# DIGITAL CIRCUITS AND SYSTEMS

**Paper Code** **ECS-504**

**Course Credits** 4

**Lectures/ Week** 3

**Tutorials/ Week** 1

**Course description**

**UNIT- I Electronic Devices**

Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, LED, photo diode and solar cell.

**UNIT- II MOS Transistor**

Metal Oxide Semiconductor (MOS) Structure, MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances.

**UNIT-III MOS Inverters: Static and Switching Characteristics**

Resistive-Load Inverter, Inverters with n-type MOSFET Load, CMOS Inverter; Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters

**UNIT–IV MOS Logic Circuits and Semiconductor Memories**

MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates); Latch and Flip-Flop Circuits, Static Random-Access Memory (SRAM) Circuits, Dynamic Random-Access Memory (DRAM) Circuits, Nonvolatile Memories.

**UNIT–V Low-Power CMOS Logic Circuits**

Need of Low power, Sources of Power Dissipation, Low-Power Design through Voltage Scaling, Estimation and Optimization of Switching Activity, Reduction of Switching Capacitance.

**Pre-Requisite** None

**Text / Reference book**

1.Donald A. Neamen, "Semiconductor Physics and Devices: *Basics Principles*", 3rd Edition, Tata McGraw-Hill, 2002.

2. Sung Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits: *Analysis and Design*", 3rd Edition, Tata McGraw-Hill, 2003.

**Course Outcome**

**CO1:** A thorough understanding of carrier transport in the semiconductor devices, and the working principle of basic semiconductor devices, such as diode, Zenor diode, BJT, LED, Photo detector, and Solar Cell etc.

**CO2:** An ability to explain the Operation and Scaling/Small-Geometry Effects of MOS Transistor (MOSFET).

**CO3:** A thorough understanding of the MOS Inverter Static and Switching Characteristics and to utilize basic understanding of the same to design complex MOS Logic Circuits.

**CO4:** An ability to design Complex MOS Logic Circuits and state of the Art Semiconductor Memories.

**CO5:** A thorough understanding of sources of power dissipation and their reduction of the same to design low power system.