

# SEMICONDUCTOR DEVICES AND INTEGRATED CIRCUITS

(For students admitted from June 2008)

Semester – I

Hours/week: 6

Credits:4

## **UNIT 1: PHYSICS OF SEMICONDUCTOR DEVICES:**

Energy band theory of semiconductors-Density of electrons in conduction band – Density of holes in valence band – Fermi levels in intrinsic and extrinsic semiconductors – Drift and diffusion currents – Recombination and life time of minority carriers – Einstein's relation – Poisson's equation – energy band diagram of a PN junction diode – continuity equation – Application of continuity equation to junction diodes and transistors.

## **UNIT 2: SPECIAL SEMICONDUCTOR DEVICES:**

**FET:** Field effect transistor – Physical interpretation of the characteristic curve – theory of JFET – FET biasing – common source and common drain amplifiers at low frequency – FET as voltage variable resistor. **MOSFET:** Depletion and Enhancement modes – MOSFET as switch and resistors – Dual gate MOSFET. **TUNNEL DIODE:** Quantum mechanical tunneling – Characteristics on the basis of energy band diagrams – Theory of tunnel diode – Applications of tunnel diode as switch amplifier and oscillator.

**GUNN DIODE:** RWH mechanism – Explanation of RWH mechanism on the basis of electron transfer – negative relaxation time – Gunn effect – Modes of operation of Gunn diode. **THYRISTORS:** PNP Diodes – construction – operation – characteristics – **SCR** construction and operation – characteristics – SCR as half wave and full wave rectifiers – Diac and Triac.

## **UNIT 3: IC FABRICATION TECHNOLOGY**

Monolithic IC Technology – Planar process – Fabrication of BJT, FET, and MOSFET – CMOS technology – monolithic diodes - Metal semiconductor contact – Integrated resistors, capacitors – Characteristics of IC components – VLSI – VHLD – Digital gates – MOSFET inverter, NOR, NAND gates – CMOS inverter, NOR, NAND gates.

## **UNIT 4: LINEAR ANALOG CIRCUITS**

DC Analysis of IC Op-Amp – Instrumentation amplifier – Transducer bridge – Instrumentation amplifier – Applications – Temperature indicator, Fluxmeter, ECG and weighing machine – Analog integrator, differentiator – Design of analog circuits for the solution of differential equation and simultaneous equations using Op-Amps – Sample and hold system – Analog multiplexer.

## **UNIT 5: NON-LINEAR ANALOG CIRCUITS**

Wave shaping circuits – Precision AC/DC converts – Precision rectifiers – Precision clamp – Fast half wave, full wave rectifier – Active average detector – Active peak detector – logarithmic & exponential amplifiers – Logarithmic multiplier – Analog squaring & square root circuits.

Comparators – Zero crossing detectors – Time marker generator – Multivibrators – astable (Square wave), Monostable (Pulse generator), Bistable (Schmitt trigger) circuits – Triangle wave generator – Timer 555 – Internal architecture and working – Monostable and astable operation – Voltage control oscillator (VCO) IC 566 – Active Butterworth filter - PLL concept – Phase locked loop IC 565 – Application – Frequency multiplier, FSK modulator and demodulator.

## **UNIT 6: MEMORY CIRCUITS AND SYSTEMS**

Programming bipolar PROMs – AIM technique – Floating gate (FAMOS) – MOS static RAM cell – MOS dynamic RAM cell – Refreshing circuits – Charged coupled devices – Basic CCD operation – Two phase CCD – Magnetic bubble memory – Auxiliary memory storage – Magnetic disk, floppy disk and Winchester hard disk – CD – Laser R/W systems – Flash memory (memory stick).

### **Books For Study:**

1. S.M.Sze, *Semiconductor devices Physics and Technology*, John Wiley & Sons, (1985) New York.
2. Jacob Millman and Christos.C.Halkias, *Integrated Electronics*, TMH, (2005) New Delhi.
3. Ramakant .A.Gayakwad, *Op Amps and integrated circuits*, 4<sup>th</sup> Edition, EEE, (1994).
4. Taub and Shilling, *Digital Integrated Electronics*, Mc Graw-Hill, (1983) New Delhi,.
5. Malvino and Leach, *Digital Principle and application* 5<sup>th</sup> edition, TMH (2002) New Delhi.

### **Books For Reference:**

- 1, R.F.Coughin and F.F.Driscol, *Opamp and linear integrated circuits*, Prentice Hall Of India, (1996) New Delhi.
- 2, M.S.Tyagi, *Introduction to semiconductor devices*, John Wiley & Sons, New York.
- 3, P.Bhattacharya, *Semiconductor Optoelectronic devices*, 2<sup>nd</sup> edition, Prentice hall of India, (2002) New Delhi.
- 4, B.Somnath Nair, *Digital electronics and Logic design*, Prentice Hall Of India, (2002) New Delhi.
- 5, R.L.Boylestad and L.Nashelsky, *Electronic devices and circuit theory*, 8<sup>th</sup> edition, Pearson Education (2003) New Delhi.