

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

Fourth Semester Examination – 2008

MATERIAL SCIENCE

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory
and any **five** from the rest.*

*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, $N = 6.023 \times 10^{23}$,
 $R = 8.314$ JK⁻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 ?



- (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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Contd.

2. (a) Deduce the mathematical expression for thermal conductivity of a conducting material. 4

(b) The density and atomic weight of a metal are 7140 kg/m^3 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

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 0 K . (density = 970 kg/m^3 , at.wt. = 23) 4

(c) Distinguish between conductor, semiconductor and insulator on the basis of band theory. 3

4. (a) There are 10^{12} magnesium atoms, which replace an equal number of silicon atoms in a 10 mm^3 wafer. Compare the conductivity with 10^{12} aluminum atoms replacing equal number silicon atoms. 3

(b) At an higher temperature, one of every 10^{10} 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. 3

(b) A paramagnetic material has a magnetic field intensity of 10^6 A/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. 4

6. (a) Differentiate between type-I and type-II superconductors. 3

(b) Calculate the critical magnetic field for Tin at 1.5K and 2.5K. ($T_c = 3.72 \text{ K}$, $H_c(0) = 0.03 \text{ Tesla}$). 4

(c) The polarisability of argon is $1.8 \times 10^{-40} \text{ Fm}^2$. Calculate the dielectric constant at NTP. 3

7. (a) What are isotactic, syndiotactic and atactic polymers ? 3

(b) The weight average degree of polymerization for polypropylene is 15000. Calculate the weight average molecular weight. 3

- (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 mechanism of LASER action of He-Ne laser. 5
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