# 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 $\eta_n >> \eta_e$
- $i = i_e + i_h$
- $\eta_e \ \eta_n = \eta_i^2$
- Number of electrons reaching from valence bond to conduction bond.

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

- $\sigma = e ( \eta_e m_e + \eta_n \mu_n)$

for $\rho$ hype $\eta_n = Na >> \eta_e$.
for $\eta$ – type $\eta_e = Na >> \eta_h$

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

## Transistor

- **CB amplifier**

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

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

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

$\Rightarrow A_V = a_{ac} \times$ Resistance gain

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

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

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

(vi) Application : For High frequency

## CE Amplifier

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

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

(iii) Voltage gain : $A_V = \frac{\Delta V_0}{\Delta V_i} = \beta_{ac} \times$ Resistance gain

(iv) Power gain = $\frac{\Delta P_0}{\Delta P_i} = \beta^2 ac \times$ 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. $g_m = \frac{\Delta i_c}{\Delta V_{EB}}$ . Also $g_m = \frac{A_V}{R_L}$ $R_L$ = Load resistance.

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