

B. Sc. Physical Sciences with Electronics as one of the Core Disciplines

DISCIPLINE SPECIFIC ELECTIVE COURSE – DSE 7 - 4 : VERY LARGE SCALE INTEGRATED CIRCUIT DESIGN

Course Title and Code	Credits	Credit distribution of the course			Pre-requisite of the course
		Lecture	Tutorial	Practical	
Very Large Scale Integrated Circuit Design DSE 7-4	4	3	0	1	

COURSE OBJECTIVES

The paper discusses basic principle of MOS Transistor operation for digital design, SPICE model, MOS transistor and Inverter layout, CMOS layout. Inverter design, CMOS inverter, inverter characteristics and specifications. MOS Logic design, pass transistor logic, static & dynamic latches, flip flops, static & dynamic registers.

LEARNING OUTCOMES

At the end of this course, students will be able to

1. Understand the concept of models of MOS devices and their implementation in designing of CMOS inverter.
2. Measure the performance parameters like threshold voltage, noise margins, time delays etc.
3. Familiarize with the techniques and components involved in combinational MOS circuit designs.

SYLLABUS OF DSE 7-4

THEORY COMPONENTS

(Hours: 45)

Unit I (10 Hours)

Metal Oxide Semiconductor (MOS)

Introduction to basic principle of MOS transistor, large signal MOS models (long channel) for digital design.

Unit II (10 Hours)

MOS SPICE model, MOS device layout

Integrated circuit technology- SSI, MSI, LSI, VLSI, Transistor layout, Inverter layout, CMOS digital circuit layout.

Unit III (15 Hours)
MOS Inverter

Inverter principle, Depletion and enhancement load inverters, the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, Propagation Delay and Power Consumption.

Unit IV (10 Hours)
Combinational MOS Logic Design

Static MOS design, Pass Transistor logic, complex logic circuits. Sequential MOS Logic Design - Static latches, Flip flops & Registers

PRACTICAL COMPONENT: VERY LARGE SCALE INTEGRATED CIRCUIT DESIGN

(Hours: 30)

Basic VLSI Design Lab (Pspice/Similar Simulation software)

Students should perform at least four practicals from the following list:

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 characteristics of a 4x1 digital multiplexer using pass-transistor logic.
6. To design and plot the characteristics of a positive and negative latch based on multiplexers.
7. To design and plot the characteristics of a master-slave positive and negative edge triggered registers based on multiplexers

REFERENCES

1. Kang & Leblebici —CMOS Digital IC Circuit Analysis & Design- McGraw Hill, 2003.
2. Rabey, —Digital Integrated Circuits Design, Pearson Education, Second Edition, 2003.
3. Weste and Eshraghian, —Principles of CMOS VLSI design, Addison-Wesley, 2002.
4. Basic VLSI design: Douglas A Pucknell, Kamran Eshraghian, PHI, 3rd edition