The University Of Sheffield.

EEE337 SEMICONDUCTOR ELECTRONICS

Credits: 10

Course Description including Aims

1. Review semiconductor band structure, doping, conduction, junctions
2. Introduce the various electronic material systems (Si, Ge, III-V, SiC, GaN, including the piezoelectric effect) and outline their electronic properties and principal applications
3. Heterojunctions
4. Introduce high speed devices/models e.g. short channel devices
5. Describe the effects, limitations and technologies of miniaturisation in CMOS devices
6. Demonstrate performance and functional improvements possible using heterojunctions
7. Explore heterostructure optoelectronic devices such as Lasers, LEDs
8. Introduce optical detector technologies and applications for different wavelength ranges
9. Describe high voltage/high current devices and design (e.g. breakdown, impact ionisation) including heat dissipation problems
10. Review Solar Cell developments

Outline Syllabus

Fundamental Properties: Band structure, doping, transport properties, p-n homojunctions, heterojunctions, Schottky barriers, ohmic contacts. **Semiconductor Materials:** review of whole family of semiconductors, specific electronic properties, chemical properties, main applications. **High Speed Devices:** bipolars, JFETs, MESFETs, HEMTs, MOS, figures of merit, models, trends in miniaturization of CMOS. **Optoelectronic devices:** LEDs, Lasers, detectors, figures of merit, applications and wavelengths. **High Power devices:** High voltage limitations, breakdown, high currents, thermal effects. **Solar Cells:** materials, device structure types, efficiencies, projections.

Time Allocation

24 lectures, 12 problem classes, 62 hours guided independent study.

Recommended Previous Courses

Knowledge equivalent to EEE118, EEE225.

Assessment

3 out of 4 questions on 2 hour examination.

Recommended Books

AUTHOR	BOOK TITLE	PUBLISHER
Simon Sze and Ming-Kwei Lee	Semiconductor Devices Physics and Technology	Wiley
Silvano Donati.	Photodetectors: devices, circuits, and applications	Prentice Hall
Streetman and Banerjee	Solid State Electronic Devices	Prentice Hall

Objectives

By the end of this module students will be able to

1. Demonstrate an understanding of how semiconductors are used to make functional electronic devices in common use today
2. Articulate the differences between the various semiconductors and why they are used in specific applications
3. Demonstrate an understanding of speed-related issues of bipolar and field effect transistors
4. Show an awareness of current and potential future technologies for high speed transistors
5. Discuss the role of heterojunctions in optoelectronic devices, the range of materials available and the wavelengths covered
6. Identify and justify detector technologies according to applications
7. Show an appreciation of factors required to design electronic devices for high current and high voltage operation
8. Demonstrate awareness of the various solar cell materials and designs to achieve cost effectiveness and efficiency