The imperfections (defects) developed in crystals gives some characteristic changes in the properties of ionic compound. These properties of solids are directly related to their composition, their lattice structure and the nature of bonds. We shall now study some of the properties of solids e.g.

1. Electrical properties
2. Magnetic properties
3. Dielectric properties

1. Electrical properties

Electrical conductivity of solids may arise through the motion of electrons or positive holes or through the motion of ions. Conduction through ions or positive holes is due to **electronic imperfection.** The conduction through electrons is called n-type conduction and through positive holes is called p-type conduction. Pure ionic solids where conduction take place only through motion of ions are Ionic solids can conduct electric current in the molten or solution state.

Types of conductors : (i) good conductors, (ii) insulators, (iii) semi-conductors.

(i) Good conductors. These allow the maximum portion of the applied electric field to flow through them. The electrical conductivity of good conductors is of the order of 10^8 ohm^{-1} cm^{-1}. ex. Metals.

(ii) Insulators. They do not practically allow the electric current to flow through them, the electrical conductivity is of the order of 10^{-22} ohm^{-1} cm^{-1}. ex. : Organic solid and inorganic solids

(iii) Semi-conductors. At room temperature, semi-conductors allow a portion of electric current to flow through them. Actually, electrical conductivity of a semi-conductor at normal temperature lies between that of a good conductor and an insulator; it is in the range of 10^{-9} to 10^2 ohm^{-1} cm^{-1}.

Two types : (a) intrinsic (b) extrinsic.

(a) Intrinsic semi-conductors. (Semi-conductors due to thermal defects). At 0 K, pure silicon and germanium act as insulators because electrons fixed in covalcnt bonds are not available for conduction. However, at higher temperatures some of the covalcnt bonds are broken and the electrons so released become free to move in the crystal and thus conduct electric current. This type of conduction is known as intrinsic conduction, as it can be introduced in the crystal without adding any external substance.

(b) Extrinsic semi-conductors. (Semi-conductors due to impurity defects). Silicon and germanium (group 14 elements), in pure state, have very low electrical conductivity. However, the electrical conductivity of these elements is greatly enhanced by the addition of traces of an element belonging to group 13 (III) or group 15 (V), to the crystals of group 14 (IV) elements, i.e. silicon or germanium. Introduction of group 15 and group 13 elements to the crystal lattice of group 14 elements (Si or Ge) produces n-type semi-conductors and p-type semi-conductors respectively.

(i) n-Type semi-conductors. This type of semi-conductor is produced (X) due to metal excess defect and (b) by adding trace amounts of group 15 element (P, As) to extremely pure germanium or silicon by a process called doping.

(ii) p-Type semi-conductors. This type of semi-conductors are produced (a) due to metal deficiency defects, and (b) by adding impurity atoms containing less electrons (i.e. atoms of group 13) than the parent insulator to the insulator lattice.

Applications of semi conductors. A large variety of semi-conductors have been prepared/ by the following types of combinations.

(i) Elements of group 14 (Si, Ge) and group 15 (P, As, Sb).
(ii) Elements of group 13 (B, Ga) and group 14 (Si, Ge)
(iii) Elcments of group 13 and group 15, e.g. InSb, AlP
(iv) Elements of group 12 and group 16, e.g. ZnS, CdS, CdSe, HgTc

Properties of a semi-conductor are considerably changed depending upon the nature of the impurity. Semiconductors are used in transistors and in exposure meters as photoelectric devices. Combination of p- and n- type of semi-conductors (known as p-n junction) allows electric current from outside to flow through it in one direction. This type of junction is known as a rectifier and is used for converting alternating current to direct current.

Super-conductivity. The electrical resistance of metals depends upon temperature. Electrical resistance