other active device

Problems:

1) When a reverse bias is applied to a pn junction diode, the reverse current at room temperature is 0.3 μA. Determine the current flowing in the diode when 0.15V forward bias is applied at room temperature [Ge diode].

Sol:- $I_0 = 0.3 \times 10^{-6} A$, $V = 0.15 V$, $\eta = 1$

$$I = I_0 \left(e^{V/\eta V_T} - 1 \right)$$

$$V_T = \frac{KT}{q} = \frac{T}{11,600} \quad \& \; T = 273^\circ + 27^\circ = 300^\circ K$$

$$\Rightarrow \frac{300}{11,600}$$

$$\Rightarrow 0.0258$$

$$I = 0.3 \times 10^{-6} \left(e^{\frac{0.15}{0.0258}} - 1 \right)$$

$$\Rightarrow 100 \; \mu A$$

2) Determine the value of forward current in the case of pn junction diode with $I_0 = 10\,\mu A$, $V_f = 0.8V$ at $T = 300^\circ K$. Assume silicon diode.

Sol:- $V_f = 0.8V$, $I_0 = 10\,\mu A$, $\eta = 2$, $T = 300^\circ K$

$$V_T = \frac{KT}{q} \Rightarrow \frac{T}{11,600} \Rightarrow 0.0258$$

$$I = I_0\left(e^{V/\eta V_T} - 1\right)$$

$$\Rightarrow 10 \times 10^{-6}\left(e^{\frac{0.8}{2 \times 0.0258}} - 1\right)$$

$$\Rightarrow 54.1\ A.$$

3) The voltage across a silicon diode at room temperature ($300^\circ K$) is 0.7V when 2mA current flows through it. If the voltage increases to 0.75V. Calculate diode current.

Sol:- $V = 0.7$, $I = 2mA$, $T = 300$, $V_T = \frac{T}{11,600}$

$\Rightarrow 0.0258$

$\eta = 2$

$$I = I_0\left(e^{V/\eta V_T} - 1\right)$$

$$I_0 \Rightarrow \frac{I}{e^{V/\eta V_T} - 1}$$

$$\Rightarrow 2.567 \times 10^{-9}$$

If $V = 0.75$, $I_0 = 2.567 \times 10^{-9}$, $V_T = 0.0258$, $\eta = 2$

$$I = 2.567 \times 10^{-9} \left(e^{\frac{0.75}{2 \times 0.0258}} - 1 \right)$$

$$\Rightarrow 5.27 \text{ mA}$$

1) The reverse saturation current of a silicon PN junction diode is 10μA. Calculate the diode current for the forward-bias voltage of 0.6 V at 25°C.

Sol:- Given,

$V_F = 0.6\ V$, $T = 273 + 25 \Rightarrow 298\ ^\circ K$

$I_o = 10\mu A = 1 \times 10^{-5} A$ $\quad \eta = 2$ for silicon

The volt equivalent of the temperature (T) is

$$V_T = \frac{T}{11600} = \frac{298}{11600} = 25.7 \times 10^{-3} V$$

$\therefore$ The diode current, $I = I_o \left[e^{\left(\frac{V_F}{\eta V_T}\right)} - 1 \right]$