

Devi Ahilya University, Indore, India Institute of Engineering & Technology				II Year B.E. (Electronics and Instrumentation Engg.)			
Subject Code & Name	Instructions Hours per Week			Credits			
	L	T	P	L	T	P	Total
4EIRC4 CMOS DIGITAL DESIGN	3	1	1	3	1	1	5
Duration of Theory Paper: 3 Hours							

Learning Objective:

- This course presents the fundamental of Digital CMOS VLSI design with different VLSI design methodologies and combinational, sequential and semiconductor memory circuit design.
- It also covers the limitations of CMOS in NANO technology with introduction to the NANO Technology.

Prerequisite:

Knowledge of Digital Circuit and Basics of Semiconductors is required.

COURSE OF CONTENTS

UNIT I : INTRODUCTION

Metal Oxide Semiconductor Structure, MOS under External Bias, Operation of MOS Transistor. Threshold voltage equation and energy band diagram of MOSFET, controlling of threshold voltage. MOSFET current-voltage characteristics, MOSFET Capacitance, Small-Geometry Effects.

UNIT II: ANALYSIS OF CMOS

Analysis of different types of inverter circuit, CMOS inverter, transfer characteristic, calculation of propagation delay, rise time, fall time, noise margin and power dissipation for CMOS Inverter. Effect of threshold voltage and supply voltage on Delay and power dissipation. Limitations of CMOS in NANO scale circuit design.

UNIT III: CMOS COMBINATIONAL LOGIC CIRCUITS

CMOS logic, Complex Logic Circuits, pseudo NMOS logic, pass transistor logic, Transmission Gate logic and Dynamic logic circuit design. Designing of Combinational logic circuit using CMOS and analysis of various design parameters.

UNIT IV: CMOS SEQUENTIAL LOGIC CIRCUIT

Sequential MOS Logic circuits, SR Latched circuits, clocked latch and Flip Flop Circuits, CMOS D latch and Edge Triggered Flip Flop, Design of the Schmitt trigger circuit, Dynamic random access and Static random access memory cell design and analysis, Sense amplifier and row and column decoder circuit.

UNIT V: VLSI DESIGN

VLSI design flow, VLSI design style, introduction to the basic fabrication processes (wafer preparation, oxidation, diffusion, etching, metalization and lithography, etc.), Fabrication process Flow: basic Steps, the CMOS n-well Process.

BOOKS RECOMMENDED :

- [1]. Sung-mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuit analysis and Design, Tata McGraw-Hill, 3/e.
- [2]. R. Jacob Baker, Harry W. Li and David E. Boyce, CMOS Circuit design, layout and Simulation, PHI,IEEE press, Series Edition,
- [3]. Yuan Taur and Tak H. Ning, Fundamentals of Modern VLSI Devices, Cambridge university Press, Special Edition, 1998
- [4]. Neil H.E. Weste and Kamran Esharhian, Principal of CMOS VLSI design, PHI, 2/e
- [5]. Jan M. Rabaey, Digital Integrated Circuit, PHI, 2/e

LIST OF EXPERIMENTS :

1. To plot the (i) output characteristics & (ii) transfer characteristics of an n-channel and p-channel MOSFET.
2. To design and plot the static (VTC) and dynamic characteristics of a digital CMOS inverter.
3. To design and plot the output characteristics of a 3-inverter ring oscillator.
4. To design and plot the dynamic characteristics of 2-input NAND, NOR, XOR and XNOR logic gates using CMOS technology.
5. To design and plot the dynamic characteristics of 2-input NAND, NOR, XOR and XNOR logic gates using CMOS technology.
6. To design and plot the characteristics of a positive and negative latch based on multiplexers.