



The
University
Of
Sheffield.

Electronic &
Electrical
Engineering.

EEE6212

SEMICONDUCTOR MATERIALS

Credits:

15

Course Description including Aims

This module describes the basic physical properties (structural, optical, electrical) of semiconductor materials used in the electronic and opto-electronic industries, and in semiconductor based research. The aim is to equip the students with a comprehensive background understanding of the physical, structural, optical, electronic properties of semiconductor materials used in modern electronic and opto-electronic devices.

Course Objectives

On successful completion of this module the students should be able to:

1. Understand the role and used of different semiconductor materials in different types of devices.
2. Understand relevant crystal structures, the reciprocal lattice, and x-ray diffraction.
3. Have knowledge of the role of the crystal structure in defining the thermal, optical, and electrical properties of the semiconductor, and describe the role of defects, dislocations and doping on these properties.
4. Understand the electronic band-structure in defining the electronic properties (e.g. carrier mobilities, intrinsic doping) and optical properties of the semiconductor (e.g. direct and indirect transitions, density of states)
5. Demonstrate an understanding of the different optical transitions and carrier relaxation processes.
6. Gain knowledge on excitonic effects, and the role of free carriers on the band-structure.
7. Understand electrical conduction processes for intrinsic and doped materials and the formation of p-n junctions.
8. Have knowledge of the effects of quantum confinement on the electronic and optical properties of the semiconductor materials
9. Demonstrate practical knowledge of the characterization and analysis of semiconductor materials.

Recommended Previous Courses

An understanding of basic physics, mathematics and physical electronics, as expected from graduates from Physics, Engineering, Materials, Chemistry, etc.

Assessment

A 2 hour exam 3/4 questions at the end of the year plus 25% based on a report on the structural and optical analysis of a semiconductor material.

Recommended Books

Ashcroft & Mermin,	“Solid State Physics”	Brooks/Cole
Kittel	“Introduction to Solid State Physics”	John Wiley & Sons
Fox	“Optical Properties of Solids”	OUP
Kelly	“Low Dimensional Semiconductors”	OUP
Sze	“Physics of Semiconductor Devices”	Wiley
Phillips	“Crystals, Defects & Microstructures”	CUP