

## Problem Sheet - 1

Q1- Consider a hypothetical semiconductor with all of the energy states filled. What would happen if I apply an electric field across the semiconductor? Will it conduct current? Give reason for your answer.

Q2- The E-K diagram is a plot which shows electron's:

- 1) Kinetic Energy. 2) Potential Energy. 3) Total Energy.
- 4) None of the above.

-> What does the lowest point in E-K diagram indicate?

Q3- Consider the effective mass of electrons to be different from that of holes and the material is intrinsic. Choose all correct options:

- 1)  $N_c = N_v$
- 2)  $E_i = (E_c + E_v)/2$ .
- 3)  $n_i = p_i$
- 4)  $E_i = E_f$

Q4- The density of states in the conduction band increases with electron energy. State TRUE or FALSE. Justify your stand.

Q5- Calculate  $n_o$  and  $p_o$  (electron concentration) of an intrinsic semiconductor if  $E_c - E_F = 0.5KT$ . Given  $N_c = N_v = 10^{19}/cm^3$ .

Q6- Given  $E = E_o + 5 * K^2$ . (Where K is wave vector) Calculate :-  
a)  $m^*$  and potential energy of  $e^-$ .

b) Now, an electric field  $E_1$  is applied across the semiconductor. Determine the expression of drift velocity ( $v_d$ ) and current density (J) of electrons after  $\tau$  seconds. (Charge of  $e^- = -q$ , Concentration of  $e^- = n$ ).