**EC2501 Semiconductor Devices and Circuits L-T-P: 3-0-0; Cr: 03**

**PREREQUISITE**

i) Elements of Electronics Engineering ii) Basics of circuits

**COURSE OBJECTIVE**

This course is intended to provide a good understanding of basic properties of semiconductor devices and circuits, physical principles and operational characteristics of different semiconductor devices and circuits. The primary focus will be on silicon based devices.

**COURSE CONTENT**

**Unit 1: Semiconductor Physics, Carrier Modelling and Carrier Action (6 Lectures)**

Energy Bands and Charge Carriers in Semiconductors: E-k diagram, Charge carrier concentration; Intrinsic carrier concentration; Law of mass action; Carrier transportation: Drift, diffusion and tunnelling, recombination, surface effects; Continuity equation in steady state condition; Fermi level; quasi-Fermi energy level; Hall effect; Optical and thermal properties.

**Unit2: Classical diodes (4 Lectures)**

Shockley equation; Junction capacitance; Diffusion capacitance; Varactor diode; Tunnel diode; IMPATT diode; Gunn diode; Difference between rectifying contact and ohmic contact; Schottky Diode.

**Unit3: Physics of Operation of BJT (6 Lectures)**

Transistor as switch: Delay time, Rise time, Storage time, Fall time, Transit frequency (wr); Ebers moll model; Gummel Poon model; Amplifier; RC coupled amplifier.

**Unit4: Physics of FET (11 Lectures)**

JFET: Ohmic or triode region of operation, Saturation region of operation, Transfer characteristics, Output characteristics (Depletion Type Device or Normally-On device), Shockley Equation, Different parameters; MOS structure: Band diagram of an ideal MOS structure, Flat-band voltage, Region of operation, C-V characteristics; MOSFET: Region of operation, Transfer characteristics and Output characteristics for both *n* and *p* channel MOSFET (Enhancement and Depletion), Threshold voltage, body effect and channel length modulation, Common source, Common gate and Common drain configurations.

**Unit5: Feedback and Power Amplifiers (7 Lectures)**

Feedback in amplifiers: Basic feedback topologies and analysis of various BJT amplifiers; CE amplifier, Emitter follower, Power amplifiers with applications: Class A, Class B / push-pull, Class AB / complementary symmetry and Class C.

**Unit6: Power Devices (4 Lectures)**

SCR; Diac; Triac; Power BJT- Power MOSFET.

**Unit 7 : Display Devices (4 Lectures)**

Direct and Indirect semiconductor: LED, Solar cell, Photodiode, LCD, Opto Coupler, CCD and its applications.

**TEXTBOOKS:**

1. B. G. Streetman and S. K. Banerjee, Solid Statu Electronic Devices, 7th Edition, Pearson.
2. Sedra and Smith, Microelectronics Circuits: Analysis and design, 6th Edition, Oxford University Press.

**REFERENCE BOOKS:**

1. Dr. A. Neamen, Semiconductor Physics and Devices, 3rd Edition, McGraw Hill, 2003
2. S. M. Size, Physics of Semiconductor Devices, 2nd Edition, John Wiley & Sons, 1981
3. R.S. Muller and T.I. Kamins, Device Electronics for Integrated Circuits, Wiley, 1986
4. S. M. Size, Semiconductor Devices: Physics and Technology, 2nd Edition, Wiley 2008.

**COURSE OUTCOMES:**

Upon successful completion of this course, students should be able to:

COl: Understand the vital concepts and essential characteristics pertaining to intrinsic and extrinsic semiconductors.

C02: Understand the operation of semiconductor devices such as diode, BJT, JFET, MOSFET, and display devices.

C03: Use models of semiconductor devices to predict terminal characteristics under diverse operating conditions.

C04: Learnconceptual understanding of how feedback and power amplifiers work.