MP-06
SOLID STATE PHYSICS AND MATERIALS SCIENCE

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

Unit	Topics
I	**Lattice Dynamics and Polarisation** Lattice vibration of monoatomic and diatomic lattice; specific heat of solids, anharmonicity and expansion of solids, Equation of state of solids, phonon mean free path in solids, Elastic waves, Microscopic and macroscopic description of the dielectric behaviour. Polarisation and dielectric constant, Electronic, Ionic, Atomic and orientational polarisation, Lorentz internal field, static dielectric constant of solids, complex, dielectric constant. Dielectric losses and relaxation time, Debye equations.
II	**Band Theory of Solids** Behaviour of electron gas in one dimension, density of states, chemical potential, paramagnetism, of free electrons, Hall effect, Fermi energy, Bloch's theorem, Kronig-Penny model, concept of the hole and effective mass, Distinction between conductor, insulator and semiconductor and intrinsic and extrinsic conductivity.
III	**Magnetism** Element ideas of diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic, ferrimagnetic and fermites, Quantum theory of para and ferromagnetism. Origin of magnetic domins. Simple theory and experimental description of Nuclear Magnetic Resonance (NMR) and Electron Paramagnetic Resonance (EPR), Mossbaurer effect and its application in determination of the nature of interatomic forces in crystalline solids with special reference to impure crystal.
IV	**Defects in Crystals** Point defects in ionic crystals and metals, Diffusion, ionic conductivity, colour centres (F and V centres), Excitons. General idea of luminescence, Dislocations and mechanical strength of crystal. Plastic behaviour, Types of dislocations, Stress field of dislocation. Grain boundaries, Ething-types of ething.
V	**Elements of Thin Films** Concept of thin films, Electrical conduction in thin films. Deposition of thin films by thermal evaporations, cathodic sputtering, Evaporation at reduced pressure, Thickness measurement (four probe method, multiple beam interferrometry). Size effect, behaviour, Fuchs-Sondheimer model (without derivation).