PH352 Jan 3:0

Semiconductor Physics and Technology

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Department: Physics

Course Time: M/W/F; 1100-1200
Lecture venue: F0-11
Detailed Course Page: http://www.physics.iisc.ac.in/~aveek_bid/courses/

Announcements

Brief description of the course

The course is suitable for students who are interested in the physics of semiconducting materials and who may be carrying out research in the field of semiconductors. It is appropriate for physics students as well as engineering students who are interested to learn about semiconductors from a physics point of view. The course will also cover some basics of semiconductor devices, particularly emphasising the physical principles on which they function.

Prerequisites:

Basic quantum mechanics, electromagnetic theory and solid state physics.

Syllabus:

Crystal structure of semiconductors; Energy bands; Band gap; Electrons and holes; Statistics; Fermi-Dirac distribution; Fermi level; Intrinsic carrier concentration; Temperature dependence; Extrinsic semiconductors; Dopant energies; Hydrogenic model of shallow dopants; Extrinsic carrier density; Kinetic theory; Boltzmann

transport; Mobility and Diffusion; Drift-Diffusion equations; Optical absorption; Generation-Recombination; Carrier lifetime; PN junctions; Bipolar transistor operation.

Course outcomes

After the course, a student must be able to:

(1) Understand the difference between metals, semiconductors and insulators

(2) Calculate the band structure using a simple tight-binding model

(3) Estimate the number of carriers at a given temperature for a semiconductor

(4) Understand the importance of doping to change carrier density

(5) Understand the importance of different scattering mechanisms that limit mobility

(6) Understand the difference between direct and indirect semiconductors

(7) Relate the optical absorption to the band structure

(8) Calculate non-equilibrium densities for different carrier lifetimes

(9) Understand the band diagram and depletion layer in PN junctions

(10) Understand the fundamental operation of a bipolar transistor

Grading policy

30% assignments; 30% mid-term; 40% final exam

Resources:

1. Semiconductor Physics (Karlheinz Seegar)
2. Semiconductor Physics and Devices (Donald A. Neamen)