GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3722611
Semester – II
Subject Name: VLSI Technology

Type of course: VLSI fabrication technology, manufacturing of VLSI devices

Prerequisite: Knowledge of basic semiconductor physics

Rationale: Students of ME in VLSI must possess a good understanding of VLSI fabrication process. Students must learn in detail about various processing steps utilized in fabrication of VLSI IC. As well student should possess knowledge of various analytical and assembly techniques. Student should be familiar with yield and reliability issue in VLSI.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**Crystal Growth, Wafer Preparation, Epitaxy and Oxidation:** Electronic Grade Silicon, Czochralski crystal growing, Silicon Shaping, processing considerations and future trends, Vapor phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation and future trends, Growth Mechanism and kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxide properties, Redistribution of Dopants at interface, Oxidation of Poly Silicon, Oxidation inducted Defects.	**10**
2	**Lithography and Relative Plasma Etching:** Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties, Feature Size control and Anisotropic Etch mechanism, Reactive Plasma Etching techniques and Equipment, Specific etch processes and future trends.	**10**
3	**Deposition, Diffusion, Ion Implementation and Metallization:** Deposition process, Poly silicon, plasma assisted Deposition, Models of Diffusion in Solids, Fick's one dimensional Diffusion Equations, Atomic Diffusion Mechanism, Measurement techniques, Range theory, Implant equipment. Annealing Shallow junctions, High-energy implantation, Physical vapor deposition, Patterning and future trends.	**10**
4	**Process Simulation and VLSI Process Integration:** Ion implantation, Diffusion and oxidation, Epitaxy, Lithography, Etching and Deposition, NMOS IC Technology, CMOS IC Technology, MOS Memory IC technology, Bipolar IC	**10**

	Technology, IC Fabrication and future trends.	
5	**Analytical, Assembly Techniques and Packaging of VLSI Devices:** Analytical Beams, Beam Specimen interactions, Chemical methods, Package types, packaging design considerations, VLSI assembly technology, Package fabrication technology and future trends.	**10**
6	**Yield and Reliability Analysis:** Mechanisms and modelling of Yield loss in VLSI, Reliability requirement in VLSI, Failure distributions, accelerated testing, Failure mechanisms.	**6**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	**30**	**10**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. S. M. Sze, "VLSI Technology", McGraw Hill Second Edition. 1998.
2. S.K. Ghandhi, VLSI Fabrication Principles, John Wiley Inc., New York, 1983
3. James D Plummer, Michael D. Deal, Peter B. Griffin, "Silicon VLSI Technology: Fundamentals Practice and Modeling", Prentice Hall India.2000.
4. Wai Kai Chen, "VLSI Technology" CRC Press, 2003.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand silicon wafer preparation processes	20 %
CO-2	Learn the different process steps involved in the fabrication of VLSI circuits along with limitations	30 %
CO-3	Appreciate use of process simulator in fabrication of VLSI Circuits	20 %
CO-4	Understand different packaging techniques and related issues	20 %

CO-5	Analyse yield and reliability issues in VLSI	10 %

List of Open Source Software/learning website:

1. www.nptel.ac.in
2. www.ocw.mit.edu
3. www.mosis.com
4. www.berkeley.edu