GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3133906
Semester – III
Subject Name: Material Science

Type of course: Material Science

Prerequisite: Solid state physic, crystal physics, mathematics (differentiation and integration), material chemistry (inorganic chemistry) and some physical properties of materials from 12thscience level syllabus.

Rationale: The purpose of this course is to develop comprehension of the rapidly changing technological scenario and the requisite expertise for appropriate selection of materials and its basic and fundamental knowledge.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Fundaments of Crystals and Crystal planes: 1.1 Introduction to Crystal Structure. 1.2 Lattice Translation Vector. 1.3 Basis and Crystal Structure. 1.4 Primitive Lattice. 1.5 Fundamental Types of Lattices 1.6 Indexing System for Crystal plane. 1.7 Miller Indices. 1.8 Features of Miller Indices 1.9 Examples of Miller Indices	7	20
2	STRUCTURAL PROPERTIES: 2.1 Simple Crystal Systems. 2.2 Seven Crystal Structure. 2.3 Bravais Lattice Sysytem 2.4 Simple Cubic 2.4.1 Atom per unit cell. 2.4.2 Coordination no. 2.4.3 Atomic Packing Factor 2.5 Body Center Cubic 2.5.1 Atom per unit cell. 2.5.2 Coordination no. 2.5.3 Atomic Packing Factor 2.6 Face center Cubic 2.6.1 Atom per unit cell. 2.6.2 Coordination no. 2.6.3 Atomic Packing Factor	6	20

	2.7 Hexagonal Close Packing. 2.7.1 Atom per unit cell. 2.7.2 Coordination no. 2.7.3 Atomic Packing Factor 2.8 Defects in solids 2.9 Summary. 2.10 Problems.		
3	WAVE DIFFRACTION AND THE RECIPROCAL: 3.1 Diffraction Waves by Crystals. 3.2 Bragg Law. 3.3 Scattered wave amplitude. 3.4 Fourier Wave Analysis. 3.5 Reciprocal lattice vector. 3.6 Diffraction Condition 3.7 Laue Equation. 3.8 Summary	7	20
4	Crystal Binding Energy: 4.1 Crystal of Inert Gas 4.2 Van Der Waals – London Interaction. 4.3 Repulsive Interaction. 4.4 Equilibrium Lattice Constants 4.5 Cohesive Energy 4.6 Ionic Crystal 4.7 Covalent Crystal 4.8 Metal 4.9 Hydrogen Bond 4.10 Summary	7	20
5	Free Electron Fermi gas in Crystals. 5.1 Energy Levels in One dimension 5.2 Effect of temperature on Fermi Dirac distribution 5.3 Free electron in three dimension. 5.4 Heat capacity of the electron gas. 5.5 Electrical conductivity and ohm's law 5.5.1. Experimental electrical resistivity of metal 5.6 Electron Motion in magnetic field 5.7 Thermal Conductivity of Metal 5.8 Summary	7	20

Reference Books:

1. Introduction to Solid State Physics C. Kittle
2. Solid State Physics:A.J. Decker
3. Solid State Physics: S.O. Pillai

CourseOutcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand basic crystallography concepts.	20
CO-2	Understand arrangement of atoms and molecules in periodic fashion leading to crystalline structures with different structural properties.	**20**

CO-3	Understand the diffraction of waves by crystal and its application for identify the crystals.	**20**
CO-4	Understand the inter atomic interaction and bond in crystals	**20**
CO-5	Understand the electronic structure in crystals.	**20**

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	30
Comprehension	40
Application	30
Analysis	0%
Evaluate	0%
Create	0%

List of Experiments:

1. Band gap determination
2. Dielectric constant measurement.
3. Photoconductivity measurement.
4. Determination of Hall coefficient and carrier type for a semiconductor material.
5. To trace the hysteresis loop for a magnetic material
6. Magnetic susceptibility – Quince's method
7. Determination of thermal conductivity – Lee's
8. Resistivity determination for a semiconductor wafer using Four probe method.