

GANPAT UNIVERSITY, FACULTY OF SCIENCE

Ph. D Course Work

Elective Paper: Physics

Condensed Matter Physics

Unit	Course Contents
01	Crystallography: X Rays production, origin and properties, diffraction of X rays, Bragg's law, Moseley's law, Ewald construction, X-ray diffraction methods (Laue, Single crystal & Powder), derivation of scattered wave amplitude, diffraction condition, scattering by an atom, Scattering by a unit cell, geometric structure factor and atomic form factor; Neutron diffraction –crystallography, Low Z element & Magnetic crystal structure determination; Low-energy electron diffraction – surface structure.
02	Dielectric Spectroscopy: Static dielectric constant, polarization, electronic and ionic polarizabilities, orientational polarization, dielectric constant, Lorentz internal field, dielectric constant of solids, Clausius-Mosotti relation, complex dielectric constant and dielectric losses, relaxation time, electronic polarization and optical absorption; ferroelectricity: dipole theory, polarization catastrophe; introduction to piezoelectricity.
03	Experimental Techniques: (a) Vacuum Technology: Rotary pump, Diffusion pump, Sputter – Ion pump, Sorption pump, Turbomolecular pump. (b) Analysis Techniques: Electron microscopy- Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM); Field Emission and Field Ion Microscopies (FEM & FIM), Application as Atom Probe, Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM). Rutherford Back Scattering (RBS), Positron Annihilation, PIXE, Auger electron spectroscopy (AES); X-ray Fluorescence Spectroscopy (XRF). Spectroscopy - X-ray Photoelectron spectroscopy (XPS); Ultra violet photo electron spectroscopy (UPS); X-ray emission (XES) and Absorption spectroscopy (XASXANES & EXAFS), Mossbauer Spectroscopy
04	Advanced Materials: Dielectric, Ferroelectric, Ferromagnetic, Multiferroic, Multi-functional ceramics, Transperent conducting oxides, Perovskite oxides, Thin films Nano Materials, Fullerenes, Nanoparticles, Carbon Nanotube, Quantum Dot, Nano crystals, Nano crystal solar cell.

Books Recommended

1. Introduction to Solid State Physics by Charles Kittel (8th Ed., Wiley Eastern, 2004).
2. Solid State Physics by N. W. Ashcroft and N. D. Mermin (2nd Ed., Holt-Saunders, 2000).
3. Solid State Physics by A.J. Dekker (Pan MacMillan, London, UK; Indian Edition by MacMillan India, 2000).
4. Principles of the Theory of Solids by J. M. Ziman (2 nd Ed., Cambridge Univ. Press 1972; Asian Ed., Cambridge Univ. Press – New Delhi 2011)
5. Introduction to Crystallography - M.J. Burger.
6. Introduction to Crystallography - F. C. Phillips.
7. Essentials of Crystallography - Y. Flint.
8. Solid State Physics - Saxena, Gupta and Saxena. Engineering Physical metallurgy - Y.Lakhtin
9. Solid State Physics - by R.L. Singhal, 7th Ed. Kedarnath Ramnath & Co.
10. Elements of X-ray diffraction, 2nd edition by B.D.Cullity, Addison Wesley Publ. Comp.Inc.(1978).