Semester - III

Major-3 (Theory): Semiconductor Devices: ELSDSC303T

(Credit: 3, Full Marks: 50, 45 Lecture-Hour)

Unit -I - Physics of Crystalline Solids (Lectures:04)

Crystalline materials: Crystal Structure in solids, Concept of Lattice, Basis, Crystal axes and planes, Primitive cells of simple cubic, face centred and body centred cubic, interplanar distance.

Unit -II - Carrier Transport Phenomena: (Lectures:0 8)

Expression for carrier concentration, Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation and Recombination Processes, Equation of Continuity.

Unit -III - Physics of P-N Junctions *(*Lectures:18)

PN junction diode: Depletion Layer at the junction, Junction potential in presence and absence of field, diode capacitance (concept of varactor diode), Current-voltage Characteristics (derivation not required), concept of Homojunction & Heterojunction.

Junction breakdown Mechanism: Zener and Avalanche.

Tunnel diode, Photo-diode – principle of operation of solar cell: circuit symbol, characteristics, applications.

Metal-Semiconductor contact: Ohmic and Schottky.

Unit -IV - Bipolar Junction Transistors (BJT) (Lectures:8)

BJT as a current control device, Basic Transistor Action, Transistor in Thermal Equilibrium, Qualitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base-Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations.

Basic idea of transistor models: Ebbers-Moll, r_e model of transistor.

Unit -V - Field Effect Transistors (Lectures:7)

Transverse Field Effect & Channel isolation, Categories of FETs.

JFET: Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics.

MOSFET: MOS capacitor, Channel formation, Threshold voltage (ideal & real), Current-voltage relation, Depletion & Enhancement type MOSFET.

Recommended Books

- S. M. Sze: Semiconductor Devices: Physics and Technology, 2nd Edition, Wiley India edition (2002).
- Ben G Streetman and S. Banerjee: Solid State Electronic Devices, Pearson Education (2006)
- Neamen: Semiconductor Physics & Devices, Tata McGraw Hill
- Jasprit Singh: Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
- Robert F. Pierret: Semiconductor Device Fundamentals, Pearson Education (2006)
- Dimitrijev: Principles of Semiconductor Devices, Oxford
- Dutta: Semiconductor Devices & Circuits, Oxford

Major-3 (Practical): Semiconductor Devices: ELSDSC303P

(Credit: 2, Full Marks: 50, 60 Laboratory Hours)

1. Study of the I-V Characteristics of Diode – Static and Dynamic
2. Study of the I-V Characteristics of Zener Diode – Forward and reverse
3. Study of the I-V Characteristics of the CE configuration of BJT and obtain r_i, r_o, β.
4. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain r_i, r_o, α.
5. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain, r_i, r_o.
6. Study of the I-V Characteristics of JFET
7. Study of the I-V Characteristics of MOSFET
8. Study of Characteristics of Solar Cell
9. Study of variation in carrier concentration with temperature