

## JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

B.Tech. (CSE, ECE, IT) VI Semester

COURSE CODE: 10B11PH611

MAX. MARKS: 25

COURSE NAME: MATERIALS SCIENCE

COURSE CREDITS: 04

MAX. TIME: 1.5 HR

*Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. Scientific calculator is allowed.*

1. (a) On being polarized an oxygen atom produces a dipole moment of  $0.5 \times 10^{-22}$  C-m. If the distance of the centre of the negative charge cloud from the nucleus is  $4 \times 10^{-17}$  m, Calculate the polarizability of the oxygen atom. **3 marks [CO-3]**
- (b) Discuss the technique to introduce piezoelectric behaviour in ceramic materials. **2 marks [CO-4]**

2. (a) Compute from the tabulated data for  $C_3H_6$ , the number average molecular weight, weight average molecular weight, degree of polymerization and poly dispersity index;

Mol. Wt. range (g/mol)	$x_i$	$w_i$
15000-45000	0.11	0.05
45000-75000	0.42	0.35
75000-105000	0.36	0.43
105000-135000	0.11	0.17

**4 marks [CO-3]**

- (b) Mention the types of copolymers. Determine the ratio of  $C_4H_6$  and  $C_3H_8$  mer units in a copolymer having number average molecular weight, 3,50,000 g/mol and degree of polymerization is 4425. Determine the type of copolymer. **3 marks [CO-2]**

3. (a) Derive an expression for Larmor precessional frequency for an electron orbiting nucleus in an atom in the presence of a magnetic field. Also discuss its significance. **4 marks [CO-1]**

- (b) Calculate the diamagnetic susceptibility for copper by assuming only one electron per atom contribution. Assume FCC crystallinity with radius 0.1 nm. **3 marks [CO-3]**

4. (a) Discuss the role of different types of energies contributing towards the creation of domains in ferromagnetic materials. **3 marks [CO-1]**

- (b) A paramagnetic system of electron spins is placed in an external field of  $10^5$  A/m. Calculate the average magnetic moment per dipole at room temperature. Also calculate the fractional number of spins which are parallel to the field. **3 marks [CO-2]**

$$\mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}; m_e = 9.1 \times 10^{-31} \text{ kg}; e = 1.6 \times 10^{-19} \text{ C}; \epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}; k_B = 1.38 \times 10^{-23} \text{ J/K};$$

$$h = 6.6 \times 10^{-34} \text{ Js}; N_A = 6.02 \times 10^{23}$$