# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Master of Engineering**
**Level: PG**
**Branch: Electronics And Communication (VLSI Design)**
**Subject Code: ME02096071**
**Subject Name: Semiconductor Manufacturing and Packaging**

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|---|---|
| **WEF Academic Year** | 2025-26 |
| **Semester** | 02 |
| **Category of the Course** | PEC-05 |

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|---|---|
| **Prerequisite:** | Basic knowledge of semiconductor materials and their characteristics |
| **Rationale:** | In semiconductor domain, the students should know semiconductor IC manufacturing, packaging, assembly process, and testing. This course includes various IC packages, families, surface mount technologies, various materials used in packaging such as polymers, metals, ceramics and glasses with their properties, characteristics, effects and analysis. It also includes various reliability testing mechanisms used in semiconductor manufacturing and packaging. |

**Course Outcome: After completion of the Course, Students will be able to:**

| No | Course Outcomes | RBT Level* |
|---|---|---|
| 01 | Understand various semiconductor package families and surface mount technology | UN |
| 02 | Analyze usage of polymers in semiconductor manufacturing | AN |
| 03 | Analyze usage of ceramics and glasses in semiconductor manufacturing and packaging | AN |
| 04 | Analyze various reliability testing techniques used in semiconductor manufacturing and packaging | AN |
| 05 | Evaluate various trends and challenges in semiconductor packaging. | EL |

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

**Course Scheme:**

| Teaching Scheme | | | Total Credits | Assessment Pattern and Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | Practical | | |
| L | T | PR | C | ESE (E) | PA(M) | ESE (V) | PA (I) | |
| 03 | 00 | 02 | 04 | 70 | 30 | 30 | 20 | 150 |

**Course Content:**

| U. No | Course Content | No of Hours | % weightage |
|---|---|---|---|
| 1 | **Package form factors and families:** package outline standardization, leaded package families, quad lead package families, substrate-based package families, chip scale packages, staked-die package family, package-on-package and related variations, flip-chip packages, wafer-level chip scale packages | 4 | 05 |
| 2 | **Surface-Mount Technology:** Introduction, background, package cracking or 'popcorning', surface-mount packages, issues with advanced packaging, current and future trends | 4 | 10 |
| 3 | **Materials used in semiconductor packaging:** **Polymers:** molding compounds, die attach adhesives, underfill materials, organics substrates. | 6 | 15 |
| 4 | **Metals:** lead frames, heat spreaders, and heat sinks, bonding wires, solders, wafer bumping, technical issues. | 6 | 15 |
| 5 | **Ceramics and Glasses:** Introduction, types of ceramics used in semiconductor packaging, types of glasses used in semiconductor packaging, | 6 | 15 |
| 6 | **Reliability Testing:** Introduction, examples of reliability tests: preconditioning conditions, temperature cycling and thermal shock, high-temperature storage life, temperature-humidity-bias tests, limitation of reliability testing. | 8 | 20 |
| 7 | **Trends and Challenges:** Introduction, copper interconnects and low-k dielectric materials, dielectric constant requirements at each technology node, future interconnect and dielectric materials, future packaging options | 8 | 20 |
| | **Total** | 42 | 100 |

**Reference Book:**


- Andrea Chen, Randy Hsiao-Yu Lo, Semiconductor Packaging Materials Interaction and Reliability, CRC Press, 2012
- Hwaiyu Geng, Semiconductor Manufacturing Handbook, McGraw-Hill Publication,2005.


**Suggested Course Practical List:**

- The practical work will be carried out based on the content covered during the academic session.

**List of Laboratory/Learning Resources Required:**

- List of Hardware: FPGA/CPLD programming tool,

- List of Software: EDA Tools – Cadence, Synopsis, Siemens
- List of Useful websites MOOCs:---
    - Course-related online MOOCs on NPTEL/SWAYAM platform
    - Recent publications in reputed journal/conferences

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