



**Master of Science in Physics**  
**M. Sc. (Physics) Semester I**

Course Code	<b>PS01EPHY51</b>	Title of the Course	<b>Solid State Physics-I</b>
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To impart the knowledge and understanding of: 1. the mathematical and geometrical framework for the quantitative description of the structure of crystals and its experimental characterization 2. the fundamental concepts of lattice vibrations, its modelling and important physical implications 3. the physics of elastic response of crystals to the applied force, related mechanical properties and propagation of elastic waves. 4. the different types of defects in the crystals and its physics
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Course Content		
Unit	Description	Weightage (%)
1.	<i>Crystal Structure and its characterization:</i> Crystal systems and symmetry elements, Miller indices, crystal zones and forms, relationship between interplanar spacing, lattice parameters and Miller indices, stereographic projection, X-ray diffraction and Bragg's law, Laue equations, equivalence of Bragg's law and Laue equations, reciprocal lattice and its properties, Ewald construction, X-ray diffraction methods: Laue method, Rotation/Oscillation method, Powder method	25%
2.	<i>Lattice vibrations:</i> Introduction to elastic properties of solids, dispersion for a one-dimensional homogeneous line, vibration of mono-atomic lattice, first Brillouin zone, group velocity and continuum limit, lattice with two atoms per primitive cell, excitation of the optical branch-infrared absorption in ionic crystals, quantization of lattice vibrations, phonon momentum, inelastic scattering of neutrons by phonons.	25%
3.	<i>Elastic properties:</i> Introduction, stress and strain components, displacement and strain components, dilation, elastic compliances and stiffness constants, work done by elastic force in a solid (Elastic energy density), Reduction of numbers of elastic constants due to existence of potential of elastic forces, elastic stiffness constants for isotropic body, Elastic constants for cubic isotropic crystals, relation between elastic stiffness constants and elastic compliance constants, Elastic Waves in [100], [110] and [111] direction, Experimental determination of elastic constants. Creep, examples.	25%





4.	<i>Imperfections in Crystals</i> Point imperfections (Frenkel and Schottky) and its concentration, Line imperfections, edge dislocation, screw dislocation, dislocation density, Burgers vector and Burgers circuit, dislocation motion, energy of a dislocation, slip planes and slip directions, Surface imperfections, grain boundary, tilt and twist boundary, stacking faults: stacking faults in FCC crystals, stacking faults in hcp crystals	25%
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Teaching-Learning Methodology	Lectures using traditional blackboard teaching as well as the ICT tools for effective delivery of the content.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Take up further studies of advanced topics in theoretical and experimental solid state physics.

Suggested References:	
Sr. No.	References
1.	Introduction to Solid State Physics Charles Kittel, Eight edition, Wiley, 2015.
2.	Elements of Solid State Physics J. P. Srivastava, Prentice Hall of India, 2009
3.	Solid State Physics: Structure and Properties of Materials, M. A. Wahab, Second edition, Narosa Publishers, 2005.
4.	Principles of Solid State Physics R. A. Levy, Academic Press, 1974





5.	Elementary Solid State Physics: Principles and Applications M. A. Omar, Addison-Wesley, 1975
6.	Elements of X-ray diffraction B. D. Cullity and S. R. Stock, Third edition, Pearson, 2014.
7.	Introduction to dislocations, D. Hull and D. J. Bacon, Fifth edition, Butterworth-Heinemann (Elsevier), 2011

On-line Resources

[www.nrce.niepa.ac.in](http://www.nrce.niepa.ac.in)

[www.quora.com](http://www.quora.com)

[www.freebookcentre.net](http://www.freebookcentre.net)

