EEE 105 – Data & Equations Provided in Exam

You may require the following:

Charge on electron, $q=1.6\times10^{-19}$ C

Boltzmann's constant, $k=1.38\times10^{-23}$ JK^{-1}

Speed of light, $c=3\times10^{8}$ m/s

Permittivity of free space, $\varepsilon_0 = 8.85\times10^{-12}$ Fm^{-1}

Planck's constant, $h=6.6\times10^{-34}$ Js

Mass of electron, $m_e = 9.11\times10^{-31}$ Kg

$$\langle v_d \rangle = -\mu E \qquad \mu = \frac{q\tau}{m^*}$$

$$E = -\frac{dV}{dx} \qquad J_e^{diffusion} = qD\frac{dn}{dx}$$

$$R = \rho L/A \qquad D = \frac{kT}{q}\mu$$

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

$$\beta = \frac{\alpha_B}{1-\alpha_B} \qquad J_e^{drift} = q\mu En$$

$$\alpha_B = \gamma_E \alpha$$

Poisson's Equation $\dfrac{d^2V}{dx^2} = -\dfrac{\rho}{\varepsilon}$

$$W = \left(\frac{2\varepsilon_0\varepsilon_r V_0}{q}\left(\frac{N_a + N_d}{N_a N_d}\right)\right)^{0.5}$$

$$J_0 = \frac{qL_e n_p}{\tau_e} + \frac{qL_h p_n}{\tau_h}$$

$$J = J_0\left[\exp\left(\frac{qV}{kT}\right) - 1\right]$$

$$p_{(p)} = p_{n0}\exp\left[\frac{q\left(V_0 - V_f\right)}{k_B T}\right]$$

Energy of a photon $=hc/\lambda$

$$\partial p = \partial p_0 \exp\left(\frac{-x}{L_h}\right)$$

For silicon;

Relative Permittivity = 12

Built-in Voltage, V_0 =0.7 V

Electron mobility $\mu_e=0.12$ m^{2}V^{-1}s^{-1}

Hole mobility $\mu_h=0.045$ m^{2}V^{-1}s^{-1}

Band-gap = 1.12 eV

Intrinsic carrier concentration at 300K $n_i = 1.45\times10^{16}$ m^{-3}