Electronic Devices & Circuits

- Fermi level $f(E) = \frac{1}{1 + e^{(E-E_F)/kT}}$
- band gap variation $E_G(T) = E_G(0) - \beta_o T$
- Law of electrical Neutrality $ND + p = NA + n$
- Conductivity of n-type $\sigma_n = nq\mu_n$
- Mass Action Law $np = n_i^2$
- DIFFUSION CURREN

$$J_n(\text{diff}) = +qD_n \frac{dn(x)}{dx} \text{ (electrons)}$$

- Mobility $\mu_n = -\frac{\langle V_x \rangle}{E_x} (\text{cm}^2 / \text{V} - \text{sec})$
- Hall coefficient $R_H = \frac{V_H w}{BI}$
- Einstein Relationship

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

- Diffusion length:

$$L \equiv \sqrt{D\tau}$$

- Diode equation is $I = I_0 \left(e^{V/\eta V_T} - 1 \right)$
- Temperature Dependence

$$I_o(T) = I_{o1} \times 2^{(T-T)_1/10}$$

- Current in ideal diode:

$$I = qA \left(\frac{D_p}{L_p} p_n + \frac{D_n}{L_n} n_p \right) \left(e^{qV/kT} - 1 \right)$$

- Equilibrium contact potential:

$$v_0 = \frac{kT}{q} \ln \frac{p_p}{p_n} = \frac{kT}{q} \ln \frac{N_a N_d}{n_i^2}$$

- Transconductance of FET

$$g_m = g_{mo} \left(1 - \frac{V_{GS}}{V_P} \right)$$

- Amplification factor, $\mu = r_d g_m$
- Schottky equation,

$$I_{DS} = I_{DSS} \left(1 - \frac{V_{GS}}{V_P} \right)^2$$