

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2021

B.Tech V Semester (ECE)

COURSE CODE: 18B1WPH531

MAX. MARKS: 35

COURSE NAME: Science & Technology of Materials

COURSE CREDITS: 03

MAX. TIME: 2 Hours

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

(Q1) In a drop of water of radius 10^{-3} m, the molecular dipoles are pointed in the same direction. If the dipole moment of water molecule is 6×10^{-30} C-m, calculate the polarization. [3]

(Q2) What are ferroelectric ceramics? Why they are considered smart materials? [2]

(Q3) (a) Polyethylene (C_2H_4) sample containing 4000 chains with molecular weight 2500 g/mol, 8000 chains with molecular weights between 7500 g/mol, 7000 chains with molecular weights between 12500 g/mol and 2000 chains with molecular weights between 17500 g/mol. Determine both number and weight average molecular weights. Also calculate polydispersity index. [2]

(b) What is meant by glass transition temperature? List the factors to plan a polymer with an increased glass transition temperature. [3]

(Q4) (a) Derive an expression for paramagnetic susceptibility on the basis of Langevin's theory. [3]

(b) Assuming the susceptibility of a diamagnetic material as -5.6×10^{-6} and its structure as a body centred cubic with a lattice constant 2.55 \AA , calculate the radius of its atom, if only one electron per atom is contributing to diamagnetism. [2]

(Q5) (a) For an optical fibre having core and cladding refractive indices 1.55 and 1.50 respectively, how many reflections per meter are suffered by the guided ray at the steepest angle with respect to the fibre axis, if the core diameter is $50 \mu\text{m}$. [2]

(b) Derive an expression to show a correlation between the core refractive index (n_1) and the fractional change in refractive index (Δ). [3]

(c) An optical fibre has the core refractive index 1.36 and the relative difference in index 0.025, Find the refractive index of the cladding (n_2), numerical aperture and the acceptance angle. [2]

(Q6) (a) Explain Meissner Effect. Show that perfect diamagnetism is an essential condition for superconductivity. [4]

(b) Calculate the critical current density for 1-mm diameter of lead at 7 K. A parabolic dependence of H_c upon T may be assumed. Given T_c for lead is 7.18 K and H_0 for lead is 6.5×10^4 A/m. [3]

(c) The density and atomic mass of niobium are $8.57 \times 10^3 \text{ kg/m}^3$ and 93 respectively. It has one conduction electron per atom. Calculate the London penetration depth for niobium. Also calculate the penetration depth at 2 K if T_c is 3.69 K. [3]

(Q7) What are salient features of nano dimension? [3]

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