FERMI DIRAC DISTRIBUTION:

In quantum theory different electrons occupy different energy levels at O`K. Electrons obey Pauli's exclusion principle. As the electrons receive energy they are excited to higher levels which are unoccupied at O K. The occupation of electrons obeys Fermi-Dirac distribution law. The particles that obey Fermi-Dirac distribution law are called Fermions.

The Fermi-Dirac distribution function at a temperature T is given by

$$f(E) \quad \frac{1}{e^{(E \;\; E_f)/KT} \quad 1}$$

Where E_f Fermi energy, $f(E)$ =the probability that a state of energy (E) is filled.

(I) At T=O K for $E \quad E_f$ $\quad E \quad \frac{n^2h^2}{8ma^2}$

$$f(E) \quad \frac{1}{e \quad 1} \quad 1$$

This means that all the energy state below E_f are filled.

For $E \quad E_f$

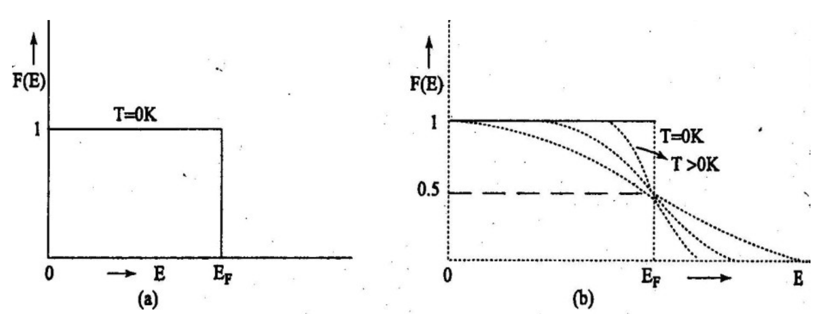
$f(E) \quad \frac{1}{e \quad 1} \quad 0$ Means that all the energy levels above E_f are empty.

From this we define Fermi level as it is the level at 0K below which all the levels are filled and above which all the levels are empty or it is the highest occupied state at 0K

(2) At T>0 and $E \quad E_f$

$$f(E) \quad \frac{1}{1\,1} \quad \frac{1}{2}$$

Fermi level is the state at which the probability of electron occupation is ½ at any temperature.



FERMI ENERGY:

The Fermi energy is a concept in quantum mechanics referring to the energy of the highest occupied quantum state in a system of Fermions at absolute zero temperature.

For the one dimensional infinite square well the energy of the particle is given by

$$E = \frac{n^2 h^2}{8ma^2}$$

Suppose now instead of one particle in this box we haven particles in the box and that particles are fermions with spin ½ then only two particles can have the same energy.i.e. Two particles have the same energy of

$$E_1 = \frac{h^2}{8ma^2}$$

Two particles having energy

$$E_2 = \frac{4h^2}{8ma^2}$$

∴All the energy levels up to n=N/2 are occupied and all the higher levels are empty.

$$E_f = E_{N/2} = \frac{(N/2)^2 h^2}{8ma^2} = \frac{N^2 h^2}{32ma^2}$$

$$\boxed{E_f = \frac{N^2 h^2}{32ma^2}}$$