PAPER-II (Special Paper) **Nanomaterials & Nanoscience**

UNIT-I: Nanomaterials

Introduction to Nanomaterials, classes of Nanomaterials, Motion of electrons in Bands, idea of quantum wells, wires and dots: Size and Dimensionality Effect, Density of states, Band structure in one, two and three dimensions,

Magnetic Nanoparticles: Classification of magnetic nanomaterial, Single domain particle, multi-domain particle, and nanoparticle, variation of magnetic parameters (e.g. Particle Magnetization, particle anisotropy, magnetic ordering temperature) with particle size.

UNIT-II: Synthesis & Charecterizations

Syntheses techniques: Bottom up: thermal evaporation, Cluster beam evaporation, ion beam deposition,hydrothermal method, Sol-gel techniques and Top down: Ball Milling techniques

characterization techniques: Field Emmisive Scanning Electron Microscopy (FESEM), Transimision Electron Microscope (TEM) , X-ray Diffraction (XRD), Energy Dispersive Spectroscopy(EDS), Optical Spectroscopic techniques FTIR, UV-Vis, Raman

UNIT III: Ion Beams in Nanotechnology

Ion solid interaction: Stopping and range of ions in solids, elastic collisions and Kinematics, Nuclear energy loss and Electronic energy loss, nano tract formation, Coulomb explosion model and Thermal spike model. Ion irradiation of surfaces, surface roughness, formation of nanopores, modifications of thin films by swift heavy Ion implantation /irradiation.

UNIT-IV: Heterostructures

General properties of Heterostructures. Growth of Heterostructures, Band Engineering, Layered structures: Quantum wells and Barriers, Doped Heterostructures, Strained Layers, Silicon-Germanium Heterostructures, Optical confinement, Effective mass Approximation, Effective mass theory in Heterostructures

References:

1. Introduction to nanotechnology, Charles P.Poole Jr Frank J. Owens
2. Ion implantation and synthesis of materials, M. Nastasi J.W.Mayer
3. Swift heavy ions for materials engineering and nanostructuring, Avasthi,Devesh Kumar, Mehta, Girijesh Kumar,Springer
3. Fundamentals of nanoscale film analysis, T. L. Alford, L.C. Feldman and J. W. Mayer, Springer USA, 2007.
4. Handbook of nano-structured materials and nanotechnology, Ed. H.S. Nalwa, Acad.

Press, CA, 2000.
5. Elementary solid state Physics, Ali Omer
6. Ferroelectrics and Anti-Ferroelectrics, W Kanzig
7. The Physics of low dimensional semiconductors, John H Davies, Cambridge University Press.