INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

CMOS VLSI DESIGN								
VII Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD57	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: VLSI Design and Electronic Devices and Circuits								

I. COURSE OVERVIEW:

This course introduces students to the fundamentals concepts of CMOS VLSI circuit design. This course will cover CMOS device characteristics and timing. CMOS fabrication will be covered including process steps, metal, active, and poly layers, and design rules. CAD tools will be introduced for use in design, simulation, and layout of integrated circuits. Design analysis techniques will be presented for the static and dynamic evaluation of CMOS circuits. Memory elements including flip-flops, SRAM, and DRAM will also be presented.

II. COURSES OBJECTIVES:

The students will try to learn

I. Fundamental concepts needed to explain about CMOS VLSI device characteristics and timing diagrams.
II. The fabrication process of CMOS transistor including design steps and rules.
III. Focus on the systematic analysis and design of basic digital integrated circuits in CMOS technology
IV. The static and dynamic evaluation of CMOS circuits and various memory elements.
V. Focus on the methodologies and design techniques related to digital integrated circuits.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1: Understand the fundamental concepts of MOS transistor for design a various integrated circuit.
CO2: Apply principles to Identify and Analyze the various steps for the fabrication of various components
CO3: Design the inverter with optimized power, area and timing using CMOS transistors.
CO4: Compare the tradeoffs of sequencing elements including flip-flops, transparent latches, and pulsed latches
CO5: Design CMOS memory arrays, understand interconnect and clocking issues.
CO6: Analyze the interconnect and timing issues in latch and flip-flops for the performance of digital systems.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO CMOS FABRICATION (10)

Issues in Digital IC Design- Quality Metrics of a Digital Design - MOS Transistor Theory. CMOS Process Technology N-well, P-well process, stick diagram for Boolean functions, Optimization using Euler Theorem, Layout Design Rules.

MODULE –II: THE CMOS INVERTER (09)

Static CMOS Inverter- Static and Dynamic Behavioural Practices of CMOS Inverter – Noise Margin. Components of Energy and Power – Switching -Short-Circuit and Leakage Components. Technology scaling and its impact on the inverter metrics - Passive and Active Devices.

MODULE –III: CMOS SEQUENTIAL LOGIC CIRCUIT DESIGN (10)

Delay Calculation using Logical Effort, Complementary CMOS -Ratioed Logic (Pseudo NMOS, DCVSL) - Pass Transistor Logic - Transmission gate logic - Dynamic Logic Design Considerations - Speed and Power Dissipation of Dynamic logic -Signal integrity issues - Domino Logic.

Introduction - Static Latches and Registers - Dynamic Latches and Registers - Pulse Based Registers - Sense Amplifier based registers -Latch vs. Register based pipeline structures.

MODULE –IV: DESIGNING MEMORY & ARRAY STRUCTURES (10)

SRAM and DRAM Memory Core - memory peripheral circuitry - Memory reliability and yield - Power dissipation in memories**.**

MODULE –V: INTERCONNECTS AND TIMING ISSUES (09)

Resistive, Capacitive and Inductive Parasitics - Computation of R, L and C for given interconnects - Buffer Chains - Timing classification of digital systems - Synchronous Design - Origins of Clock Skew/Jitter and impact on Performance - Clock Distribution Techniques - Latch based clocking - Synchronizers and Arbiters -Clock Synthesis and Synchronization using a Phase Locked Loop.

V. TEXT BOOKS:

1. Jan M. Rabaey, Anantha Chadrakasan and Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, 2016, Second Edition, PHI.
2. Neil.H, E.Weste, David Harris and Ayan Banerjee, CMOS VLSI Design: A Circuit and Systems Perspective, 2011, Fourth Edition, Pearson Education.

VI. REFERENCE BOOKS:

1. H Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits - Analysis and Design, 2014, Fourth Edition, McGraw-Hill.
2. Sorab K Gandhi, VLSI Fabrication Principles: Si and GaAs, 2010, Second Edition, John Wiley and Sons.

VII. ELECTRONICS RESOURCES:

1. NPTEL :: Physics - NOC:CMOS VLSI DESIGN
2. https://nptel.ac.in/courses/ 108/107/108107129/

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper - I
7. Model question paper - II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations