For p-type semiconductors,

$$R_H = \frac{1}{pe} \text{ ---------- (6) where p is hole density.}$$

DETERMINATION OF HALL COEFFICIENT (R_H)

If V_H be the Hall voltage across the sample of thickness 't'

$$E_H = \frac{V_H}{t} \text{ --------- (7)}$$

From (4) and (7),

$$R_H J B = \frac{V_H}{t} \quad \text{or} \quad V_H = R_H J B \times t \text{ ----------- (8)}$$

If 'b' be the width of the sample then current density $J = \dfrac{I}{A}$

$$V_H = \frac{R_H \, IxBxt}{bxt} \quad \text{or}$$

$$R_H = \frac{V_H bxt}{IxB} \text{ ---------- (9)}$$

SIGNIFICANCE OF HALL EFFECT

1. By means of Hall Effect we can assess the type of semiconductor whether it is n-type or p-type. Hall coefficient is negative for n-type material.

2. Charge carrier concentration can be evaluated by means of Hall Effect.

$$R_H = \frac{1}{ne} \text{ or } n = \frac{1}{eR_H}$$

3. Mobility of charge carriers can be calculated by means of Hall Effect.

$$\sigma = ne\mu \text{ and } R_H = \frac{1}{ne}$$

$$\therefore \mu = R_H \sigma$$

4. Hall Effect can be used to determine the power flow in electromagnetic wave

DIRECT AND INDIRECT BANDGAP SEMICONDUCTORS

According to the band theory of solids, the energy spectrum of electrons consists of large number of allowed energy bands and separated by forbidden regions. The lowest point of the C.B is called conduction band edge and the highest point in V.B is called valence band valence band edge. The gap between them is called band bap or forbidden gap. Based on the band gap semiconductors are classified into two types.

(i)   Direct band gap semiconductors and
(ii)   Indirect band gap semiconductors
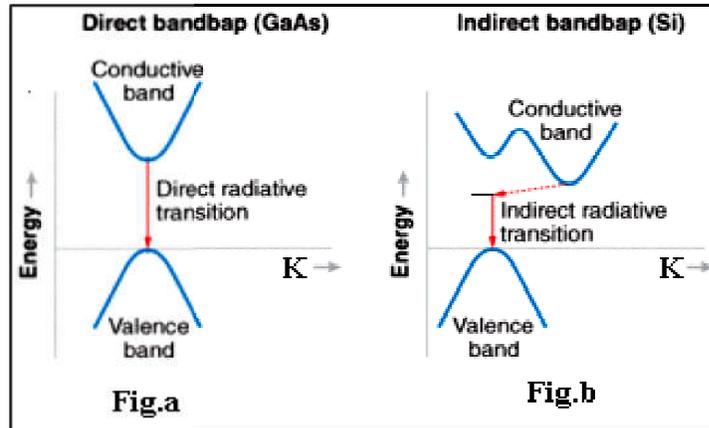
DIRECT BAND GAP SEMICONDUCTORS

o   Fig.a shows E-K curve for direct band gap semiconductor. In this case the maximum of the valence band and the minimum of the conduction band occurs at the same value of the 'K'.

o   In direct band gap semiconductors electrons in the C.B directly recombine with the holes in the V.B.

o   Energy is released in the form of photons. So LED's and Lasers diodes are prepared with them.

o   In direct band gap semiconductors life time of charge carries is very less. (i.e excited electrons cannot stay long time in the higher energy states)

o   Direct band gap semiconductors are formed by compound semiconductors. Ex. InP, GaAs etc.

INDIRECT BAND GAP SEMICONDUCTORS

o   Fig b shows E-K curve for direct band gap semiconductor. In this case the maximum of the valence band and the minimum of the conduction band cannot occur at the same value of the 'K'.

o   In indirect band gap semiconductors electrons in the C.B do not directly recombine with the holes in the V.B. Electrons are trapped in the energy gap called trapping centers.

o   Energy is released in the form of heat.

o   In indirect bandgap semiconductors life time of charge carries is longer. So they are used to amplify the signals in diodes and transistors.

o   Indirect band gap semiconductors are formed by elemental semiconductors. Ex.Si, Ge.