Fundamentals of Electronics Devices

Unit-4

Lecture-7

Bipolar Junction Transistors

- As isolated atoms are brought together to form a solid, various interactions occur between neighboring atoms, including those described in the preceding section.
- The forces of attraction and repulsion between atoms will find a balance at the proper inter-atomic spacing for the crystal.

Introduction

- To determine the energy levels of the bonding and the anti-bonding states, it is important to recognize that in the region between the two nuclei the coulombic potential energy V(r) is lowered compared to isolated atoms (dashed lines).
- It is easy to see why the potential energy would be lowered in this region, because an electron here would be attracted by two nuclei, rather than just one.

- Qualitatively, we can see that as atoms are brought together, the application of the Pauli exclusion Principle becomes important.
- When two atoms are completely isolated from each other so that there is no interaction of electron wave functions between them, they can have identical electronic structures.

Direct and Indirect Semiconductors

The “thought experiment” in which isolated atoms were brought together to form a solid, is useful in pointing out the existence of energy bands and some of their properties.

Other techniques are generally used, however, when quantitative calculations are made of band structures.

Charge Carriers in Semiconductors

- The mechanism of current conduction is relatively easy to visualize in the case of a metal; the metal atoms are imbedded in a “sea” of relatively free electrons, and these electrons can move as a group under the influenced of an electric field.
- This free electron view is oversimplified, but many important conduction properties of metals can be derived from just such a model.

Carrier Concentrations

- As the temperature of a semiconductor is raised from 0 K, some electrons in the valence band receive enough thermal energy to be excited across the band gap to the conduction band.
- The result is a material with some electrons in an otherwise empty conduction band and some unoccupied states in an otherwise filled valence band.