MSE684A

Introduction to Advanced Microelectronics Packaging

Credits: 3-0-0-9

Prerequisites: Some basic knowledge of phase diagrams, Consent of the instructor

Course Objective: This course will introduce students to advanced microelectronics packaging along with different packaging architectures. The students will learn the fundamentals of package design and the impact of materials and processes used in manufacturing microelectronics packages. Additionally, the course will also cover the reliability challenges and failure analyses techniques involved in the packaging. Finally, specialized applications of microelectronics packaging like automotive, bioelectronics, flexible electronics etc., will be covered.

References:

1. Tummala, R.R., 2019. Fundamentals of Device and Systems Packaging: Technologies and Applications. McGraw-Hill Education.
2. Greig, W., 2007. Integrated circuit packaging, assembly and interconnections. Springer Science & Business Media.
3. Morris, J.E., 2018. Nanopackaging. Springer, Cham.
4. Bath, J. ed., 2020. Lead-free Soldering Process Development and Reliability. John Wiley & Sons.
5. Suhir, E., Lee, Y.C. and Wong, C.P. eds., 2007. Micro-and opto-electronic materials and structures: physics, mechanics, design, reliability, packaging.
6. Selected research papers

Course Contents:

S. No	**Topics**	**Number of Lectures**
1	Microelectronics Packaging Architectures	4
	History of microelectronics packaging	
	Moore's law for packaging, 2.5D and 3D packaging technologies	
2	Design Aspects of Packaging	3

	Electrical design for signal, power, and electromagnetic interference	
	Heat transfer in packaging	
	Warpage management through design and materials	
3	Wafer Level Processes and Materials	3
	Die backside metallization	
	Die prep processes and adhesive tape and wafer coat materials	
4	Substrate Level Processes and Materials	7
	Basics of ceramics, glass, organic, and silicon package substrates	
	Passive components	
	Chip-to-package interconnections and assembly	
	Underfill and mold materials chemistry and process	
6	Surface Mount Technology (SMT)	3
	Solder materials including Sn-Pb, SAC, SnBi, and high-reliability solders	
	PCB design and SMT process optimization	
7	Reliability Challenges	4
	Thermomechanical and drop-shock reliability	
	Current stressing and electromigration driven failures	
8	Relevance of Different Characterization Techniques in Packaging	2
	Microscopy, Surface characterization, physical properties measurements techniques	
9	Specialized Applications of Packaging	6
	Packaging technologies for applications in automotive, bioelectronics, flexible electronics, smartphones, etc.	
10	Overview of Recent Advancements in Packaging Through the Latest Literature	8