Effect of Temperature on Diode :→

1- The cut-in voltage decreases as the temperature increases. The diode conducts at smaller voltage at large temperature.

2- The reverse saturation current increases as temperature increases.

- This increase in I_0 is such that it doubles at every 10°C rise in temperature. Mathematically,

$$\boxed{I_{02} = I_{01}\left(2^{\Delta T/10}\right)}$$

Here $\Delta T = T_2 - T_1$

where,

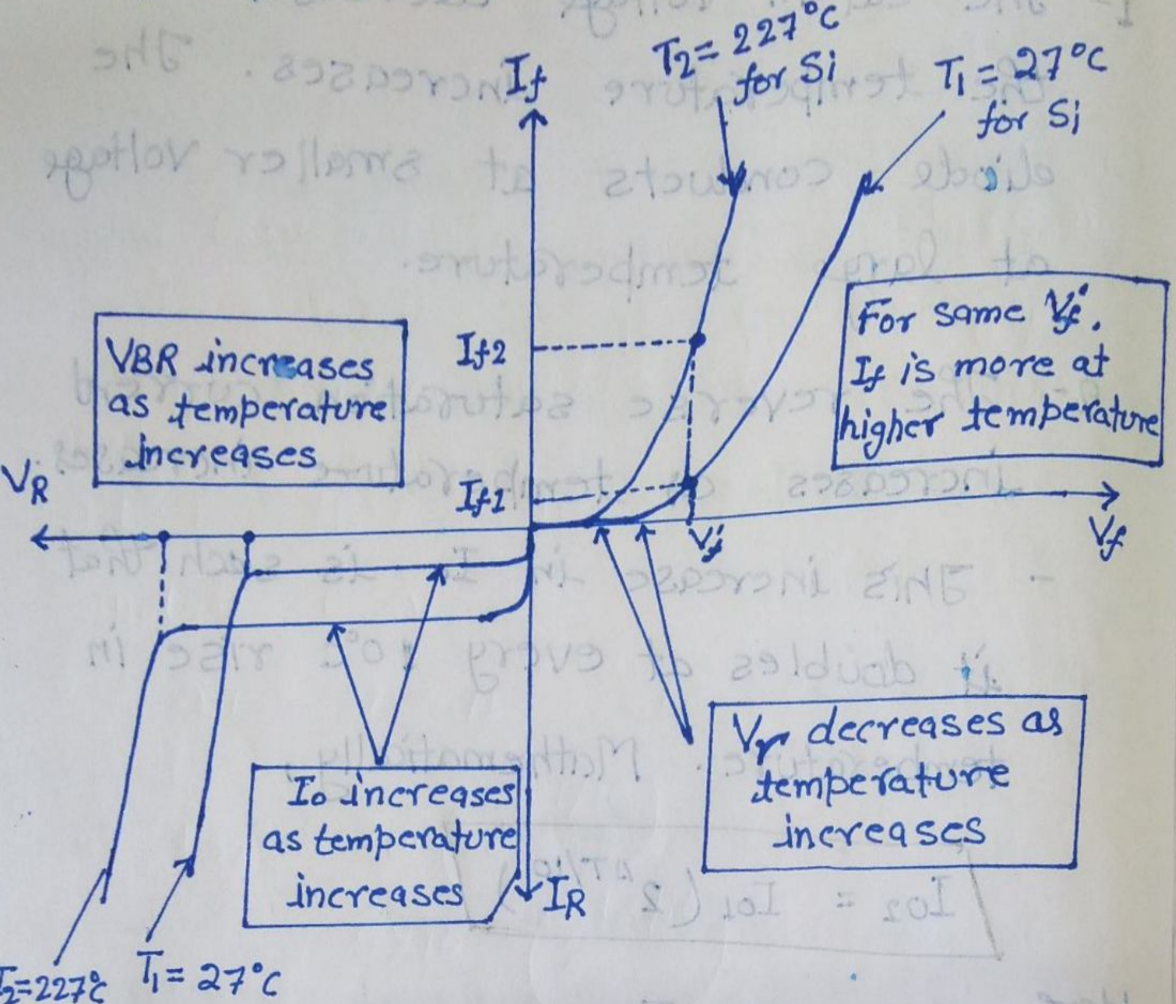
I_{02} = Reverse current at T_2°C

& I_{01} = Reverse current at T_1°C

3- The voltage equivalent of temperature (V_T) also increases as temperature increases.

4- The reverse breakdown voltage increases as temperature increases.

The effect of temperature on diode is shown below -



Q. The reverse saturation current of a silicon diode (I_o) is 3nA at 27°C. Find

(i) Reverse saturation current at 82°C

(ii) Forward current at 82°C, if forward voltage applied is 0.25 V.

Soln- Given that

$T_1 = 27°C$, $I_{o1} = 3nA$

(i) Here, $T_2 = 82°C$ & $I_{o2} = ?$

$\therefore \Delta T = T_2 - T_1 = (82-27)°C$

$= 55°C$

$\therefore$ Reverse saturation current at 82°C is-

$I_{o2} = I_{o1} (2^{\Delta T/10})$

$= 3 \times 10^{-9} (2^{55/10})$

$= 3 \times 10^{-9} \times 45.2548$

$= \underline{135.764\ nA}$ Ans

(ii) Here, $T = 82°C$ and $V = 0.25V$

$\therefore V_T = KT = \frac{T}{11600} = \frac{(82+273)°K}{11600}$

$= \frac{355}{11600} = 0.0306\ V$

Now, from eqn -

$I = I_o (e^{V/\eta V_T} - 1) = 135.764 \times 10^{-9} [e^{0.25/(2 \times 0.0306)} - 1]$

$= 135.764 \times 10^{-9} [e^{0.25/0.0612} - 1]$

$= 8.069 \times 10^{-6} = \underline{8.069\ \mu A}$ Ans

Q. The reverse saturation current of a Si diode is 5mA at room temperature. Find the diode current at 40°C and a forward voltage of 0.3V.

Soln - Given that,

$I_{01} = 5\,mA$ at room temperature be,

$T_1 = 27°C = (27+273)°K = 300°K$

At $T_2 = 40°C = 40+273 = 313°C$

and $V = 0.3V$

$\therefore \Delta T = T_2 - T_1 = 313 - 300 = 13$

$$\therefore I_{02} = I_{01}\left(2^{\Delta T/10}\right)$$

$$= 5\times10^{-3}\left(2^{13/10}\right)$$

$$= 5\times10^{-3} \times 2.462$$

$$= 12.311\ mA$$

Since $\eta = 2$ for Si

$$\therefore V_T = \frac{T}{11600} = \frac{T_2}{11600} = \frac{313}{11600} = 0.02698V$$

$\therefore$ diode current

$$I = I_0\left[e^{V/\eta V_T} - 1\right] = I_{02}\left[e^{V/\eta V_T} - 1\right]$$

$$= 12.311\times10^{-3}\left[e^{0.3/2\times0.02698} - 1\right]$$

$$= 12.311\times10^{-3} \times 258.7381$$

$$= 3.185\ A$$