

Fundamentals of Semiconductor Devices and Circuits

Course Description

This course delves into the fundamental principles underlying semiconductor devices and circuits. It provides a comprehensive understanding of semiconductor materials, diodes, transistors, amplifiers, oscillators, and other essential components in electronic circuits. Through theoretical concepts and practical applications, students will gain proficiency in analyzing, designing, and troubleshooting semiconductor-based circuits.

Audience

This course is designed for participants in electrical engineering, electronics engineering, or related fields. It is also suitable for professionals seeking to enhance their knowledge and skills in semiconductor device technology and circuit design.

Pre-requisite Knowledge/Skills

Basic knowledge of electrical circuits, electronic components, and principles of physics is recommended. Familiarity with mathematical concepts such as algebra and calculus would be beneficial.

Course Objectives

- Understand the atomic structure of semiconductors and the concept of energy bands.
- Explore the formation and characteristics of intrinsic and extrinsic semiconductors.
- Analyze the operation of diodes, including forward and reverse biasing, rectification, and applications.
- Comprehend the structure, operation, and characteristics of bipolar and unipolar transistors.
- Examine different transistor configurations and their biasing techniques.
- Evaluate the performance of transistor amplifiers, including single-stage CE amplifiers and multistage configurations.
- Investigate the principles of oscillators and their classifications, along with various oscillator circuits.
- Identify different types of semiconductor devices, such as Zener diodes, thyristors, and photodiodes, and their applications.

Course Outline

Module 1: Semiconductor Basics

- Atomic structure and energy levels
- Energy bands in materials
- Intrinsic and extrinsic semiconductors
- Doping and formation of P-N junctions
- Diode characteristics and rectifiers

Module 2: Transistors

- Bipolar transistor structure and operation
- Transistor configurations: CE, CB, CC
- Transistor biasing techniques
- Transistor amplification and testing
- Unipolar transistors: FET and MOSFET

Module 3: Transistor Amplifiers

- Amplification concepts and advantages
- Analysis of single-stage CE amplifiers
- Multistage amplifier configurations
- Power amplifiers and transistor switching

Module 4: Oscillators

- Oscillator classifications and feedback mechanisms
- R-C, L-C, and phase-shift oscillators
- Wien-bridge oscillator
- Hartley and Colpitts oscillators
- Sawtooth oscillator

Module 5: Semiconductor Devices

- Overview of various diode types: Zener, Varactor, Schottkey, Photodiode, LED
- Introduction to thyristors: SCR, TRIAC, DIAC