

## EC302 VLSI DESIGN (Dept. Elective - III)

### **Course Description & Objective:**

To introduce students to basic concepts of digital VLSI chip design using the simpler VLSI technology and CMOS devices and manufacturing technology. To introduce CMOS logic gates and their layout, to design Combinational (e.g., arithmetic) and sequential circuit.

### **Course Outcomes:**

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

- I Ability to HDL in different styles.
- I Understand the operation of MOS transistor.
- I Ability to Analyze static characteristics of MOS inverters.
- I An ability to design logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits.
- I Demonstrate a clear understanding of important concepts in CMOS technology and fabrication that affect design.

### **UNIT I - Hardware Description Language:**

**The VHDL Hardware Description Language:** Design flow, program structure, types and constants, Functions and procedures, libraries and packages.

**The VHDL Design Elements:** Structural design elements, data flow design elements, behavioral design elements,

### **UNIT II - Mos Technology:**

**Introduction :** State of art of different technology, Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies-Oxidation, Lithography, Diffusion, Ion implantation, Metallization, Encapsulation processes, N-MOS, C-MOS fabrication.

### **UNIT III - Basic Electrical Properties:**

MOS Transistor, operation,  $I_{DS}$ - $V_{DS}$  relationships, MOS transistor parameters: threshold Voltage,  $g_m$ ,  $g_{ds}$ , figure of merit ( $w_0$ ); Pass transistor, NMOS Inverter,

Various pull ups, CMOS Inverter , Zpu/Zpd with and without pass transistor, Bi-CMOS Inverters.

**UNIT IV - VLSI Circuit Design Processes:**

VLSI Design Flow, MOS Layers, Stick Diagrams, Layouts and Design Rules for NMOS, CMOS and BICMOS circuits, CMOS inverters and gates. The delay unit, Inverter delays, Driving capacitive loads, Propagation delays, wiring capacitances, Introduction to scaling.

**UNIT V - Subsystem Design:**

Adders-Carry ripple adder, carry propagate adder, Multipliers-Array Multiplier, Booth encoding,Latches,Flip Flops; Simulation, Synthesis, Design Capture Tools, Design For Testability, Alternate gate circuits-Pseudo-nMOS, Dynamic CMOS, CMOS Domino Logic and Cascaded Voltage Switch Logic (CVSL),Standard cell, Seaofgates, FPGA.

**TEXT BOOKS:**

1. Kamran Eshraghian, EshraghianDouglas and A. Pucknell, Essentials of VLSI circuits and systems, PHI, 2005 ed.,
2. Weste and Eshraghian, Principles of CMOS VLSI Design , Pearson Education, 1999.

**REFERENCE BOOKS:**

1. John f walkerly, digital design principles and practices, 3rd ed., phi/pearson education, 2005.
2. J.Bhasker, vhdl primer, 3rd ed., pearsonedn / phi.
3. S.M. SZE, "VLSI Technology" , 2nd ed., TMH, 2003
4. Wayne Wolf, "Modern VLSI Design", 3rd ed., Pearson Education, 1997