2015

M.Sc.

2nd Semester Examination

ELECTRONICS

PAPER—ELC-203

Full Marks : 50

Time : 2 Hours

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

(*Electronic Materials*)

Answer *Q. No. 1* and any *three* from the rest.

1. (a) Explain the significance of Burgers vector.

(b) What are hot electrons ?

(c) Distinguish between soft and hard superconductors.

(d) Why ceramics are usually brittle ?

(e) Why are the direct-bandgap semiconductors suitable for LED and semiconductor lasers ? 2×5

2. (a) Distinguish between Frenkel and Schottky defects.

   (b) Derive an expression for the density of Schottky defects in ionic crystals.

   (c) If the observed interionic distance is 2.82Å in a certain sample of sodium chloride, calculate the average energy required for creation of one Schottky defect if the density of Schottky defects is 5×10^{11} per m^3 at 25°C. 3+4+3

3. (a) Mention the different scattering mechanisms affecting the transport of carriers in semi-conductors.

   (b) Given that at 300K, the effective mass and mobility of electrons in GaAs are $0.067m_0$ and 8500 $cm^2/V-s$, respectively. Calculate the relaxation time. If the GaAs sample is doped at $N_d = 10^{17} cm^{-3}$, the mobility decreases to 5000 $cm^2/V-s$. Calculate the relaxation time due to ionized impurity scattering.

   (c) Derive the expression for Hall coefficient of a semiconductor. 2+(2+2)+4

4. (a) Obtain an expression for the internal field in a solid dielectric.

   (b) Derive Clausius-Mosotti relation in dielectrics subjected to static fields.

(c) The relative dielectric constant of sulphur is 3.75 when measured at 300K. Assuming the internal field constant $\nu = \frac{1}{3}$, calculate the electronic polarizability of sulphur if its density at this temperature is 2050 kg m^{-3}. Given the atomic weight of sulphur is 32. 4+3+3

5. (a) What is Heisenberg's interpretation of exchange field ?

(b) Describe the structure of ferrites.

(c) 18 atomic percentage of Fe^{2+} in Fe_3O_4 is replaced by Mn^{2+}. What is the percentage change in saturation magnetization ?

Given,

Lattice parameter = 0.839×10^{-9}m

and

Ion	Electronic Configuration	Spin(s)	Magnetic moment
Fe^{2+}	$3d^6$	2	$4\mu_B$
Fe^{3+}, Mn^{2+}	$3d^5$	$\frac{5}{2}$	$5\mu_B$

3+4+3

6. (a) Calculate the thickness of a semiconductor to absorb 80% of the incident optical power falling on the surface of the material for $\alpha = 10^4 cm^{-1}$ and R = 0.1 (*the symbols have their usual meanings*).

(b) What bandgaps of semiconductors are considered as solar cell materials and why ?

(c) Derive an expression for maximum output power of a p-n junction solar cell. How are the series and shunt resistances developed in the cell ?

2+(1+1)+(4+2)

Internal Assessment — 10