

## **VLSI & MICROELECTRONICS**

**EE-605C**

**Credit: 3**

**Contact: 3L**

Module 1 [8]

**Introduction to VLSI Design:** VLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA), Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioral, Structural, Physical), Y-Chart, Digital VLSI Design Steps.

Module 2 [12]

**MOS structure:** E-MOS & D-MOS, Charge inversion in E-MOS, Threshold voltage, Flatband voltage, Potential balance & Charge balance, Inversion, MOS capacitances.

**Three Terminal MOS Structure:** Body effect.

**Four Terminal MOS Transistor:** Drain current, I-V characteristics. Current-voltage equations (simple derivation).

**Scaling in MOSFET:** Short Channel Effects, General scaling, Constant Voltage & Field scaling.

**CMOS:** CMOS inverter, Simple Combinational Gates - NAND gate and NOR Gate using CMOS.

Module 3 [10]

**Micro-electronic Processes for VLSI Fabrication:** Silicon Semiconductor Technology- An Overview, Wafer processing, Oxidation, Epitaxial deposition, Ion-implantation & Diffusion, Cleaning, Etching, Photo-lithography – Positive & Negative photo-resist

**Basic CMOS Technology** – (Steps in fabricating CMOS), Basic n-well CMOS process, p-well CMOS process, Twin tub process, Silicon on insulator

**Layout Design Rule:** Stick diagram with examples, Layout rules.

Module 4 [10]

**Hardware Description Language** – VHDL or Verilog Combinational & Sequential Logic circuit Design.

### **Text Books:**

1. Digital Integrated Circuit, J.M.Rabaey, Chandrasan, Nolic, Pearson Education.
2. CMOS Digital Integrated Circuit, S.M.Kang & Y.Leblic, TMH.
3. Modern VLSI Design, Wayne Wolf, Pearson Education.
4. VHDL, Bhaskar, PHI.
5. Advance Digital Design Using Verilog , Michel D. Celliti, PHI

### **References:**

1. Digital Integrated Circuits, Demassa & Ciccone, John Willey & Sons .
2. Modern VLSI Design: system on silicon, Wayne Wolf; Addison Wesley Longman Publisher
3. Basic VLSI Design, Douglas A. Pucknell & Kamran Eshranghian, PHI
4. CMOS Circuit Design, Layout & Simulation, R.J.Baker, H.W.Lee, D.E. Boyee, PHI