

MT-616 Semiconductors and Devices

CRYSTALLINE MATERIALS: Bravais Lattice, Translation vectors, primitive translation vectors, Basis, Primitive cell, FCC and HCP structures, Zinc Blende and Wurtzite, Important Planes in Zinc Blende or Diamond Structures.

ELECTRONS IN PERIODIC STRUCTURES: Electronic Band Structure (E vs k relation), Bloch Theorem, Electrons in an atom, Atomic Levels and Energy Bands, Electrons in a solid crystal, Filling of energy Bands/ Fermi Distribution in Metals, Insulators and Semiconductors.

CARRIER DYNAMICS:Transportation and Scattering of Carriers, Scattering of Electrons and Mobility, High Field Transportation, Band to band Tunneling and electric field, Transport by Diffusion, Quasi-Fermi Levels, Generation and Recombination of Electrons and Holes, Equation of Continuity for Carriers in Semiconductors, Carrier Injection and Distribution.

SEMICONDUCTOR DEVICE PROCESSING:Overview of devices, Bulk Crystal Growth, Epitaxial Crystal Growth, Lithography, Doping, Etching, Interfaces Between Materials, Example of High Performance Devices.

PN-DIODES:Non-Linear Current-Voltage, Non-Ideal Effect in PN-Diodes, Depletion and Mechanism of Current Flow, Band Profile, Minority Charge Distribution and Current in Forward Bias, Important Issues Controlling the Transportation in PN-Diodes, A Model for a PN-Diode, Mathematical Modelling and Simulations of various properties.

METAL-SEMICONDUCTOR JUNCTIONS: Band Profile of Junction, Schottky Junction on P-type Semiconductor, Current flow in a Schottky Diode, A Model of a Schottky Diode, Comparison Between PN and Schottky Diode, Mathematical Modelling and Simulations of various properties.

NANOGENERATORS:Introduction, Fabrication of a Nanogenerator, Material Structure, Working of a Nanogenerator, Harvesting Phenomenon in Nanogenerators, Mechanism of Piezoelectric potential Generation, Mathematical Modelling and Simulations of a Nanogenerator.

Reference Books:

Semi Conductor devices (Basic Principles)by Jasprit Singh, 2001.