

17BSP502					Solid State Physics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

**COURSE OBJECTIVES**

- ☐ To understand the chemical bond and nature of solids.
- ☐ To acquire concept of crystalline lattices, crystal structure and its determination techniques.
- ☐ To understand the basic knowledge of phonons, estimates of their dispersive and thermal properties
- ☐ To understand the origin of the energy bands in solids and basic notions on their calculation
- ☐ To understand the Electrical, Optical and Magnetic properties of Solid.

**UNIT 1 Crystal Structure and Diffraction****14 Hrs.**

Introduction, Crystalline and amorphous materials – crystal systems – Bravais lattices – Miller Indices – Symmetric elements – symmetric groups – reciprocal lattice – Brillouin zone – point, line, surface and volume defects – colour centers – crystal bindings – ionic bond, covalent bond, molecular bond, hydrogen bond, metallic bond & Van der waals bond.  
Diffraction of X-rays: Bragg's Law – experimental methods in X-ray diffraction – Laue method – rotating crystal method – powder photograph method.

**UNIT 2 Lattice Vibrations and Thermal Properties****12 Hrs.**

Lattice dynamics: Concept of phonons – momentum of phonons – normal and Umklapp processes – vibrations of one dimensional monatomic and diatomic linear lattices.  
Thermal properties: Theories of specific heat – Dulong and Petit's law – Einstein's theory & Debye's theory – Weidemann-Franz law.

**UNIT 3 Conductors and Semiconductors****12 Hrs.**

Conductors: Free electron theory – Classical and quantum theory – band theory of solids – density of states – K-space – Bloch functions – Kronig Penny Model.  
Semiconductors: Types – carrier statistics in intrinsic and extrinsic semiconductors – electrical conductivity – Hall Effect – electronic specific heat.

**UNIT 4 Super conducting, Optical, Dielectrics and Magnetic Materials****20 Hrs.**

Superconductors: Properties – BCS theory – flux quantization – Josephson effects (AC & DC) - high T<sub>c</sub> superconductors – applications.  
Optical Materials: Optical absorption, colourcentres, Trap, recombination, excitons, Photoconductivity, luminescence  
Dielectrics: Macroscopic electric field – local electric field – dielectric constant and polarizability – Clausius-Mossotti equation – measurement of dielectric constant.  
Magnetic Materials: Types: dia, para, ferro, ferri and antiferrimagnetic materials – hysteresis curve – susceptibility measurement: Guoy balance, Quincke's method – quantum theories of para and ferro magnetism – Curie point and exchange integral – Curie temperature & Neel temperature (definitions) – magnons – domain theory.

**Max. <58> Hrs.****COURSE OUTCOMES**

- CO1: Students will be able to analyze different types of matter depending on the nature of chemical bonds and their properties.  
CO2: Students will be able analyze the crystal structures by applying crystallographic parameters and determine crystal structure by XRD data.  
CO3: Students will be able to analyze the lattice vibration phenomenon in the solids.  
CO4: Students know what phonons are, and be able to perform estimates of their dispersive and thermal properties.  
CO5: Students will be able to calculate thermal and electrical properties in the free-electron model.  
CO6: Students will be able to evaluate and analyze the electrical optical and magnetic properties of solids

**TEXT/REFERENCE BOOKS**

- Elements of Solid State Physics, By J.P. SRIVASATAVA, PHI Learning PVT. LTD., 2014.
- Introduction to Solid State Physics, Charles Kittel, John Wiley & Sons, 2019.
- Solid State Physics, S. O. Pillai, Wiley Eastern Ltd., 2006.
- Solid State Physics, A.J. Dekker, Prentice Hall of India 1985.
- Solid-State Physics: Introduction to the Theory, James D. Patterson, Bernard C. Bailey, Springer International Publishing, 2018.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max. Marks: 100****Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks

36 Marks

Part B/Question: 2 Questions from each unit, each carrying 8 marks

64 Marks

