INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

VLSI DESIGN								
VI Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD30	**Core**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisites: Electronic Devices and Circuits, IC applications								

I. COURSE OVERVIEW:
This course introduces students about the fabrication techniques of design and implementation of VLSI circuits. Specific topics include: CMOS logic, MOSFET theory, design rules & layout procedures. The course further elaborates data path subsystems, PLD's performance parameters and testing approaches.

II. COURSES OBJECTIVES:
The students will try to learn

I. The aspects of hierarchical VLSI design from the metal oxide semiconductor transistor up to the system level, fabrication and testing.

II. The subsystem design incorporating into a VLSI chip with contemporary techniques for achieving high-speed, low-power and low area overhead.

III. Advanced modern tools such as Vivado and cadence for front end and back end for chip design through a practical approach.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO1 Summarize the MOSFET fabrication process, electrical properties and scaling for understanding latest developments in VLSI.

CO2 Make use of stick diagrams and layout designs to convey layer information in MOSFET circuits.

CO 3 Analyze inverters, complex gates and dynamic CMOS circuits to calculate power consumption, distortion and speed of operation.

CO4 Illustrate data path subsystems and array subsystems using stick diagrams and layouts.

CO5 Outline the role of Programmable logic devices for realization of complex Boolean functions.

CO6 Examine the test strategies, implementation approach on full custom and semi-custom design for optimizing speed, cost, reconfiguration and reliability parameters.

IV. COURSE CONTENT:

MODULE - I: BASICS MOSFETS BASICS (10)

Evolution of VLSI Design, Moore's Law, Basic MOS Transistor Operation, Fabrication Steps for MOSFETS, Ids-Vds relationships in saturation and ohmic regions, Threshold voltage concept in MOSFETs, Figure of merit; NMOS Inverter, Determination of Pull up to Pull Down Ratio, Transmission Gates, CMOS Inverter analysis and design; Simple form of Bi-CMOS Inverters and it's alternative forms.

MODULE –II: VLSI CIRCUIT DESIGN PROCESSES (10)

VLSI Design Flow; Series and Parallel equivalent circuits, MOS Layers; Stick Diagrams; Physical design rules: Absolute and lambda based design rules for wires, contacts and transistors; Euler's rule for physical design and Layout; Transistors Layout Diagrams for NMOS and CMOS Inverters; Sheet Resistance and area capacitance of layers; Scaling of MOS circuits

MODULE –III: BASIC CIRCUIT CONCEPTS AND GATE LEVEL DESIGN (10)

Inverter Time delays; Driving large capacitive loads; Super Buffers, Propagation Delays; Wiring capacitances; Fan-in and Fan-out; Choice of layers. Power Dissipation: Static, Dynamic and Total Power Dissipations, Latching in VLSI.

Gate Level Design: Complex gates; Other forms of CMOS logic such as Pseudo –nMOS, dynamic CMOS, clocked CMOS, CMOS domino, n-p CMOS.

MODULE –IV: DATA PATH SUBSYSTEMS (8)

Data Path Sub Systems: Sub system design; Carry Look Ahead; Carry select Adders; Manchester carry chain; ALUs; Multipliers; Parity generators; Comparators; Zero/one detectors; Array Subsystems: SRAM, DRAM, ROM, Floating gate concepts and Flash Memories, Serial access Memories, Content Addressable Memories.

MODULE –V: CMOS CHIP DESIGN AND TESTING (10)

Programmable Logic Devices: Design Approach – PROM, PLA and PAL; FPGAs; CPLDs; FPGA building block architectures; FPGA interconnect routing procedures; Speed and area tradeoff. Design strategies, ASICs; Routing Procedures: Global Detailed and Special Routings, CMOS Testing; Built-in Self –Test Strategies.

V. TEXT BOOKS:

1. A. Pucknell, Kamran Eshraghian, "BASIC VLSI Design," Third Edition, Prentice Hall of India, 2007. ISBN: 978-81-203-0986-9.
2. R. Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation," Wiley-IEEE Press, USA, 2005. ISBN: 978-0-470-88132-3
3. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective," Second Edition, Phi Learning, 2009. ISBN: 97881203225789

VI. REFERENCE BOOKS:

1. N. Weste, K. Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley, 1993. ISBN: 978-81-317-1942-8
2. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, First edition, 1997. ISBN- 13: 978-0321602756.
3. John P. Uyemura, "CMOS Logic Circuit Design," Springer, USA, 2007.
   ISBN 0-7923-8452-0 Yuan S W, "Foundations of fluid Mechanics", Prentice-Hall, 2nd Edition, 1987.

VII. ELECTRONICS RESOURCES:

1. https://nptel.ac.in/courses/117106092
2. https://akanksha.iare.ac.in/index?route=course/details&course_id=1630
3. https://nptel.ac.in/courses/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