

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

COURSE CODE (CREDITS): 18B1WPH532 (3)

MAX. MARKS: 25

COURSE NAME: Applied Materials Science

COURSE INSTRUCTORS: VSA, SKT, HAZ

MAX. TIME: 1 Hour and 30 Minutes

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

Q1. (a) If a dielectric is introduced between the plates of a parallel plate capacitor, show that the induced charge

varies with the dielectric as $\epsilon_r = \left(1 - \frac{\sigma'}{\sigma}\right)^{-1}$ where σ and σ' are surface densities. [2-marks][CO-2]

(b) There are 1.6×10^{20} molecules/m³ in NaCl vapour. Determine the orientation polarization at room temperature (300 K) if the vapour is subjected to a field of 5×10^6 V/m. Assume that the NaCl molecule consists of Na⁺ and Cl⁻ ions separated by a distance 2.5 Å. [2-marks][CO-3]

(c) What kind of synthesis methods are adopted in laboratories to synthesize high quality ceramics for advanced applications? [1-marks][CO-4]

Q2. (a) On the basis of Weiss theory of ferromagnetism, show that spontaneous magnetization exists below the Curie temperature and vanishes above the Curie temperature. [3-marks][CO-1]

(b) A magnetic material has a magnetization of 3300 A/m and flux density of 0.0044 Wb/m². Calculate the magnetizing field and the relative permeability of the material. [2-marks][CO-3]

Q3. (a) Show that for an antiferromagnetic substance the Curie temperature equals the Neel temperature. [3-marks][CO-1]

(b) An electron in an atom of hydrogen circulates in the orbit of radius 0.051 nm. Calculate the change in magnetic moment for this electron if a magnetic field of induction 2 weber/m² acts at right angles to the plane of the orbit. [2-marks][CO-3]

Q4. (a) For a system of electron spins in an applied magnetic field of 2 Tesla, the number of down spins is twice as large as the number of up spins at a temperature T. Find T. [3-marks][CO-3]

(b) Assuming the susceptibility of a diamagnetic material as -5.6×10^{-6} and its structure as a body centred cubic with lattice constant 2.55 Å. Calculate the radius of its atom, if only one electron per atom is contributing to diamagnetism. [2-marks][CO-3]

Q5. (a) On the basis of the length of polymers, bonding in polymers differentiate between crystalline and amorphous polymers. [3-marks][CO-4]

(b) Analyse the commercial polymer range and give its relevance. [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; $e = 1.6 \times 10^{-19}$ C