

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI

COURSE PLAN (June - November 2026)

Department : PHYSICS
Name/s of the Faculty : DR. D. SUKANYA
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	K5, K6

	complex materials with diverse properties						
Week	Unit No.	Content	Cognitive Level	Teaching Hours	COs	Teaching Learning Methodology	Assessment Methods
Jun 15 – 22, 2026 (Day Order 1- 6)	1	1.1 Theory of elastic vibrations in mono and diatomic lattices - group and phase velocities	K1- K6	5	CO1-5	Lecture, PowerPoint presentation and Discussion	Discussion
Jun 23 – July 1, 2026 (Day Order 1- 6)	1	Phonons – Dispersion relations - Phonon momentum - Inelastic scattering by phonons 1.2 Heat Capacity Vibrational modes - Density of states in one and three dimensions -	K1- K6	5	CO1-5	Lecture, and powerpoint presentation discussion with simulation software	Quiz and Problem-assignments
July 2 – July 8, 2026 (Day Order 1- 6)	1	Debye's theory of lattice heat capacity – Einstein's theory of specific heat – relation between C_p and C_v – Gruneisen constant - Anharmonic effects: Explanation for Thermal expansion, Thermal Conductivity and resistivity – Umklapp process.	K1- K6	5	CO1-5	PowerPoint presentation discussion and Problem solving	Assignment and discussion on applications of phonons
July 9 – 16, 2026 (Day Order 1- 6)	2	2.1 Free electron gas in one & three dimensions – quantum free electron theory – density of states	K1- K6	5	CO1-5	Lecture and discussion with	Group assignment activity

		- Electronic heat capacity - Electrical conductivity – Wiedemann-Franz law - Hall effect				interactive simulation	
July 17 – 24, 2026 (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	CO1-5	Powerpoint lecture with simulation software and practical application	Third component problem test (K3, K4) – 20 marks
July 25 – 28, 2026 (Day Order 1- 3)	2	2.3 Fermi surfaces and construction – Experimental methods in Fermi surface studies – de Hass-van Alphen effect.	K1- K6	1	CO1-5	Lecture and problem solving	Discussion and Revision on topics for CA test
July 29 – Aug 3, 2026	C.A. Test - I						
Aug 4 - 6, 2026 (Day Order 4 - 6)	3	3.1 Polarization – macroscopic electric field – Local electric field at an atom – Clausius -Mosotti Relation - dielectric constant and polarizability	K1- K6	4	CO1-5	Lecture and discussion with interactive simulations	Group Assignments and discussion

Aug 7 – 14, 2026 (Day Order 1- 6)	3	electronic polarizability –ionic polarizability - dipolar polarizability – Piezoelectricity 3.2 Ferroelectricity – Ferroelectric crystals -	K1- K6	5	CO1-5	Lecture and discussion with videos on real world applications	Third component Seminar presentation on advanced topics (K5, K6) – 15 marks
Aug 17 - 24, 2026 (Day Order 1- 6)	3 4	Classification of ferroelectric crystals - ferroelectric domains – Antiferroelectricity – Ferroelectricity 4.1 Diamagnetism – Quantum theory of paramagnetism – Rare earth ionHund’s rule – Quenching of orbital angular momentum – Adiabatic demagnetization 4.2 Ferromagnetic order – Curie point – Exchange integral – Heisenberg’s interpretation of Weiss field –	K1- K6	5	CO1-5	Lecture and discussion with visual aids Problem solving practices	Quiz and problem sheet assignment
Aug 25 – Sep 2, 2026 (Day Order 1- 6)	4	Ferromagnetic domains – Bloch wall – Spin waves – Quantization – Magnons – Thermal excitation of magnons	K1- K6	5	CO1-5	Powerpoint lecture and demonstration with animated videos	Online Quiz activity
Sep 3 – 11, 2026 (Day Order 1- 6)	4	4.3 _Ferrimagnetic order - Curie temperature and susceptibility of ferrimagnets – Theory of	K1- K6	5	CO1-5	Lecture discussion and Problem-solving	Seminar presentation on advanced topics (Third component)

		antiferromagnetism – Neel temperature – Structure of Ferrites – applications				practices	
Sep 15-17, 2026 (Day Order 1 - 3)	5	5.1 Experimental facts: Occurrence – Effect of magnetic fields – Meissner effect – Type I and II Superconductors	K1- K6	1	CO1-5	Lecture explanation and demonstration with superconductivity apps (AURORA)	Computational software/simulation assignment cum demonstration from all units (1-5) (K1- K4) – 15 marks
Sep 18 –23, 2026	C.A. Test - II						
Sep 24 - 28, 2026 (Day 4 – 6)	5	Critical field – Critical current – Entropy and heat capacity – Energy gap– Microwave and infrared properties – isotope effect 5.2 Theoretical Explanation: Thermodynamics of super conducting transition – London equations	K1- K6	5	CO1-5	Lecture and problem practices	Discussing the advancements in the field of superconductors
Sep 29 – Oct 7, 2026 (Day Order 1 - 6)	5	Coherence length – Isotope effect – Cooper pairs – Bardeen Cooper Schrieffer (BCS) Theory – Flux quantization – Single particle tunnelling – Josephson	K1- K6	5	CO1-5	Lecture and demonstration of the materials relevance to real world applications	Questioning and Discussion

		tunnelling – DC and AC Josephson effects –					
Oct 8 - 14, 2026 (Day Order 1 - 6)	5	High temperature Superconductors – SQUIDS.	K1- K6	5	CO1-5	Lecture with PowerPoint presentation and simulations	Discussion and Problem solving test
Oct 15 - 21, 2026 (Day Order 1- 4)	REVISION						

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