

EP 311
PHYSICS OF SEMICONDUCTOR
DEVICES

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Contents

1. Atoms and bonding

- The periodic table
- Ionic bonding
- Covalent bonding
- Metallic bonding
- Van der Waals bonding

2. Energy bands and effective mass

- Semiconductors, insulators and metals
- Semiconductors
- Insulators
- Metals
- The concept of effective mass

3. Carrier concentration in semiconductors

- Donors and Acceptors
- Fermi level , E_f
- Carrier concentration equations
- Donors and acceptors both present

4. Conduction in semiconductors

- *Carrier drift*
- *Carrier mobility*
- *Saturated drift velocity*
- *Mobility variation with temperature*
- *A derivation of Ohm's law*
- *Drift current equations*
- *Semiconductor band diagrams with an electric field present*
- *Carrier diffusion*
- *The flux equation*
- *The Einstein relation*
- *Total current density*
- *Carrier recombination and diffusion length*

5. p-n junction

- The p-n junction in thermal equilibrium
- p-n junction barrier height
- Depletion approximation, electric field and potential
- One-sided, abrupt p-n junction
- Applying bias to the p-n junction
- Qualitative explanation of forward bias
- The ideal diode equation
- Reverse breakdown
- Depletion capacitance

6. LED, photodetectors and solar cell

- *The light emitting diode*
- *Materials for LEDs*
- *Materials for visible wavelength LEDs*
- *Junction photodetectors*
- *Photoconductor*
- *Photoconductive gain analysis*
- *Solar cell*

Core Book;
Introductory Semiconductor Device Physics
by Greg PARKER

OBJECTIVES

At the end of the semester, students should:

- be able to discuss the alternative bonding mechanisms which constitute the solids.
- get a knowledge of energy band diagrams and effective masses.
- give an understanding of current carriers of electrons and holes in semiconductors.
- be able to calculate the number density of current carriers.
- calculate the currents flowing in real devices.
- have a deep understanding of the physics and operation of p-n junction diodes.
- get a knowledge of the physics of p-n junction devices.