Important Formulas (Unit – 1)

Mobility of the charge carrier

$$\mu = \frac{v_d}{E}$$

Conductivity for the metal (conductors)

$$\sigma = ne\mu$$

$$\sigma = \frac{1}{\rho}$$

Conductivity for the semi conductor

$$\sigma = (n\mu_n + p\mu_p)e$$

Resistivity of conductor

$$\rho = \frac{A}{l} R$$

Current density

$$J = \sigma E$$

$$J = env_d$$

Fermi Level for pure semiconductor

$$E_F = \frac{E_c + E_v}{2}$$

Fermi Level for N type semiconductor

$$E_F = E_C - kT \ln\frac{n_c}{N_D}$$

Fermi Level for P type semiconductor

$$E_F = E_V - kT \ln\frac{n_v}{N_A}$$

Fermi Dirac Function

$$f(E) = \frac{1}{1 + e^{\left(\frac{E - E_F}{kT}\right)}}$$

Mass action law

Pure Semi conductor

$$np = n_i^2$$

Doped Semiconductor

$$n + N_D = p + N_A$$

P Type doped semi conductor

$$N_A = 0 \ and \ p \ll n$$

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

N Type doped semi conductor

$$N_D = 0 \ and \ n \ll p$$

$$n = \frac{n_i^2}{N_A}$$

Diffusion Equation

$$\frac{D_n}{\mu_n} = \frac{D_p}{\mu_p} = \frac{kT}{e} = V_T$$

Total current conduction in the P N junction (due to conductivity and diffusion)

Hole Current density

$$J_p = e\left(p\mu_p E - D_p \nabla_p\right)$$

Electron Current density

$$J_n = e\left(n\mu_p E + D_n \nabla_n\right)$$

Total Current Density

$$J = (J_n + J_p)$$

Diode current conduction

$$I = I_0 \left[e^{V/\eta V_T} - 1 \right]$$

General equation for forward bias

$$I = I_0 e^{V/\eta V_T}$$

General equation for reverse bias

$$I = -I_0$$

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