DURGAPUR INSTITUTE OF ADVANCED TECHNOLOGY AND MANAGEMENT

(Affiliated to MAKAUT and recognized by AICTE, New Delhi)

Subject Code: IT705D Subject Name: Microelectronics & VLSI Design
Semester : VII Year: 4th Session : 2018

Branch Name: Information Technology Faculty Name: Amit Kumar Datta
Assistant Professor
IT Department

Syllabus

Module -1: [6L]
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: [10L]
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: [10L]
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: [10L]
Hardware Description Language – VHDL or Verilog Combinational & Sequential Logic circuit Design.

TEXT BOOK:

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

REFERENCE BOOK:

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

Course Outcomes:

1. Get the knowledge about the trends in semiconductor technology, and how it impacts scaling and performance.
2. Able to learn Layout, Stick diagrams, Fabrication steps, Static and Switching characteristics of inverters
3. Get the knowledge Synthesis of digital VLSI systems from register-transfer or higher level descriptions in hardware design languages.
4. Get the knowledge to understand MOS transistor as a switch and its capacitance.
5. Student will be able to design digital systems using MOS circuits.

LESSION PLAN

Sr. No.	Day	Reference of the Syllabus	Remarks
1	Lecture 1	VLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only).	
2	Lecture 2	Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA).	
3	Lecture 3	Design principles (Digital VLSI – Concept of Regularity, Granularity etc).	
4	Lecture 4	Design Domains (Behavioral, Structural, Physical).	
5	Lecture 5	Y-Chart, Digital VLSI Design Steps.	
6	Lecture 6	Digital VLSI Design Steps.	
7	Lecture 7	E-MOS & D-MOS, Charge inversion in E-MOS.	
8	Lecture 8	Threshold voltage, Flat band Voltage.	
9	Lecture 9	Potential balance & Charge balance, Inversion.	
10	Lecture 10	MOS capacitances.	
11	Lecture 11	Three Terminal MOS Structure: Body effect.	
12	Lecture 12	Four Terminal MOS Transistor: Drain current, I-V characteristics. Current-voltage equations (simple derivation).	
13	Lecture 13	Four Terminal MOS Transistor: Drain current, I-V characteristics. Current-voltage equations (simple derivation).	
14	Lecture 14	Short Channel Effects, General scaling,	
15	Lecture 15	Constant Voltage & Field scaling.	
16	Lecture 16	CMOS: CMOS inverter, Simple Combinational Gates - NAND gate and NOR Gate using CMOS.	
17	Lecture 17	Silicon Semiconductor Technology- An Overview	
18	Lecture 18	Wafer processing, Oxidation,	
19	Lecture 19	Epitaxial deposition, Ion-implantation & Diffusion,	
20	Lecture 20	Cleaning, Etching,	
21	Lecture 21	Photo-lithography – Positive & Negative photo-resist	
22	Lecture 22	Steps in fabricating CMOS	

23	Lecture 23	Basic n-well CMOS process, p-well CMOS process	
24	Lecture 24	Twin tub process, Silicon on insulator	
25	Lecture 25	Stick diagram with examples	
26	Lecture 26	Stick diagram with examples, Layout rules.	
27	Lecture 27	VHDL- Combinational & Sequential Logic circuit Design.	
28	Lecture 28	VHDL- Combinational & Sequential Logic circuit Design.	
29	Lecture 29	VHDL- Combinational & Sequential Logic circuit Design.	
30	Lecture 30	VHDL- Combinational & Sequential Logic circuit Design.	
31	Lecture 31	VHDL- Combinational & Sequential Logic circuit Design.	
32	Lecture 32	VHDL- Combinational & Sequential Logic circuit Design.	
33	Lecture 33	VHDL- Combinational & Sequential Logic circuit Design.	
34	Lecture 34	VHDL- Combinational & Sequential Logic circuit Design.	
35	Lecture 35	VHDL- Combinational & Sequential Logic circuit Design.	
36	Lecture 36	VHDL- Combinational & Sequential Logic circuit Design.	

Signature of HOD

Signature of the faculty