

Course Objectives:

1. To understand VLSI circuit design processes.
2. To understand basic circuit concepts and designing Arithmetic Building Blocks.
3. To have an overview of Low power VLSI.

UNIT-I

Introduction: Brief Introduction to IC technology – MOS, PMOS, NMOS, CMOS & Bi-CMOS technologies–Oxidation, Lithography, Diffusion, Ion implantation, Metallization, Encapsulation.
Basic Electrical Properties of MOS and BiCMOS Circuits: Ids–Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit ω_0 ; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT-II

Basic Circuit Concepts: Sheet Resistance R_s and its concepts to MOS, Area Capacitance calculations, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out.

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Case study: $2\mu\text{m}$ CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

UNIT-III

Gate level Design: Logic gates and other complex gates, Switch logic, Alternate gate circuits.
Physical Design: Floor-Planning, Placement, routing, Power delay estimation, Clock and Power routing

UNIT-IV

Subsystem Design: Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters, High Density Memory Elements.
VLSI Design styles: Full-custom, Standard Cells, Gate-arrays, ASIC, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices.

UNIT-V

VLSI Design Tools: The role of design tools in VLSI design process, VLSI design flow using design tools, front-end and back-end tools and their utilization in VLSI design process, study of cadence tools, case study of design of ALU using front-end and back-end tools Layout, Design capture tools, Design Verification Tools.

Course Outcomes: Students can able to

- a. Design and explain the fabrication of various VLSI circuits.
- b. Explain the basic circuit concepts
- c. Design various subsystems.
- d. Learn about different styles of VLSI design
- e. Learn the utilization of design tools for VLSI design process
- f. Learn about VLSI design for ASIC's and programmable platforms.

TEXT BOOKS:

1. Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, "Essentials of VLSI circuits and systems", 1st Edition, PHI, 2011.
2. K.Lal Kishore and V.S.V. Prabhakar, "VLSI Design", 1st Edition, IK International Publishing House, 2009.

REFERENCES:

1. Weste and Eshraghian, "Principles of CMOS VLSI Design", 2nd Edition, Pearson Education, 2010.
2. Wayne Wolf, "Modern VLSI Design", 3rd Edition, Pearson Education, 1997.

