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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST-3 EXAMINATION - JUNE -2016
B.Tech. VI Semester

COURSE CODE: 10B11PH611 MAX. MARKS: 35
COURSE NAME: Materials Science
COURSE CREDITS: 04 MAX. TIME: 2 HRS

Note: *All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. Scientific calculators are allowed.* ***Attempt all parts of a question sequentially.***

1. Obtain an expression for the dielectric constant in terms of the frequency and the relaxation time. Illustrate its diagrammatic representation [5]
2. (a) Discuss the specific heat using band gap in a superconductor. [2]
   (b) A polymer consists of 20% by weight of macromolecular with molecular weight 20000 and 80% by weight of macromolecular with molecular weight 200000. Calculate number average molecular weight, weight average molecular weight and polydispersity index. [3]
3. (a) Derive an expression for magnetic susceptibility keeping in view that the field strength is not too high and temperature is not too low. [3]
   (b) An atom contains 10 electrons revolving in a circular path of 0.01 nm. Assuming homogeneous charge distribution, calculate the angular frequencies for an applied field of 2 Tesla. [2]
4. (a) Considering quantum approach, derive an expression for paramagnetic susceptibility, and hence show that for L=0, J=S=1/2, the effective magnetic moment is similar to that of spin moment. [3]
   (b) A system of electron spins is placed in a magnetic field of 2 weber/m^2 at a temperature T. The number of spins parallel to the magnetic field is twice as large as the number of antiparallel spins. Determine T. [2]
5. (a) Derive an expression to show that Neel temperature is the same as the paramagnetic Curie temperature. [3]
   (b) The Curie temperature is 770 °C. Assume that iron atoms in metallic form have magnetic moment of 2 Bohr magneton per atom. Given iron is BCC with lattice parameter 0.286 nm, calculate (i) saturation magnetization (ii) the magnitude of the internal field. [2]
6. (a) Derive an expression for intermodal dispersion in an optical fiber and discuss its significance. [3]
   (b) For a step index fiber (diameter 10 μm) operating at 850 nm with n_1=1.480, Δ=0.0101, calculate the acceptance angle and number of propagating modes. [2]
7. (a) Discuss the losses in an optical fiber due to linear and non-linear scattering. [3]
   (b) A GI fiber has n_1=1.50, n_2=1.49 and core diameter=50 μm. Consider the guided ray travelling at the steepest angle with respect to the fiber axis, how many reflections per meter are there? [2]

Standard constants:
k_B=1.38x10^{-23} J/K; e=1.6x10^{-19} C; m_e=9.1x10^{-31} kg; ε_o=8.85x10^{-12} F/m; μ_o=4πx10^{-7} H/m; h=6.62x10^{-34} Js; c=3x10^8 m/s.