

B.Sc., Electronics Minor
SEMESTER-III

COURSE 2: SEMICONDUCTOR DEVICES AND MATERIALS
(w.e.f 2024-25)

Theory

Credits: 3

3 hrs/week

Objective:

1. To provide basic knowledge and concepts of Semiconductor materials and devices.
2. To facilitate students learn on the physical principles and operational characteristics of Semiconductor devices and some of its important applications. Pre-requisites: Basic understanding of semiconductors.

Outcomes:

- Ability to apply basic concepts of Inorganic and Organic Semiconductor materials for electronic device application in modern electronic industry.
- Detailed knowledge of various classifications and applications to VLSI, LEDs and solar cells.
- Holistic view of the latest progress in two-dimensional (2D)-one-dimensional(1D) and nano materials.
- Emphasis on nano-electronic applications such as Schottky barrier transistors, flexible Electronics

Unit I: (12 Hours)

Inorganic and Organic Semiconductor: Energy bands in semiconductors, carrier transport, mobility, drift- diffusion, excess carrier, injection and recombination of the excess carriers, carrier statistics; High field effects: velocity saturation, hot carriers and avalanche breakdown.

Unit II: (12 Hours)

Majority carrier Devices: MS contacts rectifier and non-rectifier, MIS structures, MESFET, hetero-junction, HEMT and band diagrams, I-V and C-V characteristics.

Unit III: (12 Hours)

Semi conductor Devices:

BJT: structure, working of NPN transistor, transistor configurations, input and output characteristics of a CE transistor.

FET: FET and its classification, construction and working of a JFET, Output and transfer characteristics of a JFET, Advantage of FET over BJT.

UJT: Structure , working and VI characteristics of a UJT. UJT as Relaxation Oscillator.

Unit IV: (12 Hours)

Optoelectronic Devices: solar cell, photo diode, photo transistor, LEDs, laser diodes.

Nano structures and concepts: quantum wells, supper lattice structures, nanorod, quantum dot, CNTs, 2D materials: grapheme, BN, MoS₂ etc, metamaterials.

UNIT-V: (12 Hours)

Multistage Amplifiers: construction and working of RC coupled amplifier- frequency response and transformer coupled amplifier.

Reference Books

1. Donald A. Neamen, Semiconductor Physics and Devices Basic Principles, 3rdedn.McGraw-Hil (2003)
2. B.G. Streetman and Sanjay Banerjee, Solid State Electronic Devices, 6thEdn.,PrenticeHall, 2006.
3. S. M. Sze and Kwok K. Ng Physics of Semiconductor Devices, Wiley (2013).
4. M. Husa, A. Dimoulas and A. Molle, 2D Materials for NanoElectronics,CRC press(2016)
5. M.S.Tyagi, Introduction to Semiconductor Materials and Devices, Willey,studentEdition

CO-PO mapping:

(1: Low 2: Medium 3: High 4.No correlation)

	PO1	PO 2	PO 3	PO 4	PO 5
CO 5	2	1	3	2	2

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Practical

Credits: 1

2

hrs/week

List of Experiments

1. To study the Hall Effect: determine the Hall coefficient, type of semiconductor and carrier concentration in the given semiconductor sample.
2. To study the four probe method: calculate the resistivity and energy band gap of given semiconductor sample.
3. To determine the resistivity of the given semiconductor specimen using Vander Pauw method.
4. To design a MOSFET as switching regulator for given duty cycle and plot the current-voltage (I-V) characteristic of MOSFET using Keithley.
5. To design a phase controlled rectifier using SCR and plot the I-V characteristic of SCR using Keithley.
6. To design a relaxation oscillator using UJT and plot the I-V characteristic of UJT.
7. I-V characteristics of a p-n diode/LEDs.