PH-9101 **Condensed Matter Physics-I**

L	T	P	C
4	1	0	5

Course Outcomes:
After successful completion of the course, the students should be able to

CO1: Explain the significance and value of condensed matter physics, both scientifically and in the wider community

CO2: Relate crystal structure to symmetry, recognise the correspondence between real and reciprocal space and describe x-ray diffraction using the reciprocal lattice.

CO3: Use models to calculate dispersion relations and able to find the thermal properties of solids.

CO4: To describe and explain the properties associated with dielectric and ferroelectric materials.

CO5: To explain various magnetic phenomena and describe the different types of magnetic ordering based on the exchange interaction.

CO6: Understand the phenomenon of superconductivity and their properties in order to their applications.

CO/PO Mapping
S-strong, M-medium and W-weak indicate the strength of correlation

COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	W	W	W	W	S	S	S	S		
CO2	S	M	S	M	M	W	W	S	M	W	M	S
CO3	S	M	M	M	S	S	S	S	S	M	S	S
CO4	S	S	S		S	S	W		M	S	W	M
CO5	S	W	S	S	S		S	S		M	S	M
CO6	S		S	S	S		S			S		M

w.e.f. July, 2021

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UNIT I

Crystal Physics, Reciprocal Lattice and X-ray diffraction: Crystal solids, unit cells and space lattice, Bravais lattices, Crystal structures-sc; bcc ; fcc ; hcp, NaCl, ZnS and diamond structure, crystal planes and Miller indices, Inter planar spacing, Atomic packing factor, close packed structures, symmetry elements in crystals, point groups and space groups.

Reciprocal lattices and its applications to diffraction techniques, Brillouin zones, Diffraction of X-rays by lattice, the Laue equation, Bragg 's law, Ewald construction, experimental diffraction techniques- powder X-ray diffraction technique, indexing of powder photographs and lattice parameter determination, applications of powder method, general concept of atomic scattering factor and crystal structure factor. **20Hrs**

Lattice Dynamics and thermal properties: Lattice waves, Vibrations of one –dimensional mono and diatomic lattice, Phonon dispersion, phonon momentum, density of normal modes in one and three dimensions, quantization of lattice vibrations, Normal and Umklapp process, Einstein and Debye's model of specific heat, Thermal expansion, Thermal conductivity. **10Hrs**

UNIT II

Dielectric and Ferroelectric Properties: The Dielectric constant and polarizability, Clausius-Mossotti relation, Measurement of dielectric constant, Dipolar polarization in solids, Ionic polarizability, electronic polarizability, Ferroelectricity, Ferroelectric domain. **12Hrs**

Magnetic and Superconducting properties: Fundamental concepts, Atomic theory of magnetism, Langevin's classical theory of diamagnetism and paramagnetism, quantum theory of paramagnetism, Ferromagnetism, Weiss molecular (exchange) field, Curie-Weiss law, Ferri and Anti Ferro-magnetic order. Anisotropic energy.
Occurrence of superconductivity, Meissner effect, Type-I and Type-II superconductors, Heat capacity, Energy gap, Isotope effect, London equation, Coherence length, Postulates of BCS theory of superconductivity, flux quantization, Josephson effect, High temperature superconductors. **18Hrs**

Total: 60Hrs

BOOKS:

1. Introduction to Solids by L.V. Azaroff
2. Crystallography for Solid State Physics by Verma and Srivastava
3. Solid State Physics by C. Kittel
4. Solid State Physics by M.A. Wahab
5. Elementary Solid State Physics by M. A. Omar
6. Crystal Structure Determination by G.H. Stout, L.H. Jensen
7. The Solid state by H.M. Rosenberg
8. Elements of solid state physics by J. P. Srivastava (Prentice Hall India; 2nd edition)

c/BOS

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