City University of Hong Kong
Course Syllabus

offered by Department of Systems Engineering
with effect from Semester B 2023 / 24

Part I Course Overview

Course Title:	Characterization Techniques for Semiconductor Manufacturing
Course Code:	ADSE6207
Course Duration:	One Semester
Credit Units:	3
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. 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.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*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%	✓	✓	
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%	✓	✓	
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%		✓	
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%	✓	✓	
		100%			

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 self-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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

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

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.				Weighting	Remarks
	1	2	3	4		
Continuous Assessment: __60__ %						
Mid-term exam	✓	✓	✓	✓	30%	
Assignments	✓	✓	✓	✓	30%	Individual assignments to evaluate understanding of the course materials.
Examination: _40_ __ % (duration: 2 hours , if applicable)						
					100%	

For a student to pass the course, at least 30% of the maximum mark for the examination should be obtained.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Mid-term exam	Gain a solid understanding of characterization principles and apply techniques to assess device quality, performance, and reliability.	High	Significant	Moderate/Basic	Not even reaching marginal levels
2. Assignments	Individual assignments to deepen the understanding of course materials.	High	Significant	Moderate/Basic	Not even reaching marginal levels
3. Final exam	Students acquire practical skills in measurement, analysis, and optimization for real-world applications in semiconductor manufacturing, ensuring device quality, performance, and reliability.	High	Significant	Moderate/Basic	Not even reaching marginal levels

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Mid-term exam	Gain a solid understanding of characterization principles and apply techniques to assess device quality, performance, and reliability.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Assignments	Individual assignments to deepen the understanding of course materials.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Final exam	Students acquire practical skills in measurement,	High	Significant	Moderate	Basic	Not even

	analysis, and optimization for real-world applications in semiconductor manufacturing, ensuring device quality, performance, and reliability.					reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

- 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

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

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

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

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