Semiconductor ITT & JEE Important Formulas

A substance with particular electrical properties, known as a semiconductor, can be used as the base for computers and other electronic devices. It is the perfect medium for controlling electrical current and common electrical appliances.

The term "conductor" refers to a material that can conduct electricity, and the term "insulator" refers to a material that cannot.

Conductivity and Resistivity

In this below table there is given the conductivity and resistivity of the following items like metals, semiconductors, insulators respectively.

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

Charge Concentration and Current

- $\eta_n = \eta_e$
- In case of intrinsic semiconductors
- $\eta_n \gg \eta_e$
- $i = i_e + i_n$
- $\eta_e \, \eta_n = \eta_i^2$
- $\eta = AT^{\frac{3}{2}} e^{-\frac{Eg}{2kT}}$
- $\sigma = e(\eta_e m_e + \eta_n \mu_n)$
- For P type $\eta_n = Na \gg \eta_e$
- For N type $\eta_e = Na \gg \eta_h$.
- Dynamic Resistance of P-N junction in forward biasing is: $\frac{\Delta V}{\Delta I}$

Transistor

A transistor is a small semiconductor that regulates or controls the flow of current or voltage in addition to generating, amplifying, and acting as a switch or gate for these electrical signals. Three layers, or terminals, of a semiconductor material typically make up transistors.

CB amplifier

- ac current gain $\alpha_c = \dfrac{Small\ change\ in\ Collector\ current(\Delta i_c)}{Small\ change\ in\ collector\ current\ (\Delta i_e)}$

- dc current gain $\alpha_{dc} = \dfrac{collector\ current(i_c)}{Emitter\ current\ (i_e)}$ Value of α_{dc} lies between 0.95 to 0.99.

- Voltage gain $A_v = \dfrac{Change\ in\ output\ voltage(\Delta V_0)}{Change\ in\ input\ voltage\ (\Delta V_f)}$

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

- Power Gain= $\dfrac{Change\ in\ output\ power(\Delta P_0)}{Change\ in\ input\ Voltage\ (\Delta P_c)}$
- Power gain= $a_{ac}^2 \times Resistance\ Gain$

CE Amplifier

- Ac current gain $\beta_{dc} = \left(\dfrac{\Delta i_c}{\Delta i_b}\right) V_{CE} = Constant$
- Dc current gain $\beta_{dc} = \dfrac{i_c}{i_b}$
- Voltage gain: $A_v = \dfrac{\Delta V_0}{\Delta V_i} = \beta_{ac} \times Resistance\ gain$
- Power Gain=$\dfrac{\Delta P_0}{\Delta P_i} = \beta^2 ac \times Resistance$
- Relation between $\alpha\ and\ \beta : \beta = \dfrac{\alpha}{1-\alpha}$ or $\alpha = \dfrac{\beta}{1+\beta}$