The University Of Sheffield.

Electronic & Electrical Engineering.

EEE6214	PACKAGING AND RELIABILITY OF MICROSYSTEMS
Credits:	**15**

Course Description including Aims

The unit describes the methods used to fabricate microsystems from electronic, opto-electronic and micro-electromechanical (MEMS) devices. It also introduces and develops an understanding of the reliability and failure mechanisms in the devices and resulting microsystems.

The aims are as follows:

Develop an understanding of the key aspects of microsystem packaging at three levels: individual component; circuit board and complete system. Emphasis will be on practical industrial solutions to modern microsystem packaging challenges.

Model the thermal behavior of microsystems.

Understand the thermal, mechanical, electrical and chemical degradation mechanisms that affect the reliability of microsystems.

Use statistical techniques to model reliability.

Appreciate microsystem test and characterization techniques.

Outline Syllabus

Résumé of electronic device evolution. General packaging principles. Component packaging (including integrated circuits, opto, MEMS, RF and power devices). Substrates (including printed circuit boards). Interconnection (including solder technologies). System-level packaging. Electrical and thermal considerations (including finite element thermal modelling). Test strategies. Reliability modelling. Degradation and failure mechanisms: thermal, chemical, electrical and mechanical. Characterization techniques.

Time Allocation

36 hours lectures

25 hours reverse engineering exercise, incorporating finite element thermal modelling

10 hours statistical exercise

20 hours group presentation

59 hours independent study

Recommended Background Knowledge

A first degree in Engineering, Physics or knowledge equivalent to our 3rd year EEE undergraduate degree programmes. Knowledge of basic semiconductor theory, elementary thermal physics and elementary optics would be an advantage.

Assessment

Formal examination; 2 hours duration; answer 3 questions from 4	70 %

Reverse-engineering exercise (short written report)		15 %
Statistical analysis of commercial reliability data (computer-based)		10 %
Group presentation		5 %
Recommended Books		
Tummala R	*Fundamentals of Microsystem Packaging*	McGraw Hill, 2001 and eBook via Library
Ohring M	*Reliability and Failure of Electronic Materials and Devices*	Academic Press, 1998 and eBook via Library
Other books		
Wu B	*3D IC Stacking Technology*	McGraw Hill 2011
Sergent JE	*Hybrid Microelectronics Handbook*	McGraw Hill, 1995
Martin PL	*Electronic Failure Analysis Handbook*	McGraw Hill, 1999
Pascoe N	*Reliability Technology*	Wiley, 2011
Hannermann RJ	*Physical Architecture of VLSI Systems*	Wiley, 1994
Lau JH	*Flip Chip Technologies*	McGraw Hill, 1995
Amerasekera E	*Failure Mechanisms in Semiconductor Devices*	Wiley, 1998
Pecht M	*Guidebook to Managing Silicon Chip Reliability*	CRC, 1999
Lall P	*Influence of temperature on Microelectronics and System Reliability*	CRC, 1997

Objectives

On completion of the module, successful students will be able to:

- Describe the range of technologies available for microsystem manufacture and design and select appropriate methods for given industrial scenarios.
- Assess the needs of a particular design – being able to choose and justify packaging options (both technologically and economically).
- Model the thermal, electrical, optical signal behavior of various component / interconnect / substrate combinations.
- Identify and explain the various types of defect in microelectronic devices.
- Identify and explain the degradation and failure mechanisms in electronic and optoelectronic devices and systems.
- Apply appropriate statistical models to analyze reliability data.
- Interpret the results from the common characterization techniques used in reliability and failure analysis of electronic and optoelectronic devices.