EE6614: RELIABILITY ENGINEERING IN ELECTRONICS INDUSTRY

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Reliability Engineering in Electronics Industry

Subject Code
EE - Electrical Engineering
Course Number
6614

Academic Unit
Electrical Engineering (EE)

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
EE2301 Basic Electronics Circuit or EE3003 (I and II) Electronic Product Design

Equivalent Courses
Nil

Exclusive Courses
MSE6814 Reliability Engineering in Electronics Industry

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the difference between chip technology and packaging technology.		x		
2	Can discuss failure modes and its cause in modern electronic packaging technology.		x	x	
3	Can explain failure analysis on electromigration, thermomigration and stress-migration.				x
4	Demonstrate independent ability and research skills to perform failure analysis as a failure engineer in electronic packaging industry.		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	Lectures	Students will engage in formal lectures to gain knowledge about chip technology and next 3D semiconductor industrialization	1, 2, 3, 4	3hrs/wk(for 11 wks)

2	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.	1, 2, 3, 4	3hrs/wk(for 2 wks)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min.: 2)	1, 2, 3, 4	30	
2	#Assignments (min.:3)	1, 2, 3, 4	10	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

Remark: To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. # may include homework, tutorial exercise, project/mini-project, presentation

Assessment Rubrics (AR)

Assessment Task

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

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal level

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

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

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

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

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

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal

(B-, C+, C) Low

Failure

(F) Not even reaching marginal level

Additional Information for AR

Constructive Alignment with Programme Outcomes

PILO 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

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

Reading List

Compulsory Readings

	Title
1	Electronic Packaging Science and Technology by King-Ning Tu

Additional Readings

	Title
1	Nil