CERTIFICATE COURSE

DEPARTMENT OF PHYSICS

COURSE NAME: LFCCPHY02 Nano science and Technology

Objectives:

1. To understand the elementary concept s of Nanoscience.
2. Learn applications of quantum mechanics in Nanoscience.
3. To get an idea of fabrication and characterization techniques of nonmaterials.
4. To understand the different applications of nanotechnology.

Duration:30 Hours

Syllabus:

Module 1: Introduction

Length scales in Physics- nanometer- Nanostructures: Zero, One Two and Three dimensional nanostructures (Chapter 3, Text 2)
Band Structure and Density of State at nanoscale: Energy Bands, Density of States at low dimensional structures. (Chapter 3, Text 1)

Module 2: Growth techniques of nanomaterials (Elementary ideas only): **(9 hrs)**

Top down vs. bottom up techniques, Lithographic process, and Non Lithographic techniques: Plasma arc discharge, sputtering. Evaporation: Thermal evaporation, Electron beam evaporation. Chemical Vapour Deposition (CVD). Pulsed Laser Deposition, Molecular Beam Epitaxy, Sol-Gel Technique, Electro-deposition., Ball-milling. (Chapter 6, Text1)
(6.1,6.2.6.3,6.4.1,6.4.2,6.4.2.1,6.4.3,6.4.3.1.6.4.3.2,6.4.4,6.4.5,6.4.6,6.4.7,6.4.8,6.4.9)

Module 3: Characterization tools of nanomaterials : (10 hrs)

Scanning Probe Microscopy(SPM) : Basic Principles of SPM techniques, The details of STM, Tunneling current, local barrier height, local density of states. Some applications of STM. (Section 7.1.1 - 7.1.3.3, 7.1.3.5, Text 1), General concepts of AFM (Section7.2.1 – 7.2.4 Text 1), Electron microscopy (7.3.1-7.3.6, Text 1)

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Module 4: Applications of nanotechnology: (Elementary ideas only) **(6 hrs)**

Buckminsterfullerene, Carbon nanotube, nano diamomd, BN Nanotune, Nanoelectronics - single electron transistor (no derivation), Molecular machine, Nanobiomatrics (Chapter 8, Text 1).Applications of nanomaterials in energy, medicine and environment (Text 2)

Text books:

1. Introduction to Nanoscience & Nanotechnology by K. K. Chattopadhyaya and A. N. Banerjee, Publisher: PHI Leaming and Private Limited
2. Nanotechnology, Rakesh Rathi, S Chand & Company, New Delhi