GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering
Level: PG
Branch: Electronics And Communication (VLSI Design)
Subject Code: ME01096041
Subject Name: Semiconductor Materials and Characterization

WEF Academic Year	: 2025-26
Semester	: 01
Category of the Course	: PEC-01

Prerequisite:	Basics of semiconductor physics
Rationale:	Students should have a good understanding of VLSI/semiconductor fabrication process. In this course, students will learn details about various processing steps utilized in fabrication of VLSI/semiconductor IC. The course covers various analytical and assembly techniques.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
03	00	02	00	70	30	30	20	150

Course Content:

Sr No	Course Content	No of Hours	% weightage
1	**Resistivity:** Introduction, Two-point Vs Four-point probe, Wafer Mapping, Resistivity profiling, contactless methods, conductivity, strengths and weakness.	6	15
2	**Carrier and Doping Density:** Introduction, Capacitance-Voltage, Current-Voltage, measurement errors and Precautions, Hall effect, optical techniques, secondary Ion Mass spectrometry, Rutherford backscattering, lateral profiling, strengths and weakness	8	20

3	**Contact Resistance and Schottky Barrier:** Introduction, metal-semiconductor contacts, contact resistance, measurement techniques, Schottky barrier heights, comparison of methods, strengths and weakness	6	15
4	**Series Resistance, Channel Length, and Width, and Threshold Voltage:** Introduction, PN junction diodes, Schottky Barrier diodes, solar cells, BJT, MOSFET, MESFETs & MODFETs, threshold voltage, pseudo MOSFET, strength and weakness	8	20
5	**Charge-based and Probe Characterization**: Introduction, background, surface charging, The Kelvin Probe, Applications, Scanning probe microscopy, strength and weakness.	7	15
6	**Optical Characterization**: Introduction, optical microscopy, Ellipsometry, transmission, reflection, light scattering, modulation spectroscopy, line width, photoluminescence, Raman spectroscopy, strengths and weaknesses.	7	15
		42	100

Recent Development in Data Analytics (Study from latest research papers published in Scopus indexed/web of science journals - 04 hours during laboratory hours)

Reference Book:

- Dieter K. Schroder, Semiconductor Material and Device Characterization, Third Edition, A John Wiley & Sons Inc., Publication, 2006

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Understanding properties of semiconductor materials.	UN
02	Model properties of semiconductor materials.	AP
03	Measure properties of semiconductor materials.	AP
04	Analyze different semiconductor material characterization techniques.	AN
05	Analyze difference semiconductor devices.	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List:

- The practical work will be carried out based on the content covered during the academic session.

List of Laboratory/Learning Resources Required:

- List of Hardware: FPGA/CPLD programming tool, Multimeter, Power supply, function generator, oscilloscope
- List of Software: EDA Tools – Cadence, Synopsis, Siemens
- List of Useful websites MOOCs:---
    - Course-related online MOOCs on NPTEL/SWAYAM platform
    - Recent publications in reputed journal/conferences

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