

MP-08 (C)
MATERIALS SCIENCE

(Questions will be set from each unit/section with internal choice)

| Units | Topics |
|-------|---|
| I | Phase Diagram and Phase Transformations: Phase rule, one and two component system. Eutectic and peritectic composition, Microstructural changes during cooling. The rule, Mg-Al, Cu-Zn, Fe-C systems (Phase diagrams), Time scale for phase change. The nucleation kinetics (Homogeneous and heterogeneous nucleation, solidification and crystallization, Glass transition. Idea of recovery and recrystallization, Hume Rothery rule for solubility. |
| II | Elastic and Inelastic Behaviour: Atomic model for elastic behaviour, Elastic deformation in single crystal, Elastic anisotropy, Elastic constants, and elastic moduli. (Cubic systems, isotropic body), Rubber like elasticity, Relaxation processes, idea of viscoelastic behaviour (Spring-Dashpot models), Elastic Waves in cubic crystals (100), (110) and (111) direction. |
| III | Diffusion and Thermal Properties: Crystallographic features, Diffusion of interstitial and vacancy, long distance motion, diffusion (I and II). The Kirkendall effect variation of diffusion coefficient with composition, Relation between atomic mobility and diffusivity, Isothermal and isochronal annealing, Double conductivity of insulator, Scattering mechanism of phonons, unklapp Processes, Thermal conductivity of metal, Hall effect in metal and semiconductors. |
| IV | Classification of Solids and Defects: Metallic, Ionic, Covalent, Molecular and van der Waal (vdW) bonds, ionic crystals, Madelung constant, Power method for structure determination, Forces and interaction between dislocations, jogs, Density of dislocation. Methods for detecting dislocations. |
| V | Magnetic and Dielectric Properties: Quantum numbers (LS and JJ coupling), Hund's rule, Magnetic moment of all iron, (rare earth and iron group). Bohr magnetism, exchange interaction, soft magnetic materials, Fermi magnets, two sublattice model of antiferromagnetism, Idea of super exchange interaction, Neel's theory of ferromagnetism, Classical theory of electronic polarization and optical absorption, idea of dielectric breakdown Claussius-Mosseti equations General properties of ferroelectric materials, Dipole theory of Ferroelectricity. |