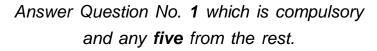
Total number of printed pages – 7 B. Tech
BSCC 2202

Fourth Semester Examination - 2008

MATERIAL SCIENCE

Full Marks - 70

Time: 3 Hours



The figures in the right-hand margin indicate marks.

(h = 6.626×10^{-34} Js, Mass of e = 9.1×10^{-31} kg, e = 1.6×10^{-19} C, c = 3×10^{8} m/s, N = 6.023×10^{23} , R=8.314JK⁻¹/mol, k= 1.38×10^{-23} J/K, $\mu_0 = 4 \times 10^{7}$, at. wt. : C = 12 amu, H = 1 amu)

- 1. Answer in brief: 2×10
 - (a) Why can not visible light produce ionic polarization?

P.T.O.

- (b) Why does corrosion occur in oxygen lean area although oxygen accelerates corrosion?
- (c) Discuss various factors that affect the drift velocity.
- (d) Why does conductivity of metal decrease at higher temperature?
- (e) What is Meissner effect?
- (f) A plane intercepts the crystal axes 'b' at 0.5b, 'c' at 0.25c. What are the miller indices if it is parallel to the third axis?
- (g) Name two elements which when added to Germanium will create holes.
- (h) What is glass transition temperature?
- (i) Why is BaTiO₃ ferroelectric below 120°C but not above it ?
- (j) What is meant by population inversion?

BSCC 2202 2 Contd.

- (a) Deduce the mathematical expression for thermal conductivity of a conducting material.
 - (b) The density and atomic weight of a metal are 7140 kg/m³ and 65.38 amu respectively. The relaxation time is 10⁻¹⁴ sec at 300 K. Calculate
 - (i) resistivity
 - (ii) mobility of electrons and
 - (iii) the average drift velocity when an electric field of 10 V/cm is applied.(no of valence electrons = 2)
- 3. (a) What is Fermi energy? What is the probability of finding the electron at the

Fermi energy level in a metal? Will the probability be higher or smaller at Fermi energy level at a higher temperature? 3

- (b) Calculate the electron velocity at Fermi energy of sodium at 0K. (density=970kg/m³, at.wt.= 23)
- (c) Distinguish between conductor, semiconductor and insulator on the basis of band theory.
- (a) There are 10¹² magnesium atoms, which replace an equal number of silicon atoms in a 10 mm³ wafer. Compare the conductivity with 10¹² aluminum atoms replacing equal number silicon atoms.

BSCC 2202 4 Contd.

BSCC 2202 3 P.T.O.

- (b) At an higher temperature, one of every
 10¹⁰ valence electrons in intrinsic silicon is in the conduction band.
 - (i) What is the conductivity?
 - (ii) What is the temperature ? $(a = 0.543 \,\text{nm}, \sigma_{20} = 5 \times 10^{-4} \,\text{mho/m}^4,$ no of atoms per unit cell = 8) 4
- (c) In an n-type semiconductor, the Fermi energy level lies 0.3eV below the conduction band. Find the position of Fermi level if the temperature is increased to 350 K.

3

- 5. (a) Distinguish between hard and soft magnetic materials.
 - (b) A paramagnetic material has a magnetic field intensity of 10⁶A/m. Calculate the

magnetization and flux density if susceptibility is 1.4×10^{-3} at room temperature.

3

- (c) Discuss the structure and applications of ferrites.
- 6. (a) Differentiate between type-I and type-II superconductors.
 - (b) Calculate the critical magnetic field for Tin at 1.5K and 2.5K.(Tc = 3.72K, Hc(o) = 0.03 Tesla).
 - (c) The polarisability of argon is 1.8×10⁻⁴⁰ Fm².
 Calculate the dielectric constant at NTP.

3

- 7. (a) What are isotactic, syndiotactic and atactic polymers?
 - (b) The weight average degree of polymerization for polypropylene is 15000. Calculate the weight average molecular weight. 3

BSCC 2202 5 P.T.O.

BSCC 2202 6 Contd.

- (c) Discuss about glass fibre reinforced polymer composite.4
- 8. (a) Discuss the phenomenon of passivity.

 Why are chromium steels more corrosion resistant than carbon steel?

 5
 - (b) What is LASER? Discuss the mechanismof LASER action of He-Ne laser.
