

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI
COURSE PLAN June - November 2024

Department : Physics
Name/s of the Faculty : Dr. Sownthari. K
Course Title : Solid State Physics
Course Code : 23PH/PC/SS34
Shift : II

COURSE OUTCOMES (COs)

COs	Description	CL
CO1	Explain the fundamental principles and concepts of solid state physics, and Apply crystallographic techniques to determine crystal structures and lattice parameters	K1
CO2	Describe the formation of energy bands in solids, calculate band gaps, and predict the electrical conductivity of materials based on their electronic structure.	K2
CO3	Solve complex problems related to solid state physics, both analytically and numerically, and interpret experimental data to draw meaningful conclusions.	K3
CO4	Comprehend and discuss advanced topics in solid state physics, including superconductivity, semiconductor physics, and the behavior of nanomaterials	K4
CO5	Assess the importance of solid state physics in technological advancements to explain the behaviour of complex materials with diverse properties	K5, K6

Week	Unit No.	Content	Cognitive Level	Teaching Hours	COs	Teaching Learning Methodology	Assessment Methods
Jun 19 – 26, 2024 (Day Order 1 - 6)	1	Lattice dynamics 1.1 Theory of elastic vibrations in mono and diatomic lattices - group and phase velocities - Phonons – Dispersion relations - Phonon momentum - Inelastic scattering by phonons	K1-K6	5	1-5	Lecture and PPT	Third Component Problem Solving
Jun 27 – July 4, 2024 (Day Order 1 - 6)	1	1.2 Heat Capacity Vibrational modes - Density of states in one and three dimensions - Debye's theory of lattice heat capacity – Einstein's theory of specific heat – relation between C_p and C_v – Gruneisen constant	K1-K6	5	1-5	Lecture and PPT	Third Component Problem Solving
July 5 – 12, 2024 (Day Order 1 - 6)	1	Anharmonic effects: Explanation for Thermal expansion, Thermal Conductivity and resistivity – Umklapp process.	K1-K6	5	1-5	Lecture and PPT	Third Component Problem Solving
July 15 – 23, 2024 (Day Order 1 - 6)	2	Theories of electrons 2.1 Free electron gas in one & three dimensions – quantum free electron theory – density of states - Electronic heat capacity - Electrical conductivity – Wiedemann-Franz law - Hall effect	K1-K6	5	1-5	Lecture and PPT	Third Component Problem Solving

July 24 – 31, 2024 (Day Order 1 - 6)	2	2.2 Band theory of metals and semiconductors - Bloch functions - Kronig-Penney model - Semiconductors - band gap determination - direct and indirect band gap semiconductors – n and p type semiconductors - free carrier concentration in semiconductors – Mobility – Thermoelectric effect	K1-K6	5	1-5	Lecture and PPT	Third Component Problem Solving
Aug 1 – 5, 2024 (Day Order 1 - 3)	2	2.3 Fermi surfaces and construction – Experimental methods in Fermi surface studies – de Hass-van Alphen effect.	K1-K6	2	1-5	Lecture and PPT	Third Component Problem Solving
Aug 6 – 10, 2024	C.A. Test - I						
Aug 12 – 14, 2024 (Day Order 4-6)	3	Dielectrics and Ferroelectrics 3.1 Polarization – macroscopic electric field – Local electric field at an atom – Clausius - Mosotti Relation - dielectric constant and polarizability	K1-K6	3	1-5	Lecture and PPT	Third Component MCQ Test
Aug 16 – 23, 2024 (Day Order 1-6)	3	electronic polarizability –ionic polarizability - dipolar polarizability – Piezoelectricity	K1-K6	5	1-5	Lecture and PPT	Third Component MCQ Test
Aug 27 – Sep 3, 2024 (Day Order 1-6)	3	3.2 Ferroelectricity – Ferroelectric crystals - Classification of ferroelectric crystals - ferroelectric domains – Antiferroelectricity - Ferroelectricity	K1-K6	5	1-5	Lecture and PPT	Third Component MCQ Test

Sep 4 – 11, 2024 (Day Order 1-6)	4	Magnetic materials 4.1 Diamagnetism – Quantum theory of paramagnetism – Rare earth ion – Hund’s rule – Quenching of orbital angular momentum – Adiabatic demagnetization	K1-K6	5	1-5	Presentation	Third Component Seminar
Sep 12 - 20, 2024 (Day Order 1-6)	4	4.2 Ferromagnetic order – Curie point – Exchange integral – Heisenberg’s interpretation of Weiss field – Ferromagnetic domains – Bloch wall – Spin waves – Quantization – Magnons – Thermal excitation of magnons	K1-K6	5	1-5	Presentation	Third Component Seminar
Sep 23 - 26, 2024 (Day Order 1-4)	4	4.3 Ferrimagnetic order - Curie temperature and susceptibility of ferrimagnets – Theory of antiferromagnetism – Neel temperature – Structure of Ferrites – applications	K1-K6	3	1-5	Presentation	Third Component Seminar
Sep 27 – Oct 3, 2024	C.A. Test - II						
Oct 4 – 5, 2024 (Day 5 & 6)	5	Superconductivity 5.1 Experimental facts: Occurrence – Effect of magnetic fields – Meissner effect – Type I and II Superconductors - Critical field – Critical current – Entropy and heat capacity – Energy	K1-K6	2	1-5	Group Discussion	Problem Solving

		gap– Microwave and infrared properties – isotope effect					
Oct 7 - 15, 2024 (Day Order 1 to 6)	5	5.2 Theoretical Explanation: Thermodynamics of super conducting transition – London equations - Coherence length – Isotope effect – Cooper pairs	K1-K6	5	1-5	Group Discussion	Problem Solving
Oct 16 - 22, 2024 (Day Order 1 to 6)	5	Bardeen Cooper Schrieffer (BCS) Theory – Flux quantization – Single particle tunnelling – Josephson tunnelling – DC and AC Josephson effects – High temperature Superconductors – SQUIDS.	K1-K6	5	1-5	Group Discussion	Problem Solving
Oct 23 - 24, 2024 (Day Order 1 to 2)	REVISION						