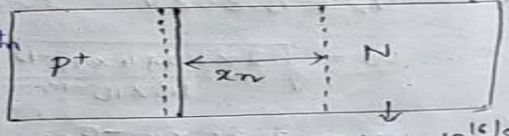


- When a reverse bias is applied to a germanium PN junction diode, the reverse saturation current at room temperature is $0.3 \mu\text{A}$. Determine the current flowing in the diode when 0.15 V forward bias is applied at room temperature. Ans: $120.73 \mu\text{A}$
- The reverse saturation current of a silicon PN junction diode is $10 \mu\text{A}$. Calculate the diode current for the forward-bias voltage of 0.6 V at 25°C . ans: 1.174 amps
- The diode current is 0.6 mA when the applied voltage is 400 mV , and 20 mA when the applied voltage is 500 mV . Determine recombination factor. Assume $v_t = 25 \text{ mV}$ ans:
- Find the value of dc resistance and ac resistance of a germanium junction diode at 25°C with $I_0 = 25 \mu\text{A}$ and at an applied voltage of 0.2 V across the diode. Ans: 3.65 ohms , 0.47 ohms
- The resistivities of the P-region and N-region of a germanium diode are 6 ohm-cm and 4 ohm-cm , respectively. (a) Calculate the contact potential V_0 and potential energy barrier E_0 . (b) If the doping densities of both P and N-regions are doubled, determine V_0 and E_0 . Given that $q = 1.602 \times 10^{-19} \text{ C}$, $n_i = 2.5 \times 10^{13} / \text{cm}^3$, $m_p = 1800 \text{ cm}^2/\text{V-s}$, $m_n = 3800 \text{ cm}^2/\text{V-s}$, and $V_T = 0.026 \text{ V}$ at 300 K .
Ans : 0.1545 v , 0.1545 ev , 0.1906 v , 0.1906 ev
- Consider a pn junction in equilibrium at room temperature ($T = 300 \text{ K}$) for which the doping concentrations are $N_A = 10^{18} / \text{cm}^3$ and $N_D = 10^{16} / \text{cm}^3$ and the cross-sectional area $A = 10^{-4} \text{ cm}^2$. Calculate p_p , n_{p0} , n_n , p_{n0} , V_0 , W , x_n , x_p , and Q_J (which is charge on either side of junction) Use $n_i = 1.5 \times 10^{10} / \text{cm}^3$, ϵ of silicon diode $1.04 \times 10^{-12} \text{ F/cm}$.
Ans : $10^{18} / \text{cm}^3$, $2.25 \times 10^2 / \text{cm}^3$, $10^{16} / \text{cm}^3$, $2.25 \times 10^4 / \text{cm}^3$, 0.814 v , $0.327 \mu\text{m}$, $0.324 \mu\text{m}$, $0.003 \mu\text{m}$, 5.18 picofarads
- For the pn junction which $N_A = 10^{18} / \text{cm}^3$, $N_D = 10^{16} / \text{cm}^3$, $A = 10^{-4} \text{ cm}^2$, and $n_i = 1.5 \times 10^{10} / \text{cm}^3$, let $L_p = 5 \mu\text{m}$, $L_n = 10 \mu\text{m}$, D_p (in the n region) $= 10 \text{ cm}^2/\text{V} \cdot \text{s}$, and D_n (in the p region) $= 18 \text{ cm}^2/\text{V} \cdot \text{s}$. The pn junction is forward biased and conducting a current $I = 0.1 \text{ mA}$. Calculate: (a) reverse saturation current (I_0) ; (b) the forward-bias voltage V
Ans $7.3 \times 10^{-15} \text{ amps}$, 0.605 v

27/1/20
1) Consider an abrupt p-n junction shown in the figure. The depletion width x_n on the n-side of the junction is $0.2 \mu\text{m}$ and the permittivity of silicon is $1.044 \times 10^{-12} \text{ F/cm}$. At the junction calculate the approximate value of peak electric field?

Sol:- $x_n = 0.2 \mu\text{m} = 0.2 \times 10^{-6} \text{ m} = 0.2 \times 10^{-4} \text{ cm}$
 $\epsilon = 1.044 \times 10^{-12} \text{ F/cm}$
 $N_D = 10^{16} / \text{cm}^3$



2) The donor and acceptor impurities in an abrupt pn junction of a silicon diode are $1 \times 10^{16} / \text{cm}^3$ and $5 \times 10^{15} / \text{cm}^3$ respectively. Assume the intrinsic carrier concentration in silicon is equal to 1.5×10^{10} at 300°K and permittivity of silicon is $1.044 \times 10^{-12} \text{ F/cm}$. Calculate the depletion width of the diode and the under Thermal equilibrium condition?

4 An Abrupt silicon p-n junction has dopant concentration of $N_A = 2 \times 10^{16} / \text{cm}^3$ and $N_D = 2 \times 10^{15} / \text{cm}^3$ at $T = 300^\circ \text{K}$.
 $n_i = 1.5 \times 10^{10} / \text{cm}^3$
 Calculate

- (i) In-Built (contact potential)
- (ii) width when reverse biased applied ($V_R = 0 \text{V}$)
- (iii) width when reverse voltage is 8V .
- (iv) Max. $\vec{E}$ in the depletion region when $V_R = 0 \text{V}$ and $V_R = 8 \text{V}$

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 5) Consider an uniformly doped Silicon p-n junction with doping concentration $N_A = 5 \times 10^{17} / \text{cm}^3$, $N_D = 10^{17} / \text{cm}^3$. The junction has a cross sectional area of 10^{-4}cm^2 and has an applied of $V_R = 5 \text{V}$.

- (i) Built in potential.
- (ii) x_n, x_p, w
- (iii) E_{max} .

7) An Ideal one side at silicon n^+p junction has uniform doping on both sides. The doping relation is $N_D = 50 N_A$ the built in potential is 0.752V . The Max. electric field in the junction is $1.14 \times 10^5 \text{V/cm}$ for a reverse bias voltage of 10V at $T = 300 \text{K}$. Calculate N_A, N_D, x_p for Reverse voltage of 10V .