Sem.	Subject code	Course title	No. of hours	Credits	Paper type
VI	17U6PME3	Solid state physics	5	6	Major Elective

Objectives:

(i) To introduce the students to bonding in solids, crystal structures and symmetry in crystals. (ii) To inculcate basic understanding of the electrical, thermal and magnetic properties of solid state systems.

Learning outcome:

(i) The student will understand the bonding in solids. (ii) They will acquire knowledge about the crystal structure and X-ray diffraction analysis of crystals. (iii) They will understand the physics that influences the presence of charge carriers in semiconductors. Learn the factors that influence the superconductivity in solids. (iv) They will gain knowledge of electrical, thermal and magnetic properties of solids. (v) They will know how to apply appropriate laboratory techniques to measure properties of semiconductors and metals.

Unit I: Bonding in solids

Bonding in solids–Ionic bonding–Bond energy of NaCl molecule–Calculation of lattice energy of ionic crystals–Calculation of Madelung constant of ionic crystals–Properties of ionic solids–Covalent bond–Directional nature of covalent bond–Hybridization–Properties of covalent compounds–Metallic bond–Properties of metallic crystals– Hydrogen bond.

Unit II: Crystal physics

Unit cells and lattice parameters–Unit cell versus primitive cell–Crystal systems–crystal symmetry–Twenty three elements in a cubic crystal–Non compatibility of five fold rotation axis with a lattice–Combination of symmetry elements–Rotation inversion axis–Translation symmetry elements–Bravais lattices–Metallic crystal structure–Other cubic structures–ZnS, NaCl, CsCl–Directions, planes and Miller indices–Important features of miller index crystal planes–X-ray Diffraction–Bragg's law– Bragg's X-ray Spectrometer.

Unit III: Electrical Properties of materials

Introduction–A survey of superconductivity–Mechanism of superconductors–Effect of magnetic field–Flux exclusion: the Meissner effect–Type I and type II superconductors–Physics of semiconductors–Introduction–The band structure of semiconductors–Semiconductors–Intrinsic semiconductors–Electrical conductivity–Extrinsic semiconductors–Hall effect–Advantages of semiconductor devices.

Unit IV: Thermal Properties of materials

Lattice specific heat–Classical theory (Dulong and petit's law)–Einstein's theory of specific heat–Debye's theory of specific heat.

Unit V: Magnetic Properties of materials

Introduction–Magnetic permeability–Magnetization–Bohr magneton–Electron spin and magnetic moment– Diamagnetism– Langevin theory- Paramagnetism–Ferromagnetism– Domain model-Magnetic hysteresis.

Text book(s):

1. Solid state Physics, S.O. Pillai, Rev. 7th edition, New Age International Pub.,India, (2015).

Unit I: Chapter 3: V-IX, XIIII, XIV, XVII – XX, XXIV.

Unit II: Chapter 4: IV-XII, XIV, XV, XVII, XVIII, XIX.
Chapter 5: VII, VIII, IX.
Unit III: Chapter 8: I to IV, VII, XIII.
Chapter 10: I to IV, VII, VIII, XIV, XV.
Unit IV: Chapter 7: (full).
Unit V: Chapter 9: I to IV, VII, IX, XI, XIX, XXVII.

Books for reference:

1. Solid state Physics, Kakani & Hemaranjani, Reprint, S.Chand & Co. India, (2005).
2. Solid state Physics, R. L. Singhal, VIth Edn., Kedarnath Ramnath & Co., India, (2006).
3. Solid state Physics, C. Kittel, VIIth Edn., Wiley & Sons, India, (2007).

Websites:

1. http://www.physics.udel.edu/~bnikolic/teaching/phys624/lectures.html
2. https://ocw.mit.edu/courses/physics/8-231-physics-of-solids-i-fall-2006/index.htm