

8. Verification of the Maximum Power Transfer Theorem.
9. Design of Low Pass RC Filter and study of its Frequency Response.
10. Design of High Pass RC Filter and study of its Frequency Response.
11. Study of Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than nine.

Essential/recommended readings

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
2. M. Nahvi and J. Edminister, Electrical Circuits, Schaum's Outline Series, Tata McGraw Hill.(2005)
3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)

Suggestive readings (if any)

1. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC-3): Semiconductor Devices

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Semiconductor Devices ELDSC-3	4	3	0	1	Course Admission Eligibility	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the Physics of semiconductor devices
- To be able to plot and interpret the current voltage characteristics for basic semiconductor devices
- The student should be able to understand the behaviour, characteristics and applications of power devices such as SCR, UJT, DIAC, TRIAC, IGBT

Learning outcomes

The Learning Outcomes of this course are as follows:

- CO1 Describe the behavior of semiconductor materials
- CO2 Reproduce the I-V characteristics of diode/BJT/MOSFET devices
- CO3 Apply standard device models to explain/calculate critical internal parameters of semiconductor devices
- CO4 Explain the behavior and characteristics of power devices such as SCR/UJT etc.

SYLLABUS OF DSC-3

UNIT – I Introduction to Semiconductors and Carrier Transport (12 Hours)

Basic Concepts of Semiconductors: Energy Bands in Solids, Concept of Effective Mass, Direct and Indirect Bandgap Semiconductors, Density of States (Qualitative understanding), Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors and its Temperature Dependence, Derivation of Fermi Level for Intrinsic and Extrinsic Semiconductors and its Dependence on Temperature and Doping Concentration

Carrier Transport Phenomena: Drift velocity, Mobility, Resistivity, Hall Effect, Conductivity, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation and Recombination Processes (Qualitative concepts), Continuity Equation.

UNIT – II P-N Junction Devices (12 Hours)

P-N Junction Diode: Space Charge at a Junction, Depletion Layer, Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction

Diode Equation and I-V Characteristics (Qualitative), Zener and Avalanche breakdown Mechanism.

Metal Semiconductor Junctions, Ohmic and Rectifying Contacts, Zener diode, Tunnel diode, Varactor Diode, Optoelectronic Devices: LED, Photodiode, Solar cell, LDR, their Circuit Symbols, Characteristics and Applications

UNIT – III Bipolar Junction Transistors (12 Hours)

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Energy Band Diagram of Transistor in Thermal Equilibrium, Emitter Efficiency, Base Transport Factor, Current Gain, Relation between alpha and beta, Base-Width Modulation, Early Effect, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations and their Applications.

UNIT – IV FET and Power Devices (9 Hours)

Field Effect Transistors: JFET, Channel Formation, Pinch-Off and Saturation Voltage, Input, Transfer and Output Characteristics.

MOSFET, NMOS, PMOS, Types of MOSFET, Circuit symbols, Working and Characteristic Curves of Depletion mode and Enhancement mode MOSFET (both N channel and P Channel), Complimentary MOS (CMOS) as an Inverter.

Power Devices: Introduction to UJT, SCR, TRIAC, DIAC, IGBT and their Basic Constructional Features (Schematic Diagram), Characteristics and Applications.

Practical component (if any) - Semiconductor Devices Lab (30 Hours)
(Hardware and Circuit Simulation Software)

Learning outcomes

- CO1 Examine the characteristics of Semiconductor Devices
 - CO2 Perform experiments for studying the behaviour of semiconductor devices for circuit design applications
 - CO3 Calculate various device parameters values from their I-V Characteristics
 - CO4 Interpret the experimental data for better understanding of the device behaviour
1. Study of the I-V Characteristics of Diode – Ordinary and Zener, Solar Cell, Photodiode
 2. Study of the I-V Characteristics of the CE, CB and CC configurations of BJT and obtain Input and Output impedances and Gains (Any one configuration to be assigned at the time of Examination)
 3. Study of the I-V Characteristics of JFET/MOSFET
 4. Study of the I-V Characteristics of the UJT
 5. Study of the I-V Characteristics of the SCR
 6. Study of the I-V Characteristics of DIAC and TRIAC
 7. Study of Hall Effect.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than six.

Essential/recommended readings

1. S.M Sze Semiconductor Devices: Physics and Technology, 2nd Edition, Wiley India Edition
2. Ben G Streetman and S. Banerjee Solid State Electronic Devices, Pearson Education
3. Dennis Le Croisette, Transistors, Pearson Education
4. Jacob Millman and Christos Halkias: Electronic Devices and Circuits, Tata McGraw-Hill Edition

Suggestive readings

1. Nutan Kala Joshi and Swati Nagpal, Basic Electronics with Simulations and Experiments, Khanna Publishers (2021)
2. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons
3. Kannan Kano, Semiconductor Devices, Pearson Education