.1.3	
14.	CD 14.1.4- 14.1.5	Nanomagnetism and Spin Electronics II
15.	CD 14.2- 14.2.3	Nanomagnetism and Spin Electronics III