SEMESTER – I

BRANCH	Subject Title	Subject Code
B.Sc. (Electronics – MAJOR)	SEMICONDUCTOR DEVICES	ELM1

Course Learning outcomes

On completion of this course, learners will be able to:
CLOI: Describe the behavior of semiconductor materials
CL02: Reproduce the I-V characteristics of to diode/BJT/MOSFET devices
CL03: Apply standard device models explain/calculate critical internal parameters of semiconductor devices
CL04: Explain the behavior and characteristics of power devices such as SCR/UJT etc.

CONTENT

Unit - 1

Semiconductor Basics : Introduction to Semiconductor Materials, Crystal Structure, Planes and Miller Indices, Energy Band in Solids, Concept of Effective Mass, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors. Derivation of Fermi Level for Intrinsic & ExtrinsicbSemiconductors. Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity. Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation And Recombination Processes, Continuity Equation.

Unit -2

P -N Junction Diode : Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism. Tunnel diode, varactor diode, solar cell: circuit symbol, characteristics, applications.

Unit - 3

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative 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. Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.

Unit - 4

Field Effect Transistors : JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics.

MOSFET, types of MOSFETS, Circuit symbols. Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel). Complimentary MOS (CMOS).

Power Devices: UJT: Basic construction and working. Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression. SCR: Construction, Working and Characteristics, Triac, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications.

Practicals

1. Study of the I-V Characteristics of Diode - Ordinary and Zener Diode.

2. Study of the I-V Characteristics of the CE configuration of BJT and obtain ri, ro, B.

3. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain ri, ro, a.

4. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain, ri, ro

5. Study of the I-V Characteristics of the UJT.

6. Study of the I-V Characteristics of the SCR.

7. Study of the I-V Characteristics of JFET.

8. Study of the I-V Characteristics of MOSFET.

9. Study of Characteristics of Solar Cell

10. Study of Hall Effect.

Semester - II

BRANCH	Subject Title	Subject Code
B.Sc. (Electronics – MAJOR)	ELECTRONICS	ELM1

Course Learning Outcomes (CLO)

On completion of this course, learners will be able to:
CLO1: Study circuits in a systematic manner suitable for analysis and design.
CLO2: Understands how to formulate circuit analysis problems in a mathematically tractable way with an emphasis on solving linear systems of equations.
CLO3: Analyze the electric circuit using network theorems.
CLO4: Determine Sinusoidal steady state response.
CLOS: Understand the two-port network parameters with an ability to find out two-port network parameters & overall response for interconnection of two-port networks.

CONTENT

Unit - 1.

Basic Circuit Concepts: Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors, resistors in series and parallel. Inductors: Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, Testing of resistance and inductance using multimeter.

Capacitors: Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors, testing of capacitors using multimeter.

Unit - 2

Circuit Analysis : Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion.

DC Transient Analysis: RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant. RL and RC Circuits With Sources, DC Response of Series RLC Circuits.

Unit - 3

AC Circuit Analysis : Sinusoidal Voltage and Current, Definition of Instantaneous, Peak. Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits: Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.

Unit - 4

Network Theorems*: Principal of Duality, Superposition Theorem. Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. AC circuit analysis using Network theorems.

Two Port Networks: Impedance (2) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters.

Practicals

1. Familiarization with

a) Resistance in series, parallel and series- Parallel.

b) Capacitors & Inductors in series & Parallel.

c) Multimeter-Checking of components.

d) Voltage sources in series, parallel and series- Parallel

e) Voltage and Current dividers

2. Measurement of Amplitude, Frequency & Phase difference using CRO

3. Verification of Kirchoff's Law

4. Verification of Norton's theorem.

5. Verification of Thevenin's Theorem.

6 Verification of Superposition Theorem

7. Verification of the Maximum Power Transfer Theorem

8 RC Circuits: Time Constant, Differentiator, Integrator

9 Designing of a Low Pass RC Filter and study of its Frequency Response

10. Designing of a High Pass RC Filter and study of its Frequency Response

11. Study of the 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