

## Problem Set - [OBE]

### Solid State Physics

#### PS-VI

Q.1. The unit cell side of NaCl is  $5.6 \text{ \AA}$  and Young's Modulus in a  $[100]$  direction is  $5 \times 10^{10} \text{ N/m}^2$ . Estimate the wave length at which electromagnetic radiation is strongly reflected by a sodium chloride crystal

Q.2. Evaluate the carrier concentration and conductivity of the intrinsic Ge at room temperature ( $T = 300 \text{ K}$ ) using the following data

$$m_e = m_n = m = 9.1 \times 10^{-31} \text{ kg}, m = \text{rest mass of electron } E_g = 0.68 \text{ eV}$$

$$\mu_e = 0.38 \text{ m}^2/\text{V}\cdot\text{sec}, \mu_n = 0.18 \text{ m}^2/\text{V}\cdot\text{sec}$$

Q.3 For an intrinsic semiconductor with a gap width of  $1 \text{ eV}$  calculate the position of Fermi level at  $T = 0 \text{ K}$  and at  $T = 300 \text{ K}$  if  $m_h^* = 6 m_e^*$  where  $m_h^*$  and  $m_e^*$  are effective mass of hole and electron respectively.  $k = 1.4 \times 10^{-16} \text{ erg/K}$

Q.4 The static dielectric constant of water is  $8.1$  and its refractive index is  $1.33$ . Calculate the percentage contribution of ionic polarizability?

Q.5 A metal has a static conductivity of  $4 \times 10^7 \text{ mho/m}$ . Assuming that the true charge carriers are free electrons and they are  $2 \times 10^{28} / \text{m}^3$ . Calculate the relaxation time?