Indraprastha Institute of Information Technology
Department of ECE

Physics of Semiconductor Devices (ECE-210)

Assignment 2, Deadline: April 26, 2024

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Q.1. Consider the uniformly doped GaAs junction at T = 300K. At zero bias, only 20 percent of the total space charge region is to be in the p region. The built-in potential barrier is V_{bi} = 1.20 V. For zero bias, determine (a) N_a, (b) N_d, (C) x_n, (d) x_p, and (e) E_{max}. **[10 marks]**

Q.2. (a) For a MS junction, the following Electric field V/s distance profile is given in Figure 1. The dopant concentration in the semiconductor is $3.5 \times 10^{15} cm^{-3}$; determine if the semiconductor is n-type or p-type.

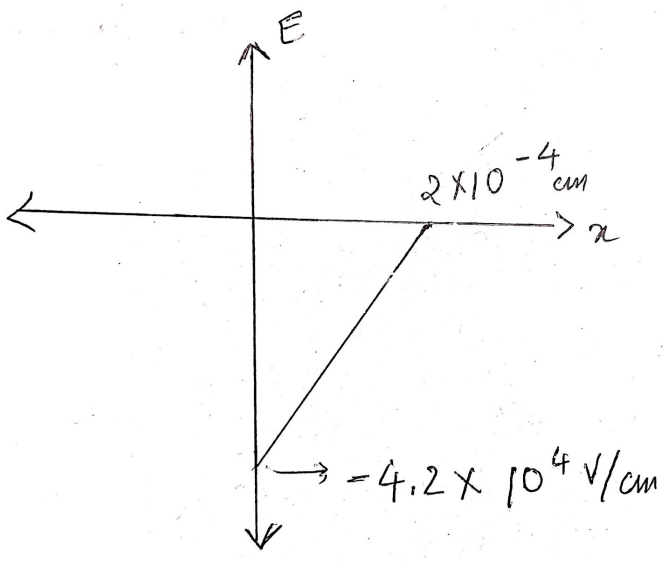

Figure 1:

(b) A Schottky barrier is formed on n-type Si, which has $N_d = 2.5 \times 10^{15} cm^{-3}$, and Φ_B= 0.55V and electron affinity as 4.01V. Determine V_{bi}? If the doping concentration is increased to $3 \times 10^{16} cm^{-3}$, what would be the change in V_{bi}?

[10 marks]

Q.3. For an abrupt, uniformly doped silicon pn junction diode, $N_a = 10^{17} cm^{-3}$, $N_d = 2 \times 10^{16} cm^{-3}$, $\mu_n = 1500 cm^2$/V-s, $\mu_p = 500 cm^2$/V-s, $\tau_n = 2\mu s$, $\tau_p = 5\mu s$ (where τ_p and τ_n is the carrier lifetime of the hole and electron resp.), A = $10^{-3} cm^2$. Compute the following for a forward

bias of 0.65 V at T = 300K: (a) depletion width W and the maximum electric field ϵ_m, (b) $n(x_p)$ *and* $p(x_n)$, (c) $J_n(x_p)$ *and* $J_p(x_n)$, (d) the diode current I, (e) electric fields in the neutral p and n regions, more than five diffusion lengths away from the depletion region, and (f) the reverse saturation current I_s. **[10 marks]**

Best wishes