### SEMICONDUCTOR

# Conductivity and resistivity

$$\begin{array}{lll} \bullet & & P \left( \pi - m \right) & & \rho \left( \pi^{-1} m^{-1} \right) \\ \text{Metals} & & 10^{-2} \cdot 10^{-6} & & 10^2 - 10^8 \end{array}$$

Insulators 
$$10^{11} - 10^{19}$$
  $10^{-11} - 10^{-19}$ 

### Charge concentration and current

• [
$$\eta_n = \eta_e$$
] In case of intrinsic semiconductors

• P type 
$$\eta_n >> \eta_e$$
  
•  $i = i_a + i_b$ 

• 
$$\eta_n = \eta_i^2$$

• Number of electrons reaching from valence bond to conduction bond.

$$\eta = A T^{3/2} e^{-Eg/2kT}$$
 (A is positive constant)

• 
$$\sigma = e (\eta_n m_n + \eta_n \mu_n)$$

$$\begin{array}{ll} \bullet \ \sigma = e \ ( \ \eta_e \ m_e + \ \eta_n \ \mu_n ) \\ \text{for } \rho \ \ \text{hype} & \eta_n = \text{Na} >> \ \eta_e. \\ \text{for } \eta - \text{type} & \eta_e = \text{Na} >> \ \eta_h \end{array}$$

for 
$$\eta - type$$
  $\eta_e^n = Na >> \eta_h^n$ 

• Dynamic Resistance of P-N junction in forward biasing = 
$$\frac{\Delta V}{\Delta I}$$

#### **Transistor**

## CB amplifier

SamII change in collector current (
$$\Delta i_c$$
)

(i) ac current gain 
$$\alpha_c = \frac{\text{Samin change incollector current}(\Delta i_e)}{\text{Samil change incollector current}(\Delta i_e)}$$

(ii) dc current gain 
$$\alpha_{\text{dc}}$$
 =  $\frac{\text{Collector current (i_c)}}{\text{Emitter current (i_e)}}$  value of  $\alpha_{\text{dc}}$  lies

between 0.95 to 0.99

(iii) Voltage gain A = Change in output voltage 
$$(\Delta V_0)$$

(iii) Voltage gain 
$$A_v = \frac{\text{Change in output Voltage}(\Delta V_0)}{\text{Change in input voltage}(\Delta V_f)}$$

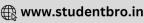
$$\Rightarrow$$
 A $_{\rm v}$  = a $_{\rm ac}$  × Resistance gain

Change in output power (
$$\Delta P_0$$
)

(iv) Power gain = 
$$\frac{\text{Change in output power } (\Delta P_0)}{\text{Change in input voltage} (\Delta P_C)}$$

$$\Rightarrow$$
 Power gain =  $a_{ac}^2 \times$  Resistance gain





## **CE Amplifier**

(i) ac current gain 
$$\beta_{ac} = \left(\frac{\Delta i_c}{\Delta i_b}\right) \, V_{\text{CE}} = constant$$

(ii) dc current gain 
$$\beta_{dc} = \frac{i_c}{i_b}$$

(iii) Voltage gain : 
$$A_{V} = \frac{\Delta V_{0}}{\Delta V_{i}} = \beta_{ac} \times \text{Resistance gain}$$

(iv) Power gain = 
$$\frac{\Delta P_0}{\Delta P_i}$$
 =  $\beta^2$ ac × Resistance

(v) Transconductance  $(g_m)$ : The ratio of the change in collector in collector current to the change in emitter base voltage is called trans

conductance i.e. 
$$g_m = \frac{\Delta i_c}{\Delta V_{FR}}$$
 . Also  $g_m = \frac{A_V}{R_L}$   $R_L$  = Load resistance.

• Relation between  $\alpha$  and  $\beta$  :  $\beta = \frac{\alpha}{1-\alpha}$  or  $\alpha = \frac{\beta}{1+\beta}$ 

