EEE6008 RELIABILITY AND FAILURE

Credits: 10

Course Description including Aims

This unit aims to introduce and develop an understanding of reliability and failure mechanisms in microelectronic and optoelectronic devices. Degradation mechanisms and the origins of defects that lead to failure will be outlined. The use of statistical models to study reliability will be introduced. Methods to improve reliability and reliability characterization techniques will be introduced.

Outline Syllabus

An overview of reliability. Mathematical models for reliability analysis. Physics of failure including defects and contaminants, charge and environment induced damage. Degradation and reliability in electro-optical devices including failure of lasers, LEDs, detectors and optical fibre. Characterisation techniques to assess failure including the use of TEM, SEM, FIB and other characterisation techniques.

Time Allocation

24 lectures.

Recommended Previous Courses

Electronic Engineering Principles, IC Technology, EMC, Optical Comm. Devices and Systems

Assessment

75% by 2 hour examination - answer 3 questions from 4. 25 % from coursework, including group presentation and computer laboratory assignment.

Recommended Books

Milton Ohring *Reliability and failure of electronic materials and devices* Academic Press

Objectives

At the end of the course successful students will be able

1. To describe degradation and failure mechanisms in microelectronic and optoelectronic devices.
2. To list the different types of defects in microelectronic devices.
3. To use basic mathematical models to analyse reliability data.
4. To outline common characterisation techniques in reliability and failure analysis of microelectronic and optoelectronic devices.

Detailed Syllabus

1. An introduction to reliability
    - 1.1 An overview of reliability
    - 1.2 Bath tub curve
    - 1.3 Reliability in solid state devices
    - 1.4 Reliability in IC
    - 1.5 Reliability models

2. Physics of failure - Materials
    - 2.1 Origin of defects
    - 2.2 Crystal defects
    - 2.3 Processing defects
    - 2.4 Contaminations

3. Physics of failure – Charge and Environment Induced Damage
    - 3.1 Electrostatic and electrical stress
    - 3.2 Hot carrier effects
    - 3.3 Dielectric failure
    - 3.4 Atmospheric moisture
    - 3.5 Corrosion in metals

4. Physics of failure - Packaging
    - 4.1 Degradation of contacts, solder and packaging

5. Degradation in electro-optical devices
    - 5.1 Failure in emitters
    - 5.2 Failure in detectors
    - 5.3 Failure in optical fibre

6. Characterisation techniques
    - 6.1 TEM
    - 6.2 SEM
    - 6.3 FIB