MPHYEC- IH Nano Science

Course Objectives:

l . The course is to understand the basic knowledge on nanoscience and nanotechnology

2. Understand the various process techniques available of nanostructure materials.
3. Acquire the knowledge of various nano particles process methods
4. To enhance the various analytical technique to understand the nano properties and characteristics of nano materials.

The End Semester Examination will be of 3 hour duration and will carry 70 marks. The Question paper will be divided into three parts A, B and C. Part A will have ten compulsory questions (multiple choice type) covering the whole syllabus (10 X 2 = 20). Part B will have five short answer questions, with one question from each unit. The student is required to answer any four out of them (4 X 5 = 20). Part C will have five long answer questions with one question from each unit. The student is required to answer any three out of them (3 X 10 = 30).

Unit-I: Introduction and Basic Principles: Definition of Nanomaterials, Properties, Applications and Scope of Nano-science, Quantum size effect, Electron confinement in infinitely deep square well, confinement in one and two dimensional well, idea of quantum well structure, Quantum wells, quantum wires and Quantum Dots: Preparation and properties; Conduction electrons and dimensionality, Properties dependent on density of states. Carbon nanostructures: Fullerenes, structure, Superconductivity in C60, Carbon nanotubes: synthesis and structure, Electrical and Mechanical properties, Graphene.

Unit-2: Synthesis: Techniques for synthesis: Top down approach: Ball milling; Bottom up approach: Chemical methods of synthesis, RF Plasma and Pulsed Laser techniques, Biological methods: synthesis using microorganisms, and plant extracts.

Unit-3: Characterization Techniques: Characterization tools for nanomaterials: Thermal analysis:
DTA, DSC, TGA, dilatometry; Electrical measurements: LCR meter, electrometer amplifier; Optical, UV-Visible spectroscopy, IR spectroscopy, Ellipsometry, Raman Photoluminescence and spectroscopy, Atomic absorption spectroscopy, Structural characterization: X-ray Diffractometer; Magnetic characterization: Vibrating sample magnetometer; T EM, SEM, STM, AFM.

Unit-4: Magnetic Nanomaterials: Magnetic nanoparticle, multiferroic and smart materials, Elementary idea of NEMS and nanotransistors

Unit-5: Dielectric and Multiferroic materials: Theory of Dielectrics, Piezoelectricity, Ferroelectricity, Anti-Ferroelectricity and their applications, Nano-structured Ferroelectric materials, Synthesis and Characterization, techniques of Ferroelectric nano-materials, multiferroic and smart materials

Course Outcome:

At the end of this course, students will be able to

l. Basic knowledge of Nanoscience and nanotechnology
2. Under the basic idea about the nano structure
3. Impart the knowledge about the properties and characteristics techniques of nano materials