SYLLABUS

IK Gujral Punjab Technical University

BACHELOR OF TECHNOLOGY

(B. Tech. 1st Year)

BTPH104-18	Semiconductor Physics	L-3, T-1, P-0	4 Credits

Prerequisite (if any): Introduction to Quantum Mechanics desirable

Course Objectives: The aim and objective of the course on **Semiconductor Physics** is to introduce the students of B. Tech. class to the formal structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1 Understand and explain the fundamental principles and properties of electronic materials and semiconductors

CO2 Understand and describe the interaction of light with semiconductors in terms of fermi golden rule.

CO3 Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.

CO4 Understand the design, fabrication, and characterization techniques of Engineered semiconductor materials.

CO5 Develop the basic tools with which they can study and test the newly developed devices and other semiconductor applications.

DETAILED SYLLABUS

PART–A

UNIT–I: ELECTRONIC MATERIALS **(10 lectures)**

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

UNIT–II: SEMICONDUCTORS **(10 lectures)**

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n

junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.

PART–B

UNIT–III: LIGHT-SEMICONDUCTOR INTERACTION (10 lectures)

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, application in semiconductor Lasers; Joint density of states, Density of states for phonons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.

UNIT–IV: MEASUREMENT TECHNIQUES (10 lectures)

Measurement for divergence and wavelength using a semiconductor laser, Measurements for carrier density, resistivity, hall mobility using Four-point probe and van der Pauw method, Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics.