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| **ECL5501** | **VLSI Design Lab** | **L-T-P: 0-0-3; Total 12 Sessions** |

***Pre-requisite:*** Basic knowledge of digital logic design, fundamentals of CMOS Inverter.

***Objectives:*** This course gives the opportunity to the students to learn about the configuration and simulation of Very Large Scale Integrated Circuits & Systems. The main purpose of this lab course is to explore various design style of simple and complex Integrated Circuits(IC) near to students. In this laboratory students are able to understand about models and model parameters of MOSFET amplifier CMOS Inverter etc. which are suited for IC Technology.

***Course Contents:***

**Unit I**: Familiarization with MOS model parameters in PSPICE software. Simulation of MOS Inverter with different loads using PSPICE software. Simulation of CMOS Inverter for different parameters Kn, Kp as a design variable in PSPICE software. CMOS inverters -static and dynamic characteristics, CMOS NAND, NOR and XOR Gates, Layout design and simulation. [2 Lab Sessions]

**Unit-II :** Simulate half-adder, full adder, half substractor, full-sunstractor following behavioral and structural modeling using VHDL\Verilog. Design of a 4-bit Multiplexer/demultiplexer using VHDL\Verilog. [4 Lab sessions]

**Unit-III :** Design Flip-Flops, latches, registers, counters, FIR & IIR filters using VHDL/Verilog and their hardware implementation on FPGA board.[5 Lab sessions]

**Unit-IV:** Implementation and Simulation of 2D/3D PN Junction Diode. Implementation and Simulation of 2D/3D NPN & PNP BJT. [1 Lab sessions]

***Text/reference Books:***

1. Jan M Rabaey, Digital Integrated Circuits, 2nd Edition, Pearson Education
2. Sung-Mo Kang, CMOS Digital Integrated Circuits, 3rd Edition, McGraw-Hill
3. Pedroni, Volnei A., Circuit Design and Simulation with VHDL, 2nd Edition, MIT Press
4. [R. Jacob Baker](https://www.amazon.com/R.-Jacob-Baker/e/B001ITTFE4/ref=dp_byline_cont_book_1) , [Harry W. Li](https://www.amazon.com/s/ref=dp_byline_sr_book_2?ie=UTF8&text=Harry+W.+Li&search-alias=books&field-author=Harry+W.+Li&sort=relevancerank) , [David E. Boyce](https://www.amazon.com/s/ref=dp_byline_sr_book_3?ie=UTF8&text=David+E.+Boyce&search-alias=books&field-author=David+E.+Boyce&sort=relevancerank) CMOS (Circuit Design, Layout, and Simulation)  Prentice-Hall of India Private Ltd.
5. J. Bhasker “A VHDL Primer” 3rd Edition, Pearson
6. S. M. Sze& Kwok K. Ng., Physics of Semiconductor devices, Wiley
7. M. Lundstrom& Jing Guo, Nano-scale transistors: Device Physics Modelling and Simulation, Springer

***Outcomes*:** Upon successful completion of this course, students should be able to:

1. Understand the concepts of digital system design methods through practical domain. Design combinational and sequential circuits.
2. Analyse and layout design of CMOS circuits in micron and submicron level using any platform.
3. Learn techniques and engineering tools (such as HDL, Xilinx / Altera) to design, implement.