JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST -2 EXAMINATIONS-2022
B.Tech-V Semester (IT)

COURSE CODE (CREDITS): 18B1WPH531 (3)

MAX. MARKS: 25

COURSE NAME: Science and Technology of Materials

COURSE INSTRUCTORS: PBB

MAX. TIME: 1 Hour and 30 Minutes

Note: All questions are compulsory. Marks are indicated against each question in square brackets.

Q1. (a) Bakelite is found to have the real part of its complex relative dielectric constant as 4.36 with a loss tangent of 2.8×10^{-2} at a frequency of 1 MHz. Calculate the complex polarizability of the material assuming Lorentz field. Given $N = 4 \times 10^{28} /m^3$ **[3-marks][CO-3]**

(b) Discuss the processing of ferroelectric ceramics. **[2-marks][CO-5]**

Q2. (a) Based on Langevin's theory of diamagnetism, show that the diamagnetic susceptibility is negative and independent of temperature and field strength. **[3-marks][CO-1]**

(b) The curie temperature of iron is 1043 K. Assume that iron atoms, when in metallic form, have moments of two Bohr magneton per atom. Iron is body centred cubic (BCC) with lattice parameter a = 0.286 nm. Calculate (i) the saturation magnetization (ii) the curie constant (iii) the Weiss field constant (iv) the magnitude of the internal field. **[2-marks][CO-3]**

Q3. (a) What is the physical basis of paramagnetism in materials? Describe the Weiss's molecular theory of ferromagnetism and derive Curie-Weiss law. **[3-marks][CO-1]**

(b) Calculate the frequency of the radiation which must be incident on a substance placed in a magnetic field of length $[(5 \times 10^5)/\pi]$ A/m, so that the electrons can absorb energy. **[2-marks][CO-3]**

Q4. (a) Discuss the susceptibility variation with temperature in antiferromagnetic materials. Obtain the expression of Neel temperature in such materials. **[3-marks][CO-2]**

(b) The saturation magnetic induction of nickel is 0.65 Wb/m^2. If the density of nickel is 8906 kg/m^3 and its atomic weight is 58.7, calculate the magnetic moment of nickel atom in Bohr magneton. **[2-marks][CO-3]**

Q5. (a) Classify polymers on the basis of thermal response. **[3-marks][CO-2]**

(b) Discuss the variation of molecular weight in polymers. **[2-marks][CO-5]**

$k_B = 1.38 \times 10^{-23}$ J/K; $m_e = 9.11 \times 10^{-31}$ kg; $\mu_0 = 4\pi \times 10^{-7}$ H/m; e=1.6x10^{-19} C; $\varepsilon_o = 8.85 \times 10^{-12}$ F/m