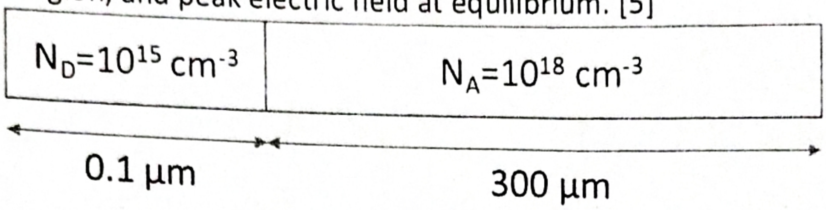
$\epsilon_r = 11$

Midsem EE207 – 2024
Total Marks - 20

Use the following semiconductor parameters unless specified otherwise:

Bandgap	1.12 eV	Diffusion length	$L_n = 50\ \mu m$ $L_p = 30\ \mu m$
Effective DOS at 300 K	$N_C = 2.8\times10^{19}\ cm^{-3}$ $N_V = 3.1\times10^{19}\ cm^{-3}$	Mobility	$\mu_n=300\times(T/300)^{-3/2}$ $\mu_p=100\times(T/300)^{-3/2}$
Temperature	300 K	Free space dielectric constant	$\epsilon_0 = 8.85\times10^{-14}$ F/cm

1. Consider a diode with the above material parameters. Find out the built-in potential, width of the depletion region, and peak electric field at equilibrium. [5]



2. Consider a long Silicon diode with $N_D=N_A=10^{17}\ cm^{-3}$. Find out the position the quasi Fermi levels for electrons and holes at both the edges the of depletion regions with respect of to the valence band. [5]

3. Consider the above semiconductor to be direct bandgap. A piece of this semiconductor is uniformly illuminated with an optical generation rate of $10^{14}\ cm^{-3}$/sec. Find out the excess current flowing through the semiconductor due to the optical generation at 1 V when the length of the semiconductor is 1 µm. [5]

4. Consider the diode in question 2. Find out the current at room temperature for forward bias 0.4 V. What is the voltage we need to apply at 400 K to get the same current. Assume minority carrier lifetime does not change with temperature. [5]