# 1.18.CLASSIFICATION OF SOLIDS

**Introduction:** There are many ways to classify the solids.

**Based on the arrangement of constituent particles:**

(i) Crystalline solids

(ii)Amorphous solids.

**Based on properties:**

(i)Diamagnetic

(ii) Paramagnetic

(iii) Ferromagnetic

(iv)Antiferromagnetic

(v)Ferrimagnetic

**Based on the conductivity or Band Theory:**

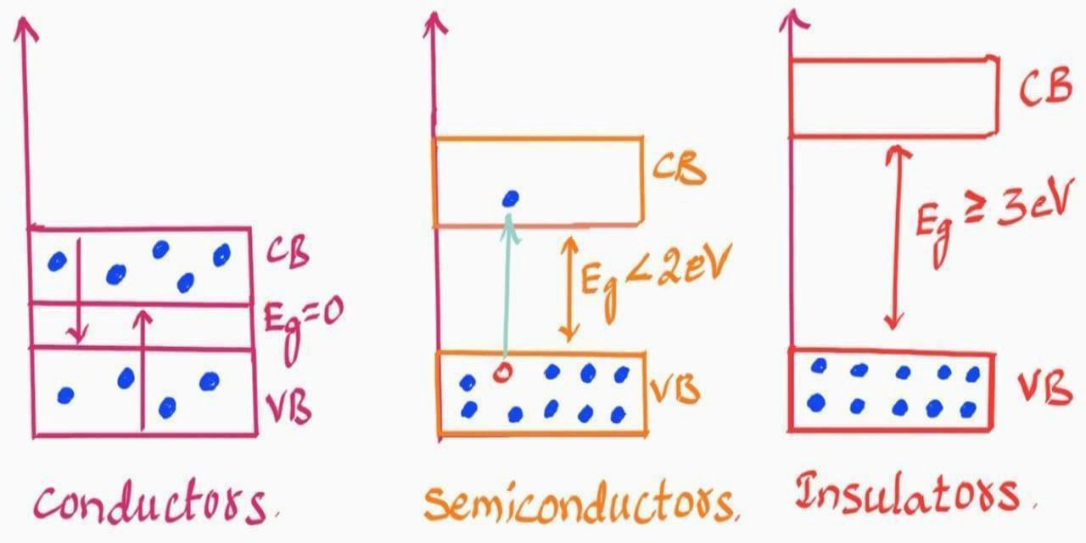
(i)Conductors

(ii)Semiconductors

(iii)Insulators.

- This classification is done on the basis of width of energy gap and conductivity of solids.
- Completely filled bands contain large numbers of electrons but do not contribute to the conductivity.
- Partially filled bands contain a smaller number of e's, which are necessary for conduction.

**ENERGY BAND DIAGRAMS:**



## CONDUCTORS:

- The solids in which CB and VB overlap each other are called conductors.
- The Forbidden energy gap/Band gap bln VB and CB is zero.
- Electrons can easily jump from lower energy bands to higher ones and become available for conduction.
- An application of small amount of voltage
- leads to generation of large amounts of current (or high conductivity).
- Hence these solid conductors are good electrical conductors and e's have charge carriers.
- Its conductivity decreases with increase in Temperature.

**Examples:** Li, Be, Na, Ag, Cu, Au, Al... are conductors

## SEMICONDUCTORS (SC):

- The solids in which the CB & VB are separated by a small energy gap of less than 2 eV are called semiconductors.
- A small energy gap means that a small amount of energy is required to free the electrons and move them from the VB to CB.
- The SC behaves like insulators at 0K, because valence electrons do not have required energy to jump to the CB.
- Its conductivity lies between conductors and insulators.
- If the Temperature is increased, valence e's acquire sufficient energy to jump into CB. Hence, the conductivity of SC's increases with increase in Temperature.

**Examples*:*** Band gap of Silicon is 1.12 eV and Germanium is 0.72 eV.

## INSULATORS:

- The solids in which the CB and VB are separated by a large energy gap of greater than 3eV are called Insulators.
- At room temperature, the valence electrons do not have enough energy to jump into CB, therefore insulators do not conduct current (zero conductivity).
- Thus, insulators have very high resistivity and extremely low conductivity at room temperature.
- It does not have free electrons, so it does not have charge carriers.
- They may exhibit small conductivity at high temperatures & high electric fields.

**Examples:** Dry wood, Diamond, Glass, plastic etc.