

**III B.Tech – II Semester
(20EC6013) VLSI DESIGN**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

Pre-Requisites: Electronic Devices and Circuits, Analog & Digital IC Applications

Course Objectives:

- To learn CMOS device fabrication process and its electrical properties.
- To realize the stick and symbolic diagrams of logic circuits with design rules.
- To understand basic circuit concepts of MOS devices and learn the concepts of designing VLSI Subsystems.
- To realize importance of testability in logic circuit design and understand the
- To learn techniques of chip design using programmable devices and to study HDL based design approach.

UNIT-I: Introduction and Basic Electrical Properties of MOS Circuits:

Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS. I_{ds} versus V_{ds} Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms of pull-up, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology.

UNIT-II: MOS and Bi-CMOS Circuit Design Processes:

MOS Layers, Stick Diagrams, Design Rules and Layout, General observations on the Design rules, 2 μ m Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2 μ m Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter, Symbolic Diagrams- Translation to Mask Form.

UNIT-III: Basic Circuit Concepts:

Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, some area Capacitance Calculations, The Delay Unit, Inverter Delays, Driving large capacitive loads, Propagation Delays, Wiring Capacitances, Choice of layers.

Subsystem Design: Switch logic, Gate logic, some examples of combinational and sequential logic.

UNIT-IV: Design for Testability:

Fault types and Models, Controllability and Observability, Ad Hoc Testable Design Techniques, Scan Based Techniques and Built-In Self-Test techniques.

Introduction to Low Power VLSI Design: Introduction to Deep submicron digital IC design, Low Power CMOS Logic Circuits: Over view of power consumption. Interconnect Design, Power Grid and Clock Design.

UNIT-V: Introduction to FPGA:

FPGA design flow, Basic FPGA architecture, FPGA Technologies, FPGA families- Altera Flex\ 8000FPGA, Altera Flex 10FPGA, Xilinx XC4000 series FPGA, Xilinx Spartan XL FPGA, Xilinx Spartan II FPGAs, Xilinx Vertex FPGA. Case studies: FPGA Implementation of Half adder and full adder.

Introduction to synthesis: Logic synthesis, RTL synthesis, High level Synthesis.

Course Outcomes:

After successful completion of the course, the students can be able to:

S. No	Course Outcome	BTL
1.	Understand the various IC fabrication methods and its electrical properties of CMOS, NMOS	L2
2.	Apply the Concept of design rules and design and analyze the layout of a circuit.	L5
3.	Understand the basic circuit concepts of CMOS in terms of resistance and capacitance and how to design the subsystem structures.	L2
4.	Analyze the concepts in testing which can help them design a better yield in IC design and understand the need for low power VLSI circuits and analyze low power reduction techniques	L4
5.	Understand various logic families of FPGA and analyze and develop digital VLSI systems using VHDL	L2

Correlation of COs with POs & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO 2	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO 3	2	2	-	-	-	-	-	-	-	-	-	1	2	-
CO 4	3	2	3	-	-	-	-	-	-	-	-	3	3	-
CO 5	2	2	2	-	-	-	-	-	-	-	-	1	2	-

Text Books:

1. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2. CMOS Digital Integrated Circuits Analysis and Design- Sung-Mo Kang, Yusuf Leblebici, Tata McGraw-Hill Education, 2003.

Reference Books:

1. Advanced Digital Design with the Verilog HDL, Michael D.Ciletti, Xilinx Design Series, Pearson Education.
2. Analysis and Design of Digital Integrated Circuits in Deep submicron Technology, 3rd edition, David Hodges.