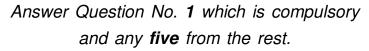
Total number of printed pages – 7 B. Tech
BSCC 2202

Fourth Semester Examination – 2008 MATERIAL SCIENCE

Full Marks - 70

Time: 3 Hours



The figures in the right-hand margin indicate marks.

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

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

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- (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?

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- (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 6
 - (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

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- 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.

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

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

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- c) Discuss the structure and applications of
- (a) Differentiate between type-I and type-II superconductors.

ferrites.

- (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.
- (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.

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- (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?

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

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