ST.JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

VII SEMESTER **PHYSICS** TIME:3Hrs/week
PH7404(4) **SOLID STATE PHYSICS (Skill Oriented)** Max.Marks:100
w.e.f. 20AH Batch **SYLLABUS**

Course Objectives:

- *To provide students with a strong foundation of theory of crystallography, defects in crystals, transport phenomena, semiconductors and superconductivity and prepare them for careers in academic or industrial research.*

Course Outcomes:

Upon the successful completion of the course, students will be able to:

- CO1: Explain the structure of crystals using Bravis lattices, types of binding and binding forces, elastic properties of crystals, lattice vibrations and phonons.
- CO2: Discuss various types of defects in crystal structures, and their effects on material properties and behavior.
- CO3: Outline the significance of transport phenomena and distinguish metals, insulators and semiconductors based on band theory.
- CO4: Describe the nature of intrinsic and extrinsic semiconductors, fermi levels and its variation with temperature and direct and indirect band gap semiconductors.
- CO5: Summarize the concepts of superconductivity and analyze the potential applications of superconductors.

SYLLABUS

UNIT–I: Crystallography, Lattice Energies and Lattice Vibrations 12 Hrs

Bravais lattices – Reciprocal lattice –X-ray diffraction – structural factor. Origin of chemical binding in ionic and van der Waals crystals – Elastic properties – Stress and strain –Elastic moduli -

– Lattice vibrations: Mono and diatomic one dimensional infinitely long lattices – Phonons – properties.

UNIT-II: Defects in Crystals 12 Hrs

Impurities-vacancies-Schottky and Frenkel vacancies-Extrinsic vacancies- Kirkendall effect-Color centers and colaration of crystals – F-Centers, V-Centers, Line Defects (the dislocations)-Geometry of dislocations, Screw dislocations

UNIT– III: Transport Phenomena and Band Theory 14 Hrs

Concept of electrical and thermal resistivity – Expression for thermal and electrical conductivities for metals – Lorenz number - Matheissens rule- Distribution function – Formulation of Boltzmann transport equation

Bloch function –Kroning - Penny model – Formation of energy bands in solids – Brillouin zones

UNIT–IV: Semiconductor Physics 12 Hrs

Intrinsic and extrinsic semiconductors–Expression for position of Fermi levels and carrier concentrations – Variation of Fermi level with temperature – np product – Direct and indirect band gap semiconductors–Hall effect Heyness- Schockley experiment – Determination of lifetime, diffusion length of minority charge carriers.

UNIT–V: Superconductivity 13 Hrs

Concept of zero resistance – Magnetic behavior– Meissner effect – Isotope effect – Specific heat behavior – London's equations – BCS theory –Josephson junctions – SQUIDS and its applications - Applications of superconductors –High TC superconductors

List of Activities:

1. Assignments
2. Student Seminars

Recommended Books

1. Elementary Solid State Physics, M. Ali Omar, 1993, Addison - Wesley.

2. Solid State Physics, M. A.Wahab, Edition: 3rd, 2020, Narosa Publishing House.

3. High TC Superconductivity, C.N.R. Rao and S.V. Subramanyam, world scientific publishing company, 1989

4. Solid State Physics, S.O. Pillai. Edition: 6th, 2009, New Academic Science Ltd

5. Solid State Physics, S.L. Kakani and C. Hemarajan, Edition: 4th, 2005, Sultan Chand and Sons

6. Electrons in Solids, Richard H. Bube, Edition 3rd, 1992 Elsevier,

7. Solid State Physics by R.K. Puri V.K. Babbar Edition: 1st 2017. S. Chand.

Reference Books

1. Solid State Physics, C. Kittel, Edition: 8th 2012, John Wiley & Sons.

2. Solid State Physics, A.J. Dekkar, Edition: 1st, 2000. Macmillan India Ltd.

3. Solid State Electronic Devices, B.G. Streetman. Edition 7th, 2018, Pearson Education India