Master of Science in Physics
M.Sc. (Physics) Semester II

Course Code	**PS02CPHY52**	Title of the Course	**Solid State Physics-II**
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To impart basic training in basic theoretical methods for the study of electronic band structure. 2. To teach experimental methods of Fermi surface measurements and correlate them to the theoretical methods. 3. Explain important aspects of screening theory required in proper explanation of metallic properties. 4. Teach basic and advanced concepts of Superconductivity observed in materials.

Course Content		
Unit	Description	Weightage* (%)
1	*Energy bands:* Bloch theorem, the Kronig-Penny model, effective mass of an electron, construction of Brillouin zones, extended, reduced and periodic zone schemes, formation of energy bands, empty lattice energy bands, plane wave method, Orthogonalized Plane Wave (OPW) method, tight binding approximation, pseudopotential method, Cellular method.	25%
2	*Fermi surfaces:* Construction of free electron Fermi surfaces. Measuring the Fermi surfaces, The de Haas-van Alphen effect, Oscillatory Galvanomagnetic effect, Free electron Landau levels, Bloch electrons Landau levels, Physical origin of oscillatory phenomena effects of electron spin, magneto-acoustic effect, ultrasonic attenuation, Anomalous skin effect, Cyclotron resonance and size effects.	25%
3	*Screening:* Dielectric function, Plasma optics, Dispersion relation for electromagnetic waves, Transverse optical modes in a plasma, Longitudinal plasma oscillations, Plasmons, Electrostatic screening, Screened Coulomb potential, scfreening and phonons in metals, Linhard dielectric function, electron-ion potential, Friedal oscillations,	25%

	ion-ion potential.	
4.	*Superconductivity:* Superconductivity-its occurrence and experimental survey, Meissner effect, Heat capacity, energy gap, Microwave and infrared properties, Isotope effects, Theoretical survey, Thermodynamics of superconducting transition and London equation, Coherence length, BCS theory of superconductivity, Flux quantization in a superconducting ring, Type II superconductors, single particle tunnelling and Josephson superconductor tunnelling, Fullerenes.	25%

Teaching-Learning Methodology	Lectures using traditional blackboard teaching, Tutorials, class assignments as well as the ICT tools for effective delivery of the content.

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.	Calculate the basic electronic band structure based on theory and apply them to more complex systems.
2.	Correlate theoretical methods of electronic band structure with experimental determination via the Fermi surface studies.
3.	Student will be equipped with concepts and basic tools to take up advanced study of superconductivity in materials.

Suggested References:

Sr. No.	References
1	Intermediate Quantum theory of crystalline solids. A.O.E. Animalu (1997)
2	Introduction to Solid State Physics C. Kittle (John Wiley & Sons) (2004)
3	Solid State Physics: Structure and Properties of Materials M. A. Wahab (Narosa Publishers)(2009).
4	Solid State Physics N.W. Ashcroft and N.D. Mermin(1976)
5	Elements of Solid State Physics J.P. Srivastava (Prentice Hall of India)(2006)

On-line Resources

www.nrce.niepa.ac.in

www.quora.com

www.freebookcentre.net

iopscience.iop.org

iopscience.iop.org

www2.physics.ox.ac.uk