GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: ALL (Except Computer Engineering / IT Engineering and Allied Branches)

Course / Subject Code : 3160004

Subject Name: Fundamental of Semiconductor Package Manufacturing and Test

w. e. f. Academic Year:	2024-25
Semester:	6th Semester
Category of the Course:	Open Elective – II

Prerequisite:	Electrical, Electronics, Materials or Mechanical Engineering Programs; Production Technology, Industrial Engineering, Foundational Statistics, Data Processing and Computer Programming (Unix/Perl/C/Python)
Rationale:	This course aims to empower students with the knowledge essential for semiconductor package manufacturing and testing.

Course Outcome:

After Completion of the Course, Student will able to gain:

No	Course Outcomes	RBT Level
01	Comprehensive knowledge of the various processes involved in semiconductor package assembly and the critical manufacturing aspects.	RM and UN
02	Knowledge on IC package testing as part of ATMP (Assembly, Testing, Marking and Packaging) requirement.	UN and EL
03	Knowledge on Package qualification requirements for semiconductor Industry needs.	UN and AN
04	Knowledge on Electrical and Mechanical Failure analysis for semiconductor packages	UN and EL
05	Knowledge from Semiconductor Industry experts on real time applications.	UN and AP

**Revised Bloom's Taxonomy (RBT)*

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

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	0	3	70	30	0	0	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**PACKAGE MANUFACTURING PROCESSES** Packaging Assembly Technology, Wafer Thinning, Dicing, Die Attach, Wire bonding, Flip Chip process, Flux Cleaning, Underfill, Encapsulation, Laser Marking, Solder Ball Attach, Reflow, Singulation, IC Packaging Toolsets & equipment operation, clean room operations	9	20%
2.	**SEMICONDUCTOR COMPONENT AND PACKAGE TEST** Overview of Testing methodologies, components tested & their characteristics, Challenges in testing, Types of Testers (Automated test equipment & Benchtop Testers), Components & Subsystems of Testers, Principles of Functional Testing, Parametric/ Boundary Scan /In-Circuit Test/ Flying Probe Test, Test Data Analysis, Design for Testability & Tester Calibration & Maintenance, Future Trends	9	20%
3.	**SEMICONDUCTOR PACKAGE MATERIALS AND QUALIFICATION** Reliability testing & qualification- MST/MSL, TC/TS, HAST & uHAST, Mold Compounds (Moldability), Underfill Materials, Die Attach Adhesives & Films, Substrate Technology, Bonding Wire, Solder & Dielectric materials	7	20%
4.	**ELECTRICAL AND PHYSICAL FAILURE ANALYSIS** Package failure modes, Failure detection mechanisms, Failure analysis tools, Test programs debugging, Data Analytics, ESD & EMI Management	8	20%
5.	**INDUSTRIAL QUALITY AND STATISTICAL PROCESS CONTROL** Quality Control Plan (QCP) & Quality Management System (QMS), Incoming Material Inspection, In-Line Quality, Measurement System Analysis, Statistical analysis methods, Statistical Process Control (SPC), Fault Detection Control (FDC), Run-to-Run Control (R2R), Auto Defect Classification (ADC), Data Analytics, Machine Communication Protocol and System Integration	7	20%
	Total	**40**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**50**	**10**	**10**	**10**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Lau, J. H. (2021). Semiconductor Advanced packaging. Springer Nature
2. Bar-Cohen et al. (2019). Encyclopedia of Packaging Materials, Processes, and Mechanics. In WORLD SCIENTIFIC, https://doi.org/10.1142/11303
3. Moyne, J., Del Castillo, E., & Hurwitz, A. M. (2000). Run-to-Run control in semiconductor manufacturing. CRC Pres
4. Emiliano R. Martins (2022). Essentials of Semiconductor Device Physics. Wiley.
5. C++ textbook
6. Python textbook
7. Harman, G. (2010). Wire Bonding in Microelectronics, 3/E. McGraw-Hill Education.
8. Ardebili, H., Zhang, J., & Pecht, M. G. (2018). Encapsulation technologies for electronic applications. William Andrew.
9. Chen, A., & Lo, R. H. (2016). Semiconductor packaging: Materials Interaction and Reliability. CRC Press
10. Gan, C. L., & Chen-Yu, H. (2023). Interconnect reliability in advanced memory device packaging. Springer.
11. Roffel, B., & Betlem, B. H. (2004). Advanced practical process control. In Springer eBooks

(b) Open source software and website:

1. C++
2. Python

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