**CURRICULUM PLAN OF Ms. VARSHA**

**FOR ODD SEMESTER 2024-25**

**B.Sc (H) -2nd YEAR**

**PAPER- (GE) SOLID STATE PHYSICS (4 PERIODS/WEEK)**

**LEARNING OBJECTIVES**

This course introduces the basic concepts and principles required to understand the various

properties exhibited by condensed matter, especially solids. It enables the students to

appreciate how the interesting and wonderful properties exhibited by matter depend upon its

atomic and molecular constituents. It also communicates the importance of solid-state physics

in modern society. Emphasis should be given to the applications and uses of solids.

**LEARNING OUTCOMES**

On successful completion of the module students should be able to,

 Elucidate the concept of lattice, basis and symmetry in crystals. Learn to appreciate

The structure and symmetry of solids.

 Understand the elementary lattice dynamics and its influence on the properties of

materials.

 Describe the main features of the physics of electrons in solids: origin of energy bands.

 Introduction to dia-, para-, ferri and ferromagnetic properties of solids and their

applications.

 Introduction to dielectric properties exhibited by solids and the concept of polarizability.

 Introduction to superconductivity.

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| CONTENTS | ALLOCATIO N OF  LECTURES | MONTH WISE SCHEDULE  FOLLOWE D | TUTORIAL/ASSIGNMENT/PRESENTATIO N ETC |
| **UNIT – I**  Review of Atomic Structure and bonding in solids: Classification of matter as solid, liquid  and gas: salient features and properties, Qualitative discussion on Rutherford Model and Bohr  model of atom, qualitative idea about discrete energy levels, wave-mechanical concept of the  atom, forces between atoms, Ionic bonding, covalent bonding, metallic bonding, Hydrogen  bonding and Van der Waals bonding, Properties of solids exhibiting different bonding.  **Crystal structure:** Periodicity in crystals: lattice points and space lattice, translational,  rotational and reflection symmetry elements, lattice with a basis and crystal structure, unit  cells and lattice parameters, Bravais lattices (in 2D and 3D) and crystal systems SC, BCC  and FCC lattices, conventional and primitive unit cell, Wigner Seitz unit cell. | **10** LECTURES | 1st Aug. – 30th Aug 2024 | Syllabus Overview  Reference books  Building concepts  Problem solving Derivations and Numericals |
| amorphous and  crystalline materials. Planes, Miller Indices, directions, density of atoms in different planes,  interplanar spacing, concept of Reciprocal Lattice, Brillouin Zones (2 D lattice). Atomic Packing and Imperfections in crystals: Packing of spheres in 2D and 3D, hexagonal  close packing, packing fraction of SC, FCC, and BCC. Point defects and line defects and  their consequences on the crystal properties  X-rays: Their generation and properties, Bragg‟s law and Laue Condition, single crystal  method and powder diffraction method, simple problems related to X-Ray diffraction in SC,  BCC, FCC. | **11** LECTURES | 1st Sept. – 30th Sept. 2024 | Related Problems and assignments  Student’s difficulties  Derivations and Numericals  Class test on unit end |
| **UNIT – II**  Elementary Lattice Dynamics: Lattice vibrations and phonons: linear monoatomic and  diatomic chains, acoustic and optical phonons, qualitative description of the phonon spectrum  in solids.  **UNIT – III**  Electrical properties of metals: Free electron theory of metals (Drude model), its success and  drawbacks, concept of relaxation time, collision time and mean free path, electrical  conductivity, mobility and Ohm‟s law, thermal conductivity of metals, Wiedemann-Franz-  Lorentz law.  Band Theory: The Kronig-Penney model (Qualitative idea), Band Gap, direct and indirect  bandgap, concept of effective mass, Hall Effect (Metal and Semiconductor).  Optical properties of solids: (Qualitative) Absorption process, transmission and reflectance in  solids. Discussion on photoconductivity, photoluminescence. | 14 lectures | 1st Oct – 30th Oct. 2024 | Discussion of Important questions  Home  Register Checking  Class Test Revision Session  Assignment given for IA  Home exam paper discussion |
| **UNIT – IV**  Magnetic Properties of solids: Dia-, Para-, Ferri- and Ferro- magnetic Materials, definition in  terms of susceptibility.Weiss‟s Theory of FerromagnetismandFerromagnetic Domains  (qualitative treatment only),B-H curve, soft and hard material and their  applications(discussion only) as cores in generators, transformers and electromagnets, energy  lossin Hysteresis curve.  **UNIT – V**  Dielectric Properties of solids: Dipole moment, polarization,local electric field in solids.  Depolarization field, electric susceptibility, various sources of polarizability,piezo-, pyro- and  ferroelectric materials and their applications(discussion only) as transducers, pickups,  sensors, actuators, delay lines.  **UNIT – VI**  Superconductivity: (Qualitative treatment only) Experimental Results. Critical Temperature.  Critical magnetic field.Meissner effect. Type I and type II Superconductors, applications of  superconductors. Discussion on applications in MRI, particle collider, power transmission,  magnetic levitation etc. | 10 lectures | 1st Nov. – 27th Nov. 2024 | Discussion of last year papers and clarification  of doubts  Revision of Syllabus  Home register Checking |

**References:**

**Essential Readings:**

1) Solid State Physics, M. A. Wahab, 2015, 3rd Ed,Narosa Publications.

2) Solid State Physics, S. O. Pillai, New Age International Publishers

3) Introduction to Solid State Physics, Charles Kittel, 8thEd., 2004, Wiley India Pvt. Ltd.

4) Elements of Solid State Physics, J. P. Srivastava, 2ndEd., 2006, Prentice-Hall of India.

5) Solid State Physics, A. J. Dekker, 2008, Macmillan Education.

**Additional Readings:**

1) Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill.

2) Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning.

3) Elementary Solid State Physics, M.Ali Omar, 2006, Pearson

4) Solid State Physics, Rita John, 2014, McGraw Hill

5) Superconductivity: A Very short Introduction – Stephen J Blundell - Audiobook