City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester A in 2024/25

Part I Course Overview

Course Title:	Reliability Engineering in Electronics Industry
Course Code:	EE6614
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	EE2301 Basic Electronics Circuit or EE3003 (I and II) Electronic Product Design
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	MSE6814 Reliability Engineering in Electronics Industry

Part II Course Details

1. Abstract

The course aims to provide students with a fundamental understanding of the basic technology and applications to modern electronic packaging in consumer electronic products. The trend of packaging starting from wire-bonding, taping-automatic bonding, flip chip solder joints, micro solder-bumps, and Cu-to-Cu direct bonding as well as hybrid bonding will be covered.

The course is designed so that the students can learn the basic concepts in circuit design of 3D IC in electronic packaging technology. Especially, the materials integration in printed circuit board, multilayered interconnections in back-end-of-line, redistribution layer, Si interposer, through-Si-vias will be covered. Device reliability issues such as electromigration, thermomigration, and stress-migration will be explained clearly. Because Joule heating is the most serious cause of yield and reliability in modern consumer electronic products, the so-called low power device means low entropy or low waste heat production device. For device lifetime prediction, the mean-to-to failure equations will be derived based on entropy production in irreversible processes. How to measure the parameters in the equations will be discussed.

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.	Describe the difference between chip technology and packaging technology.		✓		
2.	Can discuss failure modes and its cause in modern electronic packaging technology.		✓	✓	
3.	Can explain failure analysis on electromigration, thermomigration and stress-migration.				✓
4.	Demonstrate independent ability and research skills to perform failure analysis as a failure engineer in electronic packaging industry.		✓	✓	
		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 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.

3. Learning and Teaching Activities (LTAs)

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

LTA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Lectures	Students will engage in formal lectures to gain knowledge about chip technology and next 3D semiconductor industrialization	✓	✓	✓	✓			3hrs/wk (for 11 wks)
Presentation and Tests	Students will participate in group discussion (or presentation) to consolidate their learn skills, and will actively engage as audience members during peers' presentations in order to expand and broaden their own skill conception.	✓	✓	✓	✓			3hrs/wk (for 2 wks)

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: 40 %								
Tests (min.: 2)	✓	✓	✓	✓			30 %	
#Assignments (min.:3)	✓	✓	✓	✓			10 %	
Examination: 60 % (duration: 2 hrs , if applicable)								
Examination	✓	✓	✓	✓			60 %	
							100%	

Remark:

To pass the course, students are required to achieve at least 30% in continuous assessment and 30% in the examination.

may include homework, tutorial exercise, project/mini-project, presentation

5. Assessment Rubrics

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

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B,)	Marginal (B-, C+, C)	Failure (F)
1. Examination	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level

6. Constructive Alignment with Programme Outcomes

PILO	How the course contributes to the specific PILO(s)
1-5	Awareness on the knowledge and analysis tools as a failure engineer in electronic packaging industry. Applications of learned knowledge and skills for practical cases in modern electronic packaging technology.

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

1. Keyword Syllabus

- Cu-to-Cu and Other Bonding Technologies in Electronic Packaging
- Randomly Oriented and (111) Uni-directionally Oriented Nanotwin Copper
- Solid-Liquid Interfacial Diffusion Reactions (SLID) between Copper and Solder
- Solid State Reactions between Solder and Copper
- Essence of Integrated Circuits and Packaging Design
- Performance, Power, Thermal and Reliability
- 2.5D/3D System-in-Packaging Integration
- Irreversible Processes in Electronic Packaging Technology
- Electromigration
- Thermomigration
- Stress-Migration
- Failure Analysis
- Artificial Intelligence on Electronic Packaging Reliability

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.	Electronic Packaging Science and Technology by King-Ning Tu

2.2 Additional Readings

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

1.	Nil