Module 1

DIODE

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$$I_D = I_0\left[e^{\left(\frac{V}{\eta VT}\right)} - 1\right]$$

Where

I_D = Diode current

I_0 = Reverse saturation Current

V = Applied Voltage

V_T = Volt Equivalent of temperature

η = 1 (Ge)
= 2 (Si)

Volt Equivalent of temperature

V_T stands for Volt Equivalent of temperature which indicates dependence of diode current on temperature.

$$V_T = \frac{k\,T}{q}$$

k is Boltzmann constant = 1.38 x 10^{-19} J/k

T is the absolute temperature (°k) = 273 + Temperature in ° C

q is the charge of an electron = 1.6 x 10^{-19} C

$$V_T = \frac{T}{11600}$$

[Putting the value of k and q]

Q. Calculate the value of Volt Equivalent of temperature (V_T) at room temp.

Solution:-

$$V_T = \frac{T}{11600}$$

$$T\,(°K) = 273 + 27° C = 300\ °k$$

$$V_T = \frac{300}{11600}$$

$$V_T = 0.02586\ V$$

V_T = 26 mV at room temp

Reverse saturation current depends on Temperature. It increases as temperature increases.

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

I_{01} = reverse current at T_1°C

I_{02} = reverse current at T_2 °C

$$\Delta T = T_2 - T_1$$

Q. Reverse saturation current I_0 for a silicon diode is 5 mA at room temperature .Find the value of I_0 at 37° C .

Solution :-

I_{01} = 5 mA

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

I_{01} = reverse current at T_1°C $\quad T_1 = 273 + 27\ °C = 300\ °K$

I_{02} = reverse current at T_2 °C $\quad T_2 = 273 + 37\ °C = 310\ °K$

$$\Delta T = T_2 - T_1$$

$$\Delta T = 310\ °K - 300\ °K = 10$$

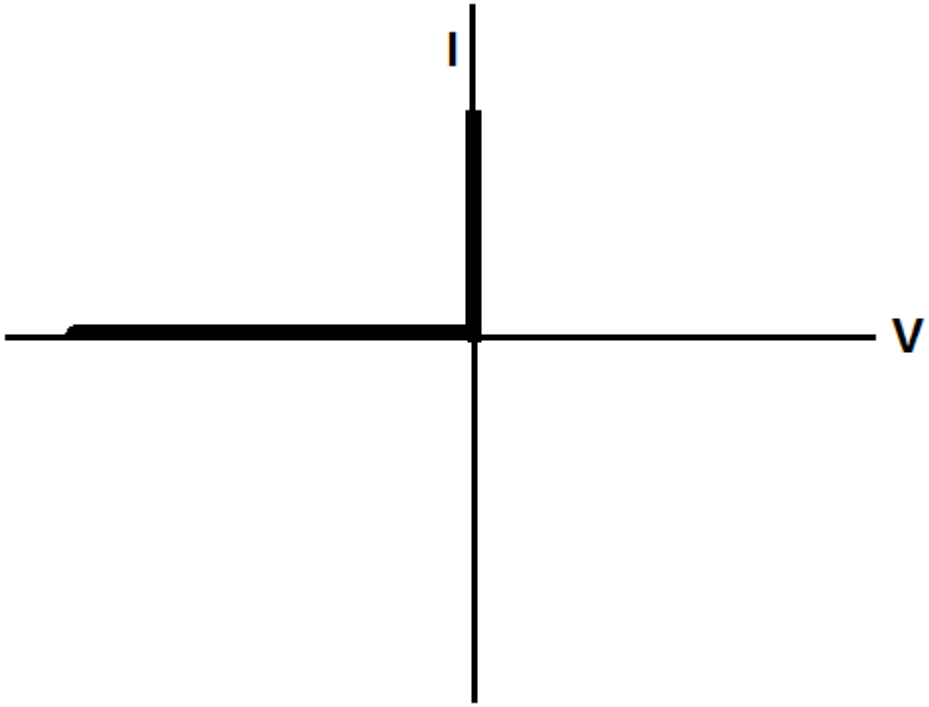
I_{02} = 10 mA

$$I_{02} = 2^{\left(\frac{10}{10}\right)} \times 5\ mA \qquad I_{02} = 2 \times 5\ mA = 10\ mA$$

Reverse saturation current depends on Temperature. It increases as temperature increases.

Note:- The reverse saturation current I_0 becomes double for every 10 ℃ rise in temperature.

Ideal diode



Below shows the VI characteristic of ideal diode.

It shows that ideal diode does not require any voltage to be in on condition unlike the silicon diode which Require 0.7 V and Germanium diode which requires 0.3 V to conduct in forward biasing.

And ideal diode does not allow any current when reverse biased.

It means it offers zero resistance in forward biasing condition and infinite resistance in reverse biasing conditions.

Ideal diode is a hypothesis and can not be made practically.

Diode Symbol