Fundamentals of Electronics Devices

Unit-3

Lecture-5

Steady State Conditions

- The simplest three-dimensional lattice is one in which the unit cell is a cubic volume, such as the three cells.
- The *simple cubic* structure (abbreviated sc) has an atom located at each corner of the unit cell.

Introduction

- The *body centered cubic* (bcc) lattice has an additional atom at the center of the cube, and the *face-centered cubic* (fcc) unit cell has atoms at the eight corners and centered on the six faces.

- As the atoms are packed into the lattice in any of these arrangements, the distances between neighboring atoms will be determined by a balance between the forces that attract them together and other forces that hold them apart.
- We shall discuss the nature of these forces for particular solids.

- For now we can calculate the maximum fraction of the lattice volume that can be filled with atoms by approximating the atoms as hard spheres.
- The packing spheres in a face-centered cubic cell of side *a*, such that the nearest neighbors touch.

- The dimension *a* for a cubic unit cell is called the *lattice constant.*
- For the fcc lattice the nearest neighbor distance is one-half the diagonal of a face, or ½(*a* 2).
- Therefore, for the atom centered on the face to just touch the atoms at each corner of the face, the radius of the sphere must be one-half the nearest neighbor distance, or ¼(*a* 2).

Exercise

- Find the fraction of the fcc unit cell volume filled with hard spheres.
- Hint:

  Each corner atom in a cubic cell is shared with seven neighboring cells; thus each unit cell contains 1/8 of a sphere at each of the eight corners for a total of one atom.