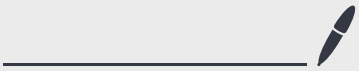
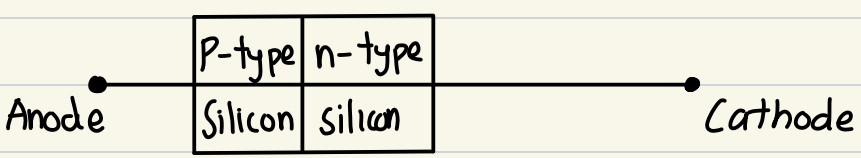
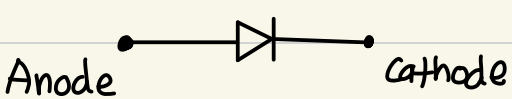


1) Long Question

a) What is PN junction diode? Starting from equilibirium current in PN junction, obtain diode eqn. Write the significance of diode eqn.

Ans A PN junction diode is one of the simplest semi conductor devices around and which has electrical characterstics of passing current through itself in one direction only. However, unlike a registor diode doesn't behave linearly with respect to applied voltage.





Equilibrium Current across the P-N junction

→ When the P-N junction is formed, a P.E barrier is formed

→ Electrons and holes continiously flow across the junction, the net flow is zero as equal to amount flow in opposite direction

→ The number of electrons Ne in the conduction band is given as:

$$Ne = Nc \exp\left(\frac{-Eg - Ef}{KB\,T}\right)$$

→ Since $Eg - E_F$ is much greater for the P-type than for the n-type, the numerical value of Ne at ambient temperature is several orders of magnitude smaller for the P-type than n type.

→ The electrons (minority carriers) in the conduction band of P region are not implemented by the P.E barrier from crossing the junction.

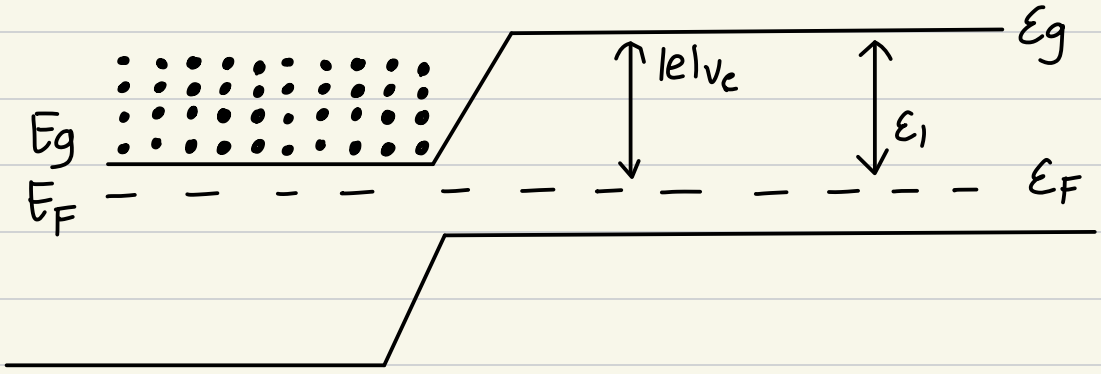
→ The electron current from p to n if (pn) will be prop to total number of electrons in P region.

$$i(p \to n) = A \exp\left(\frac{-\mathcal{E}_1}{K_B T}\right)$$

→ After the function is formed, an equilibrium is established where there is no net flow of electron (or holes) across the junction.

→ The minority carries electron in the p side are not impeded by the energy barrier from crossing the function. This flow is compensated by the flow in opposite direction of those electrons in the n-side with energy E > |e| Ve

← $i(p \to n)$



→ In the n side there are large number of electron (majority carries) in the conduction band.

→ However, only those having energy equal to or greater than the barrier energy level will be able to cross the junction from n-side to p-side.

→ i(p→n) will be prop to the number of electron In the n region with energies greater than or equal to level;

$$I(n \to p) = A N_e f(E \geq level)$$

→ Ne is the total number of electrons in the conduction band of the n side and f(E≥level) is the fraction of these electrons.

→ The fraction of electrons having energies greater than the barrier le)

$$f(\mathcal{E} \geq |e|V_c) = \exp\left(-\frac{|e|V_c}{K_B T}\right)$$

$$i(n \to p) : A \exp\left(\frac{-\mathcal{E}_z + |e|Vc}{K_B T}\right)$$

Significance of diode eqn:

1) It is use for modeling Diode behaviour
2) It is use for designing circuits.
3) For understanding Diode characterstics
4) Use for optimizing efficency of circuits.