

SEMICONDUCTOR

Conductivity and resistivity

	$P (\pi - m)$	$\rho (\pi^{-1}m^{-1})$
Metals	$10^{-2} - 10^{-6}$	$10^2 - 10^8$
semiconductors	$10^{-5} - 10^{-6}$	$10^5 - 10^{-6}$
Insulators	$10^{11} - 10^{19}$	$10^{-11} - 10^{-19}$

Charge concentration and current

- $[\eta_n = \eta_e]$ In case of intrinsic semiconductors
- P type $\eta_n \gg \eta_e$
- $i = i_e + i_h$
- $\eta_e \eta_n = \eta_i^2$
- Number of electrons reaching from valence bond to conduction bond.

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

- $\sigma = e (\eta_e m_e + \eta_n \mu_n)$
- for p type $\eta_n = Na \gg \eta_e$.
- for n-type $\eta_e = Na \gg \eta_n$

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

Transistor

- **CB amplifier**

(i) ac current gain $\alpha_c = \frac{\text{Small change in collector current } (\Delta i_c)}{\text{Small change in emitter current } (\Delta i_e)}$

(ii) dc current gain $\alpha_{dc} = \frac{\text{Collector current } (i_c)}{\text{Emitter current } (i_e)}$ value of α_{dc} lies between 0.95 to 0.99

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

$\Rightarrow A_v = a_{ac} \times \text{Resistance gain}$

(iv) Power gain = $\frac{\text{Change in output power } (\Delta P_o)}{\text{Change in input power } (\Delta P_i)}$

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

(v) Phase difference (between output and input) : same phase

(vi) Application : For High frequency

CE Amplifier

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

(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 = $\frac{\Delta P_0}{\Delta P_i} = \beta^2 ac \times \text{Resistance}$

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

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

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