

Course Code	Course Title	L	T	P	C
BAEVD304	VLSI Technology	3	0	2	4
Pre-requisite	BAEVD101 Electronic Devices	Syllabus Version			
		1			
Course Objectives					
1. Introduce the fundamentals of VLSI manufacturing processes and technology 2. Understand the various patterning techniques and their limitations. 3. Gain a stronger grasp of thin film deposition and etching methods and understand the fundamental principles of metals used in gate and packaging applications					
Course Outcomes					
1. Illustrate crystal structure, lithography techniques, wafer exposure system concepts, types of resists etc. 2. Interpret thermal oxidation, diffusion and ion implantation techniques. 3. Apply thin film deposition and etching techniques. 4. Apply back-end technology to define contacts, interconnect, gates, source and drain, and measurement techniques to ensure the quality of designs. 5. Interpret process variations on the material/device properties					
Module:1	Introduction	9 hours			
Introduction to Semiconductor Manufacturing and fabrication (Si, III-V devices), Clean Room types and standards, Crystal structure, Czochralski growth method, Wafer preparation, and defects, Photolithographic Process, Photomask Fabrication, Comparison between positive and negative Photoresists, Exposure Systems					
Module:2	Lithography and oxidation	10 hours			
Characteristics of Exposure Systems, Baking, and development, Mask making, E-beam Lithography, Nano imprint lithography. The Oxidation Process, Nitridation, Masking Properties of Silicon Dioxide, Technology of Oxidation, Characterization methods, Segregation, Interfacial dopant pileup, oxidation-enhanced diffusion, and dopant-defect interaction					
Module:3	Diffusion and Ion Implantation	8 hours			
Basic concepts, Diffusion process and models, High energy and ultralow energy implantation, shallow junction formation & modeling, Electronic stopping, Damage production and annealing, RTA Process and dopant activation, Ion Implantation.					
Module:4	Thin film deposition techniques	10 hours			
Thermal and e-beam evaporation, DC Sputtering, RF sputtering Atomic Layer Deposition (ALD), Chemical Vapour Deposition (CVD) and its types (thermal, plasma-enhanced, metal-organic), Electrodeposition, Wet etching, Plasma etching, RIE, Etching of materials used in VLSI.					

Module:5	Metallization and packaging	6 hours
Contacts, Vias, Multi-level Interconnects, Silicide gates and S/D regions, Reflow & planarization, Multi-chip modules, packaging and its types.		
Module:6	Contemporary Issues	2 hours
Contemporary Issues		
Total Lecture Hours:		45 hours
Text Book(s)		
R.C. Jaeger, " Introduction to microelectronic fabrication ", Pearson, 1 st Edition, 2013 J.D. Plummer, M. Deal, P.D. Griffin, " Silicon VLSI Technology: Fundamentals, Practice, Modeling ", Prentice Hall, 2 nd Edition, 2009 Wang Yangyuan, Jesse Jen-Chung Lou, Min-Hwa Chi, Chun-Zhang Chen, " Handbook of Integrated Circuit Industry ", Springer Nature Singapore, 1 st Edition, 2023		
Reference Books		
S.A. Campbell, " Fabrication Engineering at the Micro- and Nanoscale ", Oxford University Press, 1 st Edition, 2013 S.K. Ghandhi, " VLSI fabrication principles ", John Wiley, 2 nd Edition, 2009 S.M. Sze, " VLSI Technology ", Tata McGraw Hill, 2 nd Edition, 2017 Shubham Kumar, Ankaj Gupta, " Integrated Circuit Fabrication ", CRC Press, 1 st Edition, 2021		
Indicative Experiments		
1. Silicon wafer dicing, pre-cleaning		2 hours
2. Oxidation of silicon wafer		4 hours
3. Evaporation of metal onto a substrate		4 hours
4. DC sputtering of metal onto a substrate		2 hours
5. Optical microscopy characterization of the deposited materials		2 hours
6. C-V characteristics of fabricated MOSFET/MOS Capacitor		2 hours
7. Introduction to oxidation modeling		2 hours
8. Modeling for SiO ₂ growth of various processes.		2 hours
9. Simulation study on diode/ BJT device structure		3 hours
10. Simulating the device characteristics of MOSFET		3 hours
11. Modeling the material structures and predicting their properties		4 hours
Total Laboratory Hours:		30 hours

Mode of Evaluation :Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Final Assessment, Presentaion	
Recommended by Board of Studies :	23-05-2025
Approved by Academic Council : No. 78	12-06-2025