Assignment-2 (Semiconductor Diode)

1. Describe the difference between n-type and p-type semiconductor materials.
2. Describe in your own words the conditions established by forward- and reverse-bias conditions on a p–n junction diode and how the resulting current is affected.
3. Describe in your own words the meaning of the word ideal as applied to a device or a system.
4. a. Determine the thermal voltage for a diode at a temperature of 25°C.
   b. For the same diode of part (a), find the diode current using the I_D equation if I_S=40 nA, n=2 (low value of V_D), and the applied bias voltage is 0.5 V.

$$I_D = I_s(e^{V_D/nV_T} - 1) \qquad V_T = \frac{kT}{q} \qquad T_K = T_C + 273^\circ \qquad k = 1.38 \times 10^{-23}\,\mathrm{J/K}$$

Assignment 2.1

Semi-Conductor Basics.

Q1:- n-type:-semiconductors are doped with atoms having extra electrons.

This changes the characteristics of the semiconductors

P-type :- are semiconductors that lake one electron in a doped atom in it. while electrons are the majority carriers in n-type, holes here are the majority in P-type.

Q2:- Forward Bias :-

This happens when we connect the positive terminal of a battery → P-side and the negative side to n-side. that external voltage will push the holes and the electrons towards the junction for example if in the silicon (Si) case, we need 0.7V to do that and the barrier will collapse and the current will flow.

Reverse Bias :-

let's flip the battery. Now the voltage of the positive is going to n-side and negative to P-side. this will push them away from each other till a wall will be created and the current flow will be zero (except for some leakage

Q3:- The is no ideal system because in reality, there's always a in-Suffrect circumstances. But when ~~de~~ in this lesson the diode is ideal when having Zero resistance, and the battery is giving a Constant Voltage.

Q4a:- $V_T = \frac{KT}{q} = \frac{1.38 \times 10^{-23}_{J/K} \cdot (25 + 273.15)}{1.6 \times 10^{-19}} = 0.02569\ V$

Q4b $I_D = I_s \left(e^{\frac{V_D}{n V_T}} - 1 \right)$

(Given)

$n = 2$

$V_T = 0.02569\ V$

$V_D = 0.5\ V$

$IS = 40 \times 10^{-9}\ A$

$I_D = 40 \times 10^{-9} \left(e^{\frac{0.5}{2 \times 0.2569}} - 1 \right)$

$\frac{0.5}{2 \times 0.2569} = 9.73$

$e^{9.73} = 16814.5$

$I_D = 40 \times 10^{-9} \left(e^{9.73} - 1 \right)$

$I_D = 40 \times 10^{-9} (16814.5 - 1)$

$I_D = 40 \times 10^{-9} \times 16813.5$

$\boxed{I_D = 6.725 \times 10^{-4}}$