

Govt. P. G. College, Ambala Cantt

Course File: (Session 2023-24)

Name of Professor: Dr. Priyanka

Class: B.Sc.-III (NM& CS), Semester – VIth

Subject code and Name: Physics (PH-601), Paper – XI : Solid State and Nano Physics

Syllabus

Max. Marks: 40

Internal Assessment: 10

Time: 3 hours

Note:- 1. Nine Questions will be set in total. 2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief but not in Yes/ No. 3. For more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.

Unit I: Crystal Structure : Crystalline and glassy forms, liquid crystals, crystal structure, periodicity, lattice and basis, crystal translational vectors and axes. Unit cell and Primitive Cell, Wigner Seitz primitive Cell, symmetry operations for a two dimensional crystal, Bravais lattices in two and three dimensions. Crystal planes and Miller indices, Interplaner spacing, Crystal structures of Zinc Sulphide, Sodium Chloride and Diamond.

Unit II: Crystal Structure II X-ray diffraction, Bragg's Law and experimental X-ray diffraction methods. K-space and reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal lattice to a simple cubic lattice, b.c.c. and f.c.c.

Unit III: Super conductivity Historical introduction, Survey of superconductivity, Super conducting systems, High T_c Super conductors, Isotopic Effect, Critical Magnetic Field, Meissner Effect, London Theory and Pippards' equation, Classification of Superconductors (type I and Type II), BCS Theory of Superconductivity, Flux quantization, Josephson Effect (AC and DC), Practical Applications of superconductivity and their limitations, power application of superconductors.

Unit IV: Introduction to Nano Physics Definition, Length scale, Importance of Nano-scale and technology, History of Nantechnology, Benefits and challenges in molecular manufacturing. Molecular assembler concept, Understanding advanced capabilities. Vision and objective of Nano-technology, Nanotechnology in different field, Automobile, Electronics, Nano-biotechnology, Materials, Medicine.

Course Objectives:

1. To understand the fundamental concepts of crystal structure.
2. To analyze the crystal structure using X-ray diffraction methods.
3. To have an insight to Superconductivity and the underlying properties.
4. To understand (i) the influence of dimensionality of the object at nanoscale on their properties; (ii) size and shape controlled synthesis of nanomaterials and their future applications in industry.

Course Outcomes:

After successfully completing the course, student will be able to:

CO-1 Have a brief idea about crystalline and amorphous substances, about lattice, unit cell, primitive cell, miller indices, Bravais lattices in two & three dimensions and crystal structures of Zinc Sulphide, Sodium Chloride and Diamond.

CO-2 Acquired knowledge about X-ray diffraction, Bragg's Law and experimental, X-ray diffraction methods and about the reciprocal lattice to a simple cubic lattice, b.c.c. and f.c.c. lattice.

CO-3 Acquired knowledge about Brillouin zone.

CO-4 Understand the basic idea about superconductors, their classifications and practical applications, the BCS theory, London equation etc.

CO-5 Understand the effects of quantum confinement on the electronic structure and corresponding physical and chemical properties of materials at nanoscale.

CO-6 Understand synthesis technique to synthesize quantum nanostructures of desired size, shape and surface properties.

CO-7 Appreciate enhanced sensitivity of nanomaterial based devices and their novel applications.

Lesson Plan

S.No.	Date	Topic
1.	8 th Jan 2024-13 th Jan2024	Unit III: Super conductivity: Historical introduction, Survey of superconductivity, Super conducting systems,
2.	15 th Jan 2024-20 th Jan2024	High Tc Super conductors, Isotopic Effect, Critical Magnetic Field, Meissner Effect, Numericals
3.	22 th Jan 2024-27 th Jan2024	London Theory and Pippards' equation, Classification of Superconductors (type I and Type II), BCS Theory of Superconductivity, Flux quantization. Discussions and Problems
4.	29 th Jan 2024-3 rd Feb2024	Josephson Effect (AC and DC), Practical Applications of superconductivity and their limitations, power application of

		superconductors. Class Test & Assignment -1
5.	5 th Feb 2024- 10 th Feb 2024	Unit IV: Introduction to Nano Physics: Introduction to Nano Physics Definition, Length scale, History of Nanotechnology, Importance of Nano-scale and technology, Size dependence properties.
6.	12 th Feb 2024- 17 th Feb 2024	Benefits and challenges in molecular manufacturing, Molecular assembler concept, Tools for synthesis for nanostructures.
7.	19 th Feb 2024- 24 th Feb 2024	Understanding advanced capabilities (SEM, TEM, FIM, STM and AFM) Vision and objective of Nano-technology. Discussions and Problems
8.	26 th Feb 2024- 2 nd March 2024	Carbon Fullerenes and nanotubes, Nanotechnology in different field, Automobile, Electronics, Nano-biotechnology, Materials, Medicine. Class Test
9.	4 th March 2024-9 th March 2024	Unit I: Crystal Structure I: Crystalline and glassy forms, liquid crystals, crystal structure, periodicity, lattice and basis
10.	11 th March 2024- 16 th March 2024	Crystal translational vectors and axes, Unit cell and Primitive Cell, Winger Seitz primitive Cell. Symmetry operations for a two dimensional crystal,
11.	18 th March 2024- 22 nd March 2024	Bravais lattices in two and three dimensions. Crystal planes and Miller indices, Interplaner spacing. Discussions and Problems
	23 rd March 2024 to 31 st March 2024	HOLI BREAK
12.	1 st April 2024 to 6 th April 2024	Crystal structures of Zinc Sulphide, Sodium Chloride and Diamond. Discussions and Problems, Class Test
13.	8 th April 2024 to 13 th April 2024	Unit II: Crystal Structure II : X-ray diffraction, Bragg's Law and experimental X-ray diffraction methods, K-space and reciprocal lattice and its physical significance,
14.	15 th April 2024 to 20 th April 2024	Reciprocal lattice vectors, Reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal lattice to a simple

		cubic lattice, b.c.c. and f.c.c.
15.	22 th April 2024 to 27 th April 2024	Revision: Doubts and Discussion.
16.	29 th April 2024 to 30 th April 2024	Revision: Doubts and Discussion.