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

Department : **Physics**
Name/s of the Faculty : **Dr. Daries Bella R.S**
Course Title : **Crystal Physics**
Course Code : **23PH/PE/CP15**
Shift : **II**

COURSE OUTCOMES (COs)

COs	Description	CL
CO1	To acquire knowledge on the classical and quantum mechanical laws which can be applied to explain the properties of the solid state.	K1
CO2	Describe the lattice dynamics and the underlying theories essential for adopting suitable growth techniques in the production of quality crystals.	K2
CO3	Apply the theoretical concepts to build models explaining the physical properties and behavior of solid matter	K3
CO4	Illustrate the classification of growth techniques, vibrational modes, and characterization techniques pertaining to crystal	K4
CO5	Interpret and investigate on structural, electrical, optical, and mechanical properties of novel crystals reported in scientific research papers	K5

Week	Unit No.	Content	Cognitive Level	Teaching Hours	COs	Teaching Learning Methodology	Assessment Methods
Jun 24 – 26, 2024 (Day Order 4 - 6)	I	Crystal Theory 1.1 Importance of crystal growth – Classification of crystal growth methods – Nucleation Theory	K1-K5	4	CO1-CO5	Lecture ,PPT demonstration video	Discussion and questioning
Jun 27 – July 4, 2024 (Day Order 1 - 6)	I	- Kinds of nucleation – Homogeneous nucleation - Heterogeneous nucleation - secondary nucleation 1.2 Classical theory of nucleation: Gibbs Thomson equations for vapour and solution	K1-K5	5	CO1-CO5	Lecture ,PPT demonstration video	Discussion and questioning
July 5 – 12, 2024 (Day Order 1 - 6)	I II	– Kinetic theory of nucleation – Becker and Doring concept on nucleation rate – Energy of formation of a spherical nucleus and cylindrical nucleus - Crystal System and Symmetry. Lattice Dynamics	K1-K5	4 1	CO1-CO5	Lecture ,PPT demonstration video	Model making , discussion
July 15 – 23, 2024 (Day Order 1 - 6)	II	2.1 Theory of elastic vibrations in mono and diatomic lattices - Phonons – Dispersion relations - Phonon momentum. Heat Capacity Vibrational modes - Einstein model -	K1-K5	5	CO1-CO5	Black board ,PPT	Discussion and questioning

July 24 – 31, 2024 (Day Order 1 - 6)	II	Density of modes in one and three dimensions - Debye Model of heat capacity. 2.2 Anharmonic effects: Explanation for Thermal expansion, Conductivity and resistivity	K1-K5	5	CO1-CO5	Lecture ,PPT,demonstration video	Discussion and questioning
Aug 1 – 5, 2024 (Day Order 1 - 3)	II	Umklapp process.	K1-K5	2	CO1-CO5	Lecture ,PPT demonstration video	Third component (Quiz)
Aug 6 – 10, 2024	**C.A. Test - I**						
Aug 12 – 14, 2024 (Day Order 4-6)	III	Growth techniques 3.1 Gel growth technique: Chemical reaction method – Single and double diffusion method – Chemical reduction method – Complex and decomplexion method	K1-K5	3	CO1-CO5	Lecture and demonstration video	Discussion and questioning
Aug 16 – 23, 2024 (Day Order 1-6)	III	3.2 Melt growth: Bridgman method - Czochralski technique – Growth apparatus – seed preparation – pulling rate – shape of crystal melt interface – Growth process	K1-K5	5	CO1-CO5	Black board ,PPT	Third component(Problem test)

Aug 27 – Sep 3, 2024 (Day Order 1-6)	III	3.3 Vapour growth: Physical Vapour Transport (PVT) – Processes of sublimation and condensation principle – Chemical Vapour Transport – Criteria for the choice of transport reaction	K1-K5	5	CO1-CO5	Lecture and demonstration video	Discussion and questioning
Sep 4 – 11, 2024 (Day Order 1-6)	IV	Crystal Characterization 4.1 X Ray diffraction (XRD) - Thermal analysis - methods of thermal analysis - thermogravimetric analysis (TGA) - Differential thermal analysis (DTA) - Differential Scanning Calorimetry (DSC)	K1-K5	5	CO1-CO5	Black board ,PPT	Discussion and questioning
Sep 12 - 20, 2024 (Day Order 1-6)	IV	4.2 Mechanical studies - methods of hardness testing (qualitative) - Vickers hardness testing - correlation of microhardness with other properties - estimation of hardness number and	K1-K5	5	CO1-CO5	Lecture ,PPT demonstration video	Third component(review research articles)
Sep 23 - 26, 2024 (Day Order 1-4)	IV	Work hardening coefficient (n) – dielectric	K1-K5	3	CO1-CO5	Lecture ,PPT demonstration video	Discussion and questioning
Sep 27 – Oct 3, 2024	**C.A. Test - II**						

Oct 4 – 5, 2024 (Day 5 & 6)	V	Liquid Crystals 5.1 Liquid Crystals: Classification-	K1-K5	2	CO1-CO5	Lecture ,PPT demonstration video	Discussion and questioning
Oct 7 - 15, 2024 (Day Order 1 to 6)	V	Isotropic-nematic, smectic-cholestic phases, Phase transition of liquid phases	K1-K5	5	CO1-CO5	Lecture ,PPT demonstration video	Discussion and questioning
Oct 16 - 22, 2024 (Day Order 1 to 6)	V	5.2 Properties- optical, electric and magnetic fields, Application of liquid crystals	K1-K5	5	CO1-CO5	Lecture ,PPT demonstration video	Discussion and questioning
Oct 23 - 24, 2024 (Day Order 1 to 2)	**REVISION**						