SYE6207: CHARACTERIZATION TECHNIQUES FOR SEMICONDUCTOR MANUFACTURING

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Characterization Techniques for Semiconductor Manufacturing

Subject Code
SYE - Systems Engineering
Course Number
6207

Academic Unit
Systems Engineering (SYE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
ADSE6207 Characterization Techniques for Semiconductor Manufacturing (offered until 2023/24)

Exclusive Courses
Nil

Part II Course Details

Abstract

The course explores various techniques used in semiconductor manufacturing to assess the quality, performance, and reliability of devices. It emphasizes the significance of characterization in process control and yield enhancement. The course covers measurement techniques, statistical analysis, and metrology concepts. It discusses key techniques and explores reliability testing and failure analysis methods, including defect identification and failure mechanism analysis. Practical examples, case studies, and hands-on exercises offer real-world applications. By completing the course, students will gain an understanding of semiconductor characterization techniques, data interpretation, performance analysis, and their contribution to process optimization and yield improvement in the industry.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the Principles: Gain a solid understanding of the principles underlying various characterization techniques used in semiconductor manufacturing, including electrical characterization, microscopy, spectroscopy, and advanced techniques.	30	x	x	
2	Apply Techniques: Learn how to select and apply appropriate characterization techniques for assessing the quality, performance, and reliability of semiconductor devices, and interpret measurement data effectively.	30	x	x	
3	Contribute to Process Optimization: Acquire the skills to analyze device performance and contribute to process optimization and yield improvement efforts within the semiconductor industry based on the insights gained from characterization techniques.	20		x	
4	Reliability Testing and Failure Analysis: Explore reliability testing techniques and failure analysis methods, such as defect identification and failure mechanism analysis, to enhance device reliability and troubleshoot manufacturing issues.	20	x	x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Lectures on the topics of the keyword syllabus.	1, 2, 3, 4	3 hours/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Mid-term exam	1, 2, 3, 4	30	-	No
2	Assignments	1, 2, 3, 4	30	Individual assignments to evaluate understanding of the course materials.	No

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

Mid-term exam (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Gain a solid understanding of characterization principles and apply techniques to assess device quality, performance, and reliability.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Individual assignments to deepen the understanding of course materials.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Final exam (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Students acquire practical skills in measurement, analysis, and optimization for real-world applications in semiconductor manufacturing, ensuring device quality, performance, and reliability.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Mid-term exam (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Gain a solid understanding of characterization principles and apply techniques to assess device quality, performance, and reliability.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate/Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Individual assignments to deepen the understanding of course materials.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate/Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Final exam (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Students acquire practical skills in measurement, analysis, and optimization for real-world applications in semiconductor manufacturing, ensuring device quality, performance, and reliability.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate/Basic

Failure
(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus
- Electrical characterization techniques (e.g., Four-point probe, Hall effect, DLTS, I-V)
- Optical characterization techniques (e.g., Microscopy, Ellipsometry, Raman spectroscopy)
- Physical and chemical characterization techniques (e.g., SEM, XRD, SIMS)

- Reliability and failure analysis yield management (e.g. Wafer acceptance test (WAT) and yield test)
- Future characterization methods

Reading List

Compulsory Readings

	Title
1	"Characterization of Semiconductor Materials: Principles and Methods", published by Wiley, 2006.
2	"Semiconductor Material and Device Characterization" 3rd Ed., published by Wiley, 2006.

Additional Readings

	Title
1	"Fundamentals of Semiconductor Manufacturing and Process Control", published by Wiley, 2006."
2	"Semiconductor Manufacturing Handbook", 2nd Ed, published by McGraw Hill, 2017.