D. Syllabus Detailing and Learning objectives

Module	Chapter	Detailed Content	Syllabus Detailing	Learning Objectives
Module 1	**Crystal Structure**	1. Introduction to crystallography; Study of characteristics of unit cell of Diamond, ZnS, NaCl and HCP; Miller indices of crystallographic planes & directions; interplanar spacing; X-ray diffraction and Bragg's law; Determination of Crystal structure using Bragg's diffractometer; Frenkel and Schotkey crystal defects; Ionic crystal legancy (3,4,6,8); Liquid crystal phases.	**Purpose**: To make students understand the crystal structure, Miller Indices, xray diffraction and crystal defects. **Scope –** **1. Academic Aspects-** To identify the particular type of crystal structure and know their application. **:** **2. Technology Aspect-** students will be able to describe Complicated structures eg. Diamond, ZnS, NaCl and HCP structures. students will be able to calculate interplanar separation distance. Students will be able to analyseLigancy and Critical radius ratio of different crystal structures **3. Application Aspect-** Students will be able to recognize and calculate Miller indices of crystallographic planes & directions. students will be able to sketch Miller indices of crystallographic planes & directions and obtain interplanar distance	1. Define polycrystalline solids, crystalline and amorphous crystals. 2. Calculate the number of stoms/ unit cell, atomic radii and packing factor for diamond/HCP lattice. 3. Calculate the "d" spacing of a crystal using h,k,l values of Miller Indices. 4. Analyse the ligancy for different crystals. 5. Identify the critical radius ratio for different crystals. 6Examine the three phases bofvliquid crystals.

			Students Evaluation – 1.Students will be able to formulate braggs diffraction formula which is useful in Determination of crystal structure using X-ray diffraction technique. Students will be able calculate d spacing using X ray diffraction technique 3 .students will be able Differentiate Liquid crystals phases. 4. students will be able generalize Liquid crystals phases. 5.students will be able to analyse the point defects and its effects on crystals	
Module 2	Quantum mechanics	2.1.Introduction, Wave particle duality; De Broglie wavelength Experimental verification of de Broglie theory; properties of matter waves wave packet, phase velocity and group velocity Physical interpretation of wave function; Heisenberg's uncertainty principle Electron diffraction experiment and Gama ray microscope experiment Applications of uncertainty principle Schrodinger's time dependent & time independent Schrodinger equation	**Purpose-** This chapter is focused on quantum mechanical basic theories like DeBroglies Hypothesis, Heisenberg Uncertainity principle etc. **Scope –** **1. Academic Aspects-**To understand the Wave particle duality of light.. Students will be able to State debroglie hypothesis and Heisenberg uncertainty pribciple **2. Technology Aspect-** Student will be able to Describe and derive	1.Define wave particle duality 2. Discuss Heisenberg uncertainity principal in one dimensional coordinate system. 3. Discuss phase velocity and group velocity 4. Identify the solution for motion of free particle or the

		Motion of free particles Particle trapped in one dimensional infinite potential well	STDE,STIE **3. Application Aspect-** Students will be able to apply STDE for finding the eigen value of a free particle or a bound particle. **Students Evaluation –** 1 Student will be able to Calculate Uncertainties 2. Student will be able to analyse the eigen value for time dependent processes for free particle. 3. Student will be able to apply the theoretical concepts of Heisenberg uncertainity principle to experimental verification of electron diffraction. 4. Students will be able to apply the shrodinger time dependent equation to calculate the eigen functions of a free particle	bound particle. 5. Calculate the uncertainity in momentum or time for a given particle using Heisenbergs Uncertainity principle.
Module 3	**Semiconductor I**	3.1. Band theory of solids, Classification of semiconductors (direct & indirect band gap, elemental and compound); Conductivity, mobility, current density **(**drift & diffusion) in semiconductors (n type and p type) 3.2 Fermi Dirac distribution function; Fermi energy level in intrinsic semiconductor	**Purpose –** To understand the concept of Femi Dirac distribution function and Fermi level. **Scope –** **1. Academic Aspects-** Student will study the basic parameters such as mobility, current density and conductivity and solve numerical based on this. **2. Technology Aspect-** Fermi Dirac distribution function **3. Application Aspect-**	1..Define mobility, conductivity, current density. **(R)** 2. Discuss the Fermi Dirac Distribution function.**(U)** 3. DiscussFermi energy level in intrinsic semiconductor (**U)** 4. Evaluate Numerical based on mobility and conductivity. **(A)**

			Fermi energy level in intrinsic semiconductor.	
			Student Evaluation - 1.Students can be asked to derive relation for Fermi energy level in intrinsic semiconductor 2. Students can be asked to find mobility, conductivity 3. Students can be asked to explain Band theory of solids.	
Module 4	**Semiconductor II**	4.1 Fermi energy level in extrinsic semiconductors; 4.2 effect of impurity concentration and temperature on fermi level; Fermi Level diagram for p-n junction (unbiased, forward bias, reverse bias)4.3 Breakdown mechanism (Zener & avalanche), Hall Effect 4.4 Applications of semiconductors: Rectifier diode, LED, Zener diode, Photo diode, Photovoltaic cell 4.5. BJT, FET. 4.6. SCR., MOSFET	**Purpose –** This chapter discusses various applications of semiconductors.	1 State Hall Effect. **(R)** 2. Discuss working of FET. **(U)** 3. Discuss working of SCR.**(U)** 4. Discuss working of Zener diode.**(U)** 5. Discuss working of solar cell.**(U)** **6.** Students will be able to solve the problems based on Hall effect.
			Scope – **1. Academic Aspects-** Students will learn various applications of semiconductors. **2. Technology Aspect-** Hall voltage and Hall coefficient. **3. Application Aspect-** BJT, FET, SCR., MOSFET	

			Student Evaluation - 1.Students can be asked to evaluate Hall voltage and Hall coefficient 2. Students can be asked to Discuss working of FET. 3. Students can be asked to Discuss working of SCR. 4. Students can be asked to draw Fermi level in extrinsic semiconductors.	
Module 5	**Superconductivity**	5.1. Introduction, Meissner Effect and related problems 5.2. Type I and Type II superconductors. 5.3 BCS Theory (concept of Cooper pair); Josephson effect 5.4 Applications of superconductors- SQUID, MAGLEV	**Purpose –** To learn the actual concept of superconductivity and its types. **Scope –** **1. Academic Aspects-** Students will explore BCS theory to explain the existence of superconductivity. 2. **Technology Aspect-** Students will understand Type-I, Type-II superconductors. **3. Application Aspect-** Maglev, Squid	1. Define critical temperature, critical magnetic field. **(R)** 2. Discuss BCS theory**(U)** 3. Discus Meissner Effect.**(U)** 4 Distuinguish between Type I and Type II superconductors. **(A)** 5.Discuss Maglev and Squid. **(U)** **6.** Evaluatecritical temperature, critical magnetic field. **(A)**

			Student Evaluation – 1.Students can be asked to explain Meissner effect. 2. Students can be asked to explain BCS Theory 3. Students can be asked to explain Maglev and Squid 4. Students can be asked to differentiate between Type I and II superconductors.	
Module 6.1	**Acoustics**	6.1 Basic definitions as Loudness, Intensity, pitch and phon 6.2 Absorption of sound; absorption coefficient; reverberation time and Sabine's formula 6.3 Conditions of good acoustics; Reflection of sound(reverberation and echo) 6.4. Common Acoustic defects, remedies and acoustic materials	**Purpose –** Student shall be able to understand acoustic design of the auditorium **Scope –** 1. **Academic Aspects-** **R**equirements for acoustic design of the hall. 2. **Technical Aspect –** Echoes**,** Echelon effect. **Application Aspect –** Apply remedies tominimize acoustic defects **Student Evaluation –** 1. Students can be asked to evaluate loudness in dB 2. Students can be asked to evaluate reverberation time. 3. Students can be asked to calculate absorption coefficient.	1.Define loudness, intensity, absorption, reverberation time. **(R)** 2. Evaluate loudness and reverberation time.**(A)** 3.Discuss common acoustic defects and related remedies.**(U)** **4.** DiscussConditions for good acoustics. **(U)**

Module 6.2	**Ultrasonics**	6.5. Magnetostriction effect; Piezoelectric effect; 6.6. Ultrasonic Wave generation; Magnetostriction Oscillator; related problems 6.7. Ultrasonic Wave generation; Piezoelectric Oscillator; related problems 6.8. Applications of ultrasonic waves	**Purpose –** students will learn production and applications ofUltrasonic Waves. **Scope –** **3. Academic Aspects-** Production of ultrasonic waves**.** **4. Technical Aspect –**Axes in Quartz crystal. **5. Application Aspect –** Cavitation, Ultrasonic sensors, Non destructive testing **Student Evaluation –** 1. Students can be asked to evaluate resonant frequency in magnetostriction oscillator 2. Students can be asked to evaluate resonant frequency in piezoelectric oscillator 3. Students can be asked to calculate distance of ship from the bottom, etc.	1.Definemagnetostriction effect and Piezoelectric effect. **(R)** 2. Evaluate resonant frequency for Magnetostriction and Piezoelectric Oscillator.**(U)** 3.Discuss construction and working of Magnetostriction oscillator. . **(A)** **4.** Discussconstruction and working of Piezoelectric oscillator.**(A)** 5. Discuss Applications of Ultrasonics. **(A)**