SS865 SEMICONDUCTING MATERIALS AND DEVICES 3-1-0-4

Course Objective:
This course is intended to familiarize the research students about the theory behind the functioning of semiconductor devices. It also provide research students the insight useful for understanding new semiconductor devices and technologies.

Unit 1: Band structure and Electronic properties of Semiconductors


Concept of band gap: Direct and indirect bands in semiconductor, Bandstructure of selected Semiconductors: Si, Ge, GaAs, GaN, ZnO, Chalcopyrites, Delafossites, Perovskites. Semiconductor alloys, Lattice-mismatched and pseudomorphic materials, variation of Energy bands with alloy composition, Amorphous Semiconductors.

Unit 2: p-n junctions

p-n junction formation, Electrostatics of the p-n junction: Contact potential and Space Charge. Current - Voltage relationship, Quasi- Fermi levels and High- level injection, Graded Junctions, Junction Breakdown, Tunnel Diode.

Unit 3: Metal-Semiconductor and Semiconductor Heterojunctions


Unit 4: Metal Oxide Semiconductor Field Effect Transistor (MOSFET)

Review of Bipolar junction transistors (BJT) and Junction Field Effect Transistors (JFET). Introduction to Metal Oxide Semiconductor Capacitor (MOS), Capacitance - Voltage Characteristics of MOS structure, MOSFET Operation: Current -Voltage Characteristics, Substrate Bias Effects, Depletion and Enhancement MOSFETs. Challenges in Real MOSFETS: Subthreshold Conduction, Mobility Variation with Gate Bias, Important Effects in Short-Channel MOSFETs. Heterojunction FET: High electron mobility transistors (HEMT), Thin film transistors (TFT).

Unit 5: Optoelectronic Devices

Optical absorption: Photon absorption coefficient, electron-hole pair Generation rate. Solar cells: p-n junction solar cell, Conversion efficiency and solar concentration,
Nonuniform absorption effects, Heterojunction solar cells. Photodetectors: Photodiode, p-i-n photodiode, Phototransistors.

**Reference Books:**


**Course Outcomes:**

On successful completion of the course, the student will able to

CO1: Understand and analyse the density of carriers and carrier transport in semiconductors

CO2: Gain deep knowledge on the physics of semiconductor junctions, metal-semiconductor junctions and heterojunctions.

CO3: Understand the working of the field effect transistors.

CO4: Describe the functioning of the optoelectronic devices.

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