GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Electronics & Communication (VLSI System Design)

Course / Subject Code : ME01000371

Course / Subject Name : Digital VLSI Design

WEF Academic Year :	2024 - 25
Semester :	1st Semester
Category of the Course :	PCC

Prerequisite:	Basic Digital Electronics and CMOS based circuits.
Rationale:	This course will provide an opportunity to the students to learn about various topics of VLSI such as design of digital circuits using MOSFET device as well as using hardware description language (HDL). In laboratory part of this course, students will be given exposure to HDL for automated design of digital circuits. This subject is very important for the students who would like to pursue their career in VLSI domain.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Introduction :** Overview of VLSI design methodology, VLSI design flow, Read-Only Memory, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL), SPLD, CPLD, FPGA, ASIC, SoC Technology.	8	15
2	**MOS Inverters :** Introduction, MOS Inverter with different loads, CMOS Inverter, Delay- Time definition, Calculation of Delay times, Switching Power Dissipation of CMOS Inverters.	7	15
3	**MOS Logic Circuits :** Introduction, MOS logic circuits with depletion nMOS loads, CMOS logic circuits, Complex logic circuits, CMOS Transmission Gates (TGs), Behavior of bistable elements, Different latches and flip flops using MOS and CMOS, Basic principle of Pass Transistor.	7	20

4	**Semiconductor Memory :** DRAM, SRAM, Non-Volatile Memory, Flash Memory.	4	10
5	**Arithmetic Building Blocks :** Architectures of Adders, Subtractors, Multipliers.	9	15
6	**Concept of HDL:** Introduction, Concept of HDL for Data-flow, Behavioral, Structural, RTL, and switch level modeling, coding of basic digital circuits using HDL.	10	25
	Total	**45**	**100**

Reference Books:

1. CMOS Digital Integrated circuits – Analysis and Design by Sung – Mo Kang, Yusuf Leblebici, and TATA McGraw- Hill Pub. Company Ltd.
2. Basic VLSI Design by Pucknell and Eshraghian, PHI, 3rd Ed.
3. Introduction to VLSI Systems by Mead C and Conway, Addison Wesley
4. Introduction to VLSI Circuits & Systems – John P. Uyemura
5. Fundamentals of Digital Logic Design with VHDL, Brown and Vranesic
6. Fundamentals of Digital Logic Design with Verilog, Brown and Vranesic, TATA McGraw
7. FPGA Based System Design, Wyane Wolf, Pearson
8. Verilog HDL, Sameer Palnitkar, Pearson

Course Outcome:

1. Analyze, design, and simulate various static CMOS circuits
2. Prepare layout of MOSFET based circuits
3. Understand CMOS latch-up, clocking strategy, and types of memory
4. Write programs in HDL for digital circuits and implementation them on FPGA/CPLD

List of Experiments:

1. Minimum 9 Practicals Based on HDL
2. Minimum 3 Practicals Based on SPICE of MOSFET Circuits
3. Minimum 2 Practicals on Layout Tools

VLSI design methodologies should be covered during Laboratory session

Suggested List of Experiments:

1. Design and implementation of different types of combinational circuits with different modeling styles.
2. Design and implementation of different types of latches and flip flops
3. Design and implementation of different types of register and counter.
4. Design and implementation of Linear Feedback Shift Register (LFSR).
5. Design and implementation of sequential adder.

6. Design and implementation of two 8-bit multiplier circuit
7. Design and implementation of 16-bit RAM.
8. Design and implementation of 8 BIT ALU.
9. Design and implementation of FSM sequence detector.
10. Design and implementation of FIFO Module.
11. Simulation and verification of CMOS Inverter using SPICE for transfer characteristic.
12. Simulation and verification of two input CMOS NOR gate using SPICE.
13. Implementation and simulation of given logic function using SPICE
14. To generate layout for CMOS Inverter circuit and simulate it for verification.
15. To prepare layout for given logic function and verify it with simulations.
16. To measure propagation delay of a given CMOS Inverter circuit.
17. Minor project

Major Equipment/software:

Circuit simulator, FPGA/CPLD programming tool, Multimeter, Power supply, function generator, oscilloscope

List of Open Source Software/learning website : NPTEL, NG-SPICE circuit simulator

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