

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN PHYSICS
SYLLABUS WITH EFFECT FROM 2020-2021

BPS-CSC16

CORE-XVI: SOLID STATE PHYSICS
(Common to B.Sc. Physics with Computer Applications-V Sem.)

Lecture: 60 Hours

Tutorial: 15 Hours

Credits:4

Course Objectives:

- To understand the fundamental concepts of crystal structure.
- To analyze the crystal structure using X-ray diffraction methods.
- To acquire knowledge on the basics of magnetic phenomena on materials and various types of magnetization.
- To learn the properties of superconducting materials.

Learning Outcomes:

- Helps as pre-requisite for understanding materials science, nano science, etc.
- Gives relationship between structure and properties of the solid state systems.
- To understand the importance of superconducting materials in engineering applications.
- To understand the different types of bonding in solid substances.
- To understand the magnetic and dielectric properties of crystalline structures.

UNIT I: CRYSTAL STRUCTURE

Crystal lattice – Primitive and Unit cells – Bravais lattices: Two Dimensional and Three Dimensional Bravais lattices – Miller Indices – Structure of Crystals – Close Packing: Hexagonal close packing and Cubic close packing – Sodium chloride structure, Zinc Blende structure, Diamond structure.

UNIT II: X RAY DIFFRACTION AND DEFECTS IN SOLIDS

X ray diffraction – Bragg's law – Van Laue equations- Experimental methods: Laue method, Powder crystal method and Rotating crystal method.

Defects in solids - Point defects - Frenkel and Schottky defects – Equilibrium concentrations - Line defects - Edge dislocation and Screw dislocation - Surface defects - Grain boundary - Effects of Crystal imperfections.

UNIT III: CHEMICAL BONDS

Interatomic forces – Condition for bonding - Different types of chemical bonds - Ionic bond – Cohesive energy of Ionic Crystals and Madelung constant - Born Haber cycle-Covalent bond - Metallic bond - van der Waals bond - Hydrogen bond.

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UNIT IV: DIELECTRIC PROPERTIES

Dielectric materials - Polarization, Susceptibility and Dielectric constant - Local field or Internal field - Clausius - Mossotti relation - Sources of Polarizability– Electronic Polarizability–Ionic Polarizability–Orientational Polarizability - Frequency and temperature effects on polarization - Dielectric Breakdown – Properties of different types of Insulating materials.

UNIT V: MAGNETISM AND INTRODUCTION TO SUPERCONDUCTORS

Different types of magnetic materials - Classical theory of Diamagnetism (Langevin theory) - Langevin theory of Paramagnetism - Weiss theory of Para magnetism– Heisenberg interpretation on Internal field and Quantum theory of Ferromagnetism –Antiferromagnetism- Hard and soft Magnetic materials.

Superconductivity - General properties –Critical Temperature and Critical Magnetic field - Type I and II Superconductors –Meissner effect - BCS theory - Applications of Super conductors.

Books for Study

1. Introduction to Solid State Physics ,Kittel, Willey Eastern Ltd (2003).
2. Solid state Physics, Rita John ,1st edition, TataMcGraw Hill publishers (2014).
3. Solid State Physics , R L Singhal, Kedarnath Ram Nath& Co., Meerut (2003).

Books for Reference

1. Solid State Physics ,S.O.Pillai, New Age International (P) Ltd.,(2002).
2. Solid State Physics , A. J.Dekker, Macmillan India(1985).
3. Solid State Physics , HC Gupta, Vikas Publishing House Pvt. Ltd., New Delhi (2001).
4. Materials Science and Engineering , V. Raghavan, Prentice Hall of India Private Limited, New Delhi(2004).
5. <https://nptel.ac.in/courses/115105099/>
6. <https://nptel.ac.in/courses/115106061/>