**FIFTH SEMESTER B.Tech. [E P]**

**TEST-I**

**EP-304-Semiconductor Devices**

***Time: 1:00 Hours Max. Marks: 20***

**Note:** Answer ***ANY FOUR*** questions

Assume suitable missing data, if any.

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1(a). Mention the drawbacks of classical free electron theory of metals. Derive the expressions for (a) drift speed and (b) Mobility of charge carriers.                           (2.5M)

(b). Calculate the free electron concentration, mobility and drift speed of electrons in aluminium wire of length of 5m and resistance 0.06 Ω carrying a current of 15 amp. Assume that each aluminium atom contributes 3 free electrons for conduction. (Density and atomic weight of aluminium are 2.7 X 103 kg/m3 and 26.98 respectively. Resistivity of aluminium is 2.7 X 10-8 Ω-m) (2.5M)

2.(a). Define density of states and deduce the expression for density of states function. (2.5M)

(b). A material which obeys Fermi-Dirac distribution law is having 6.50 eV Fermi energy value. In such material calculate the temperature at which there is 10% probability that a state 0.30 eV below the Fermi energy level will not be occupied by an electron. (2.5M)

3.(a). Deduce an expression of thermal equilibrium hole concentration in the valence band of an intrinsic semiconductor. (2.5M)

(b). Calculate the thermal equilibrium electron and hole concentration in GaAs at T= 300 K for the case when the Fermi energy level is 0.30 eV above the valence band.                                                                                                                            (2.5M)

(For GaAs effective density states function in conduction band (Nc) and valance band (Nv) at T=300 K are 4.7 X 1017/cm3 and 7.0 X 1018/cm3 respectively) (2.5M)

4. (a). Deduce an expression for Fermi level position with respect to the centre of band gap of an intrinsic semiconductor. (2.5M)

(b). Determine the position of the intrinsic Fermi level with respect to the centre of the band gap in silicon at T=300 K. (effective mass of electron and hole are 1.08 m0 and 0.56 m0 respectively, where m0 is rest mass of electron) (2.5M)

5. Define Hall effect and deduce an expression for hall coefficient and density of charge carriers. Write all the applications of Hall effect phenomenon. (5 M)