

Name of the Course: T. Y. B. Sc. Physics Major Course 8
MJ - 8: Solid State Physics (2 Credits)

Sr. No.	Heading	Particulars
1	Description the course (Including but Not limited to)	: Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	Vertical	: Major /Minor/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3	Type	: Theory
4	Credits	: 2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted	: 30 Hours
6	Marks Allotted	: 50 Marks
7	Course Objectives (CO): The students are expected to:	
	CO 1.	learn the basic structure of crystals, including lattice points, unit cells, and crystal systems.
	CO 2.	understand common metallic crystal structures, like SC, BCC, FCC) and calculate their basic properties. Also develop the skill to describe crystallographic directions and planes using Miller indices.
	CO 3.	introduce the phenomenon of superconductivity, its types, physical properties, and applications.
	CO 4.	introduce the quantum theory of free electrons and explain its significance in the electrical behaviour of metals.
	CO 5.	provide understanding of Fermi-Dirac statistics and band theory of solid. Also differentiate between conductors, insulators, and semiconductors using band theory
8	Course Outcomes (OC): After successful completion of the course, the student will be able to:	
	OC 1.	understand and explain the basic concepts of space lattices, unit cells, primitive cells, and crystal systems.
	OC 2.	identify and compare metallic crystal structures (SC, BCC, FCC, and HCP) and compute lattice-related parameters. Use Miller indices to describe crystal planes and directions.
	OC 3.	explain superconductivity and distinguish between Type I and Type II superconductors.
	OC 4.	apply the Sommerfeld free electron model to describe electron behavior in a metal and analyze limitations of the classical free electron theory.
	OC 5.	describe electron behaviour in solids using quantum models and explain energy bands of metal, semiconductors, and insulators.
9	Modules / Units: - There will be One Module / Unit Per Credit	
	Module I / Unit I: Crystal Physics and Superconductivity (15 Hours)	
	Crystal Physics: Lattice points and Space lattice, Unit Cells, Primitive Cells, and lattice parameters, Crystal Systems, The Bravais space lattices, Metallic Crystal Structures (SC, BCC, FCC), Relation between the density of crystal material and lattice constant in a cubic lattice, Directions, Planes, Miller Indices, Distribution of atoms in atomic planes in a simple cubic crystal, separation between planes in a cubic crystal.	
	Superconductivity: Survey, Mechanism of Superconductors, Critical Currents, The Meissner effect, The penetration depth, Type I and Type II Superconductors, Applications of	

	superconductivity (SQUIDS, MRI-Magnetic resonance imaging, Maglev train) SOP: CH 4 - II, III, IV, V, VI, XIV, XV, XVI, XVIII, XI, XXI, XXII SOP: CH 8 – II, III, IV, VI, VII, XII, XIII, XXIV, XXV									
	Module II / Unit II: Electrical Properties of Metals (15 Hours) Quantum theory of free electrons: Sommerfeld free electron model, Potential energy box, Fermi Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, The Fermi distribution function, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations, Failure of Sommerfeld's free electron Theory. Band theory of solids: Band theory of solids, The Kronig- Penney model (Omit solution of determinant), Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, Distinction between metals, insulators and intrinsic semiconductors. SOP: CH 6 – V, XIV, XV, XVI, XVIII, XX, XXXV, XXXVI to XXXXI									
10	Reference Books: 1. SOP: Solid State Physics by S. O. Pillai New Age International Publishers Revised Sixth Edition Additional Reference Books: 1. Solid State Physics-Structure and Properties of Materials by M. A. Wahab Narosa Publishing House 3rd edition. 2. Elementary Solid State Physics-Principles and Applications by M.Ali Omar, Pearson Education, 2012. 3. Modern Physics and Solid State Physics: Problems and solutions by S.O. Pilla, New Age International. 4. Solid State Physics: A. J. Dekker, Prentice Hall 5. Solid State Physics: Ashcroft & Mermin, Harcourt College Publisher.									
11	Internal Continuous Assessment: 40% (20 Marks)	External Assessment, (60%) (30 Marks)								
12	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	Evaluation: through Exam at the End of the Semester / Term.								
13	Format of Question Paper for Semester End Examination Total Marks: 30 Marks Duration: One Hour <table border="1"> <tr> <td rowspan="2">Module I / Unit-I 15 Marks</td><td>Q.1 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory</td><td>10 Marks</td></tr> <tr> <td>Q.1 B) Attempt any One (Each carry 05 Marks) i) Problem / Theory ii) Problem</td><td>05 Marks</td></tr> <tr> <td>Module II / Unit-II 15 Marks</td><td>Q.2 A) Attempt any Two (Each carry -5 Marks) i) Theory ii) Theory iii) Theory iv) Theory</td><td>10 Marks</td></tr> </table>		Module I / Unit-I 15 Marks	Q.1 A) Attempt any Two (Each carry 05 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks	Q.1 B) Attempt any One (Each carry 05 Marks) i) Problem / Theory ii) Problem	05 Marks	Module II / Unit-II 15 Marks	Q.2 A) Attempt any Two (Each carry -5 Marks) i) Theory ii) Theory iii) Theory iv) Theory	10 Marks
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