Fundamentals of Electronics Devices

Unit-5

Lecture-4

Bonding Forces

- The cell has an atom at each corner shared with adjacent cells.
- Notice that we can define vectors **a** and **b** such that if the unit cell is translated by integral multiples of these vectors, a new unit cell identical to the original is found (e.g., O'D'E'F')

- These vectors **a** and **b** (and **c** if the lattice is three dimensional) are called the *basis vectors* for the lattice.
- Points within the lattice are indistinguishable if the vector between the points is

$$\mathbf{r} = p\mathbf{a} + q\mathbf{b} + s\mathbf{c}$$

where p, q and s are integers.

Primitive cell

- The smallest unit cell that can be repeated to form the lattice is called a *primitive cell.*
- In many lattices, however, the primitive cell is not the most convenient to work with.
- The importance of the unit cell lies in the fact that we can analyze the crystal as a whole by investigating a representative volume.

Example

- From the unit cell we can find the distances between nearest atoms and next nearest atoms for calculation of the forces holding the lattice together; we can look at the fraction of the unit cell volume filled by atoms and relate the density of the solid to the atomic arrangement.

- But even more important for our interest in electronic devices, the properties of the periodic crystal lattice determine the allowed energies of electrons that participate in the conduction process.
- Thus the lattice determines not only the mechanical properties of the crystal but also its electrical properties.