Condensed Matter Physics - Semiconductor Devices

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The aim of the course is to give an introduction to semiconductor device physics. The syllabus for the course is:

Simple treatment of p-n junction, p-n and p-i-n structures as photodetectors, light-emitting diodes and lasers (excluding optical gain and cavity properties). Semiconductor heterojunctions, quantum wells and nanostructures. Low dimensional semiconductor devices, e.g. quantum well laser. (Non-examinable) transistors and their uses.

Suggested textbooks:

‘Optoelectronics and Photonics: Principles and Practices’ S.O. Kasap (Prentice-Hall)
‘Semiconductor Physics and Applications’ Balkanski and Wallis (OUP)
‘Semiconductor Devices, Physics and Technology’, S M Sze, (Wiley)
‘The Solid State’, H M Rosenberg (OUP)
‘Electricity and Magnetism’, Bleaney and Bleaney (OUP)
‘Solid State Physics’, H Ibach and H Luth (Springer)
‘The Physics of Semiconductor Devices’, D.A. Fraser (OUP)
‘Solid State Physics’, N W Ashcroft and N D Mermin (Saunders)

I will also make use of WEB-based material in the lectures: see for example applets at: **http://www.eng.buffalo.edu/Courses/ee240/applets.html**

The lecture notes and accompanying problem sheets should help students obtain an understanding of the basic principles of semiconductor devices and introduce them to some recent developments.

Lecture Synopsis:

Lecture 1
The p-n junction including drift, diffusion, recombination and depletion layer at a p-n junction; p-n junction under applied bias; voltage-current relation for a p-n diode; solar cells.

Lectures 2&3:
Photodiodes; light emitting diodes; semiconductor lasers; transistor characteristics; field effect transistors.

Lectures 4&5:
Semiconductor heterojunctions; modulation doping; high electron mobility transistor; quantum wells and quantum dots; quantum structure lasers; single electron transistors.