Course Title: **Physics of Nanomaterials**  
Level: B.Sc. (Applied Physics)  
Year: IV  
Course Code: **PHYS 403**  
Cr. Hrs : 3  
Semester : I

Course Objectives: The main objectives of course are to introduce the basic physics behind size and effect of nano materials and to understand the working principle of equipment used in nanostructures. In this course, students will gain knowledge of introduction to nanomaterials and their properties like magnetic, electrical, thermal and mechanical properties and growth techniques like plasma arc discharge, sputtering, chemical vapor deposition and sol-gel techniques. It also discusses tools like XRD, SEM, AFM etc. to characterize the nanomaterials and applications of nanomaterials.

1. **Nanotechnology**: Introduction, definition of nanotechnology, scope of nanotechnology, significance of nanosize and properties, classification of nanostructured materials, challenges and future prospects. [6 Hrs.]

2. **Unique Properties of Nanomaterials**: Microstructure and defects in nanomaterials, dislocations, twins, stacking faults and voids, grain boundaries, triple junctions and declinations, effect of nanodimension on material behavior, elastic properties, melting point, diffusivity, grain growth characteristics, solubility, magnetic, electrical, thermal and mechanical properties of nanomaterials. [8 Hrs.]

3. **Growth Techniques in Nanomaterials**: Introduction, top down and bottom up approaches, lithographic process and limitations, non-lithographic processes- plasma arc discharge, sputtering, evaporation, chemical vapor deposition, molecular beam epitaxy, sol-gel technique, electrodeposition, other techniques. [10 Hrs.]

4. **Tools to Characterize Nanomaterials**: X-ray diffraction, small angle X-ray scattering, scanning electron microscopy, atomic force microscopy, scanning tunneling microscope, field ion microscope, three dimension atom probe, nanoindentation. [10 Hrs.]

5. **Application of Nanomaterials**: Sectors influenced by nanomaterials- health, communication, energy, environment, safety, security and defense. [8 Hrs.]

6. **Nanostructured Materials with High Application Potential**: Quantum dots, carbon nanotube, fullerenes, GaN nanowires, nanocrystalline ZnO, nanocrystalline Titanium Oxide, multilayered films. [6 Hrs.]

Text Books


References


3. G. Cao, *Nanostructures and Nanomaterials*. Imperial College Press.
