SEMESTER VI

PHY(N)-302 ELEMENTARY SOLID STATE PHYSICS CREDIT: 3

BLOCK 1 Crystal Structure

Unit –1: **Crystal structure:** Crystalline and amorphous solids, single crystal and poly crystal, elementary ideas about crystal structure, lattice and bases, unit cell, Bravais lattices, SC, BCC and FCC lattices, characteristics of lattices cell, some crystal structures.

Unit –2: **Crystal symmetry:** Miller indices, lattice planes, spacing of planes in crystal lattices, symmetry operation, translational symmetry, basic idea about liquid crystal.

Unit –3: **Reciprocal lattice**: X ray diffraction, Bragg equations, Determination of crystal structure with X-rays, Laue and Powder method, Reciprocal lattice system, Ewald's construction.

Unit –4: **Crystal bonding**: Crystal bonding, ionic crystal, potential and lattice energy of ionic crystal, Madelung constant, covalent bonding, Van der wall bonding, Lenard Jones potential, hydrogen bond, metallic bond.

BLOCK 2 Band theory of solids

Unit –5: **Free Electron theory:** Free electron theory of metals, Lorentz Drude theory, electrical conductivity, thermal conductivity. Wiedemann-Franz law

Unit –6: **Band theory of solids:**Band formation in solids, Band structure in conductors, Periodic potential and Bloch theorem, Kronig-Penny model, origin of band gap

Unit –7: **Semiconductors:** Semiconductors, effect of impurity on semiconductor, Fermi level, Electron and hole concentration, drift current, mobility and conductivity, Effective mass, Hall effect.

BLOCK3 Lattice vibrations and Specific heat

Unit –8: **Lattice vibrations:** Elastic and atomic force constants, quantization of lattice vibrations, Dynamics of a chain of monoatomic lattice, optical and acoustic modes, dispersion relation, concept of phonon, comparison of phonon and photons.

Unit –9: **Specific heat:** Specific heat of solids, Dulong and Pettit's law, lattice heat capacity, Einstein theory of specific heat, Debye's theory of specific heat, Density of state , lattice thermal conductivity, normal and Umklapp processes, Para magnetism of free electrons.

BLOCK 4: Dielectric and Magnetic properties of materials

Unit –10: **Dielectricproperties:** Electronic, ionic and dipolar polarizability, local fields, induced and oriented polarization, molecular field in a dielectric; Clausius-Mossotti relation.

Unit –11: **Magnetic properties:** magnetization,magnetic materials, Dia, para and ferro-magnetic properties of solids, magnetic moment, spin angular moment, Langevin's theory of diamagnetism and Para magnetism, Quantum theory of Para magnetism, Curie's law,

Unit –12: **Ferromagnetism**: Ferromagnetism, hysteresis and hysteresis loss, permanent magnet, spontaneous magnetization and domain structure, Weiss theory of ferromagnetism, anti-Ferromagnetism, ferrites, use of ferrites.

BLOCK 5: Superconductivity

Unit –13: I**ntroduction**: (Kamerlingh-Onnes experiment), effect of magnetic field, Type-I and type-II superconductors, Isotope effect, Meissner effect, Heat capacity, Energy gap, Quantum theory of superconductor, BCS theory, Basic Ideas about High-Tc superconductors, application.