

COURSE DETAILS:

Course Title	Physical Chemistry-III
Semester	Semester-III
Course Code	CC-A9
Course ID	
Total Credits	04 (Lecture: 03, Tutorial: 0, Practical: 01)
Total Marks	100
Marks Distribution	Theory External: 50 Theory Internal: 25 Practical External: 20 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 5	
Lectures (L) Hours per Week: 3	Practicals (P) Hours per Week: 2

Course Objectives:

- To understand the fundamental concepts of crystal structures, including unit cells and Miller indices.
- To analyze crystal systems, Bravais lattices, and their applications using vector algebra.
- To explore the principles and applications of X-ray diffraction and Bragg's Law.
- To examine the structures of common crystals and the principles of close packing in metals.
- To study the electronic properties of semiconductors and insulators, and the effects of defects in crystals.

Course Outcomes:

- Students will be able to describe unit cells, Miller indices, and the classification of crystal systems and Bravais lattices.
- Students will apply vector algebra to describe crystal geometry and properties.
- Students will understand and explain the principles of X-ray diffraction and use Bragg's Law to analyze crystal structures.
- Students will describe the structures of NaCl, CsCl, KCl, diamond, and graphite, and understand the principles of close packing in metals.
- Through practical experiments, students will develop skills in studying adsorption



isotherms, determining surface area using the BET method, and analyzing the solubility and partitioning behavior of substances.

DETAILED CONTENT OF COURSE:

Theory & Practical Syllabus:

Total Contact Hours: 45 (Theory) + 30 (Practical)

Unit	Topics	Contact Hours
I	Solid State – I Unit cells and Miller indices: Explaining the basic building blocks of crystal structures and the notation for crystal planes. Crystal systems and Bravais lattices: Detailing the classification of crystals into different systems and the possible lattice structures. Elementary applications of vectors to crystal systems: Using vector algebra to describe crystal geometry and properties.	11
II	Solid State – II X-ray diffraction: Describing the principles and techniques used to determine crystal structures. Bragg's Law: Explaining the conditions for constructive interference in crystal diffraction. Structure of NaCl, CsCl, KCl, diamond, and graphite: Analyzing the arrangement of atoms in these common crystal structures.	10
III	Solid State – III Close packing in metals and metal compounds: Discussing the arrangements that maximize packing efficiency. Semiconductors and insulators: Describing the electronic properties of these materials and their applications. Defects in crystals: Analyzing point defects, dislocations, and their effects on material properties, Line defects (dislocations) and plane defects (grain boundaries), Role of defects in modifying material properties. Lattice energy: Discussing the energy associated with forming a crystal lattice from individual ions or atoms. Isomorphism: Explaining the phenomenon where different compounds crystallize in the same structure.	9
IV	Solid State - IV Electronic Properties of Solids Band theory: Conductors, semiconductors, and insulators, Magnetic properties: Diamagnetism, paramagnetism, ferromagnetism, Dielectric properties and ferroelectric materials. Thermal and Optical Properties Heat capacity and thermal conductivity in solids, Optical properties of solids, including photoconductivity. Advanced Topics and Applications Superconductivity: Basic concepts and types, Applications of solid-state materials in electronics, energy storage, and catalysis.	15
V	Practicals: 1. Study of adsorption isotherms (e.g., adsorption of acetic acid on	30

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	activated charcoal). 2. Determination of the surface area of a solid using BET adsorption method. 3. Study of the effect of temperature on adsorption. 4. Adsorption of dyes on different adsorbents. 5. Determination of the partition coefficient of a substance between two immiscible liquids. 6. Determination of the solubility product of a sparingly soluble salt. 7. Determination of the distribution coefficient of benzoic acid between water and benzene. 8. Study of the solubility of gases in liquids. 9. Determination of the common ion effect on solubility.	
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COURSE EVALUATION METHODS

Theory Exams: Total Marks: 75 (External: 50 + Internal: 25)

Internal Assessment: 25 Marks	<ul style="list-style-type: none"> • Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 15 Marks
External Assessment: 50 Marks (02 Hours)	<ul style="list-style-type: none"> • End Term Exam: 50 Marks

Practical Exam: Total Marks: 25 (External: 20 + Internal: 05)

Internal Assessment: 05 Marks	<ul style="list-style-type: none"> • Class Participation: 05 Marks
External Assessment: 20 Marks (02 Hours)	<ul style="list-style-type: none"> • End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instruction for End Term Theory Exam:

The Examiner is requested to set nine questions in total, selecting two questions from each section. Question-1 will be a compulsory question consisting short answer type questions covering all the units of the syllabus. All questions should carry equal marks. Log table and non-programmable calculator is allowed.

Recommended Textbooks:

Theory:

1. Solid State Chemistry and Its Applications – A.R. West, Wiley.
2. Introduction to Solid State Physics – C. Kittel, Wiley.
3. Solid State Physics – N.W. Ashcroft and N.D. Mermin, Cengage Learning.
4. Principles of the Solid State – H.V. Keer, New Age International.

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5. Concise Inorganic Chemistry – J.D. Lee, Wiley.
6. Introduction to Solids – L.V. Azaroff, McGraw Hill.
7. Solid State Physics: Structure and Properties of Materials – M.A. Wahab, Narosa Publishing.
8. Introduction to X-ray Crystallography – Anthony R. Easterling, Springer.
9. Solid State Physics – S.O. Pillai, New Age International.
10. Understanding Solids: The Science of Materials – Richard J.D. Tilley, Wiley.
11. Principles of Physical Chemistry – Puri, Sharma, and Pathania, Vishal Publishing Co.

Practical:

1. "Experiments in Physical Chemistry" by C. N. R. Rao and U. C. Agarwala
2. "Practical Physical Chemistry" by B.S. Bahl and Arun Bahl

