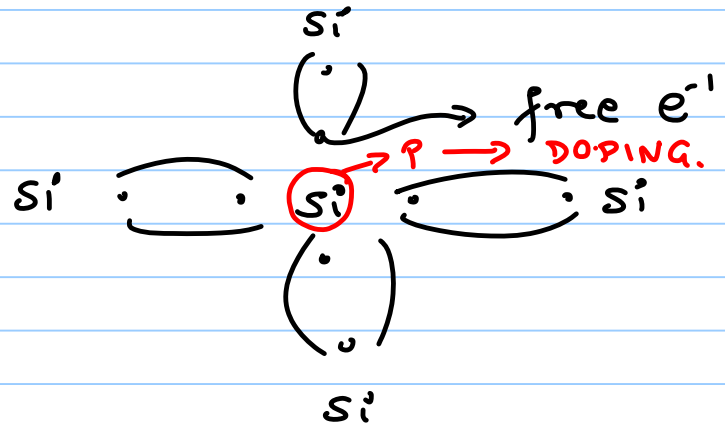
01/08/2019

EE5311

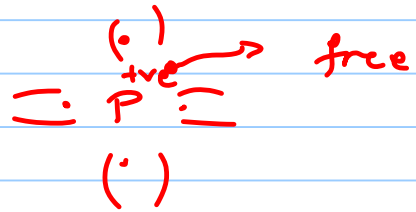
MODULE - 1

THE TRANSISTOR



Si density : $10^{22}/cm^3$

@ Room Temp (27°C) = $n_i = p_i$
$= 10^{10}/cm^3$



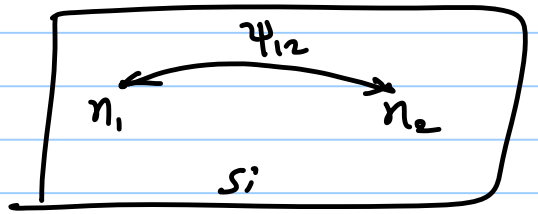
$n = N_D$ = Doping Conc
$\sim 10^{15}/cm^3$

LAW OF MASS ACTION:

$$np = n_i^2$$

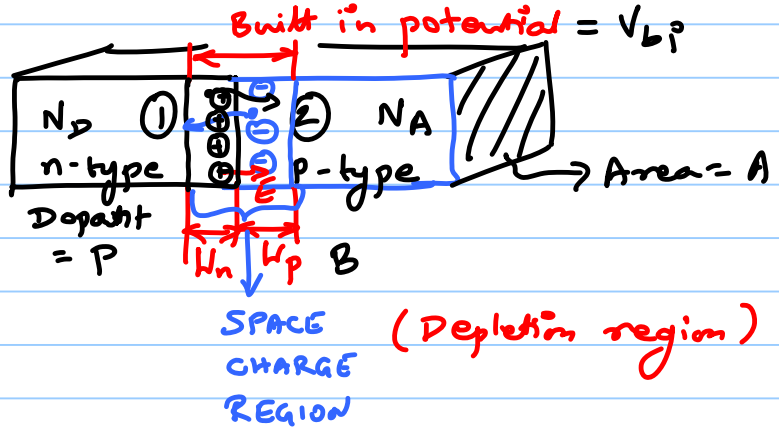
$n = N_D$

$$p = \frac{n_i^2}{N_D}$$



$$\frac{n_1}{n_2} = e^{\psi_{12}/(KT/q)}$$

$\frac{KT}{q}$ @ RT = 25 mV



$$\frac{n_1}{n_2} = e^{\frac{qV_{bi}}{KT}}$$

$$n_1 = N_D$$

$$p_2 = N_A$$

$$\Rightarrow n_2 = \frac{n_i^2}{N_A}$$

$$\therefore \quad \frac{N_D N_A}{n_i^2} = e^{\frac{qV_{bi}}{KT}}$$

$$\therefore \quad V_{bi} = \frac{KT}{q} \ln\left(\frac{N_A N_D}{n_i^2}\right)$$

$$qN_D W_n \cdot A = qW_p N_A \cdot A$$

$$\Rightarrow \quad \boxed{W_n \cdot N_D = W_p N_A}$$

if $N_D >> N_A$

$\Rightarrow W_p >> W_n$