JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST -3 EXAMINATIONS-2022
B.Tech-III Semester (CS/IT)

COURSE CODE (CREDITS): 18B1WPH532 (3) MAX. MARKS: 35
COURSE NAME: Applied Materials Science
COURSE INSTRUCTORS: VSA, SKT, HAZ MAX. TIME: 2 Hours

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

Q1. (a) Determine the ratio of butadiene (C_4H_6) to acrylonitrile (C_3NH_3) mers in a copolymer having a weight average molecular weight of 2,50,000 g/mol and a weight average degree of polymerization 4640. [2-Marks] [CO-5]

(b) Propylene sample contains 2000 chains with molecular weight between 1000 and 4000 g/mol, 4000 chains with molecular weight between 6000 and 9000 g/mol, 3500 chains with molecular weight between 10000 and 15000 g/mol and 1000 chains with molecular weight between 15000 and 20000 g/mol. Determine the number and weight average molecular weight and calculate the polydispersity index for the same. [3-Marks][CO-5]

Q2. (a) What are the two characteristic changes and their physical significance when the matter is reduced to nanoscale? [1-Mark] [CO-4]
(b) What are shape memory alloys? Give suitable examples. [1-Mark] [CO-4]

Q3. (a) Derive an expression for London penetration depth and plot a graph between magnetic field and penetration depth. [2-Marks] [CO-1]
(b) Show that in superconductor current density is constant even in the absence of applied electric field. [2-Marks] [CO-1]

Q4. (a) Explain type-I and type-II superconductor on the basis of magnetization versus applied field graph. Also graphically show the variation of entropy with temperature for a normal and superconducting sample. [3-Marks] [CO-4]

(b) The critical field and critical temperature of lead are 6.5×10^4 A/m and 7.18 K, respectively. Calculate the critical current density for 1 mm diameter wire of lead at 4.2 K. [2-Marks] [CO-3]

Q5. (a) Discuss the refractive index profile in different optical fibers. Also, plot the variation of the numerical aperture with the acceptance angle of the fiber. [3-Marks] [CO-4]
(b) The fractional refractive index (Δ) for a step index optical fiber having diameter 50 micron is 1.33%. What is the critical angle? If the numerical aperture of this fiber is 0.244, calculate the refractive index of the core and the number of modes supported by this fiber for an operating wavelength of 900 nm. [2-Marks] [CO-5]

Q6. (a) A 125 micron step index fibre has numerical aperture 0.28 and clad refractive index 1.5. Compute the intermodal pulse broadening for 5 km fiber. [1-Mark] [CO-3]
(b) List the various types of losses in an optical fiber. [2-Marks] [CO-5]
(c) The optical power, after propagating through a fiber that is 450 m long, is reduced to 30% of its original value. Calculate the fiber loss in dB/km. [1-Mark] [CO-3]

Q7. (a) Sodium metal with a bcc structure has two atoms per unit cell. The radius of the sodium atom is 1.85 Å. Estimate the order of the diamagnetic susceptibility in sodium. [3-Marks] [CO-3]
(b) Discuss the importance of ceramics in the manufacturing of space shuttle. [2-Marks] [CO-5]

Q8. (a) Two parallel plates have equal and opposite charges. They are separated by a dielectric of 5 mm thick whose dielectric constant is 3. If the electric intensity in the dielectric is 10^6 V/m, calculate the free charge per unit area on the plate and the polarization in the dielectric. [3-Marks] [CO-3]
(b) What are piezoelectric materials? How they are different from pyroelectric materials. [2-Marks] [CO-5]

$k_B=1.38\times10^{-23}$ J/K· $m_e = 9.11\times10^{-31}$ kg; $\mu_0=4\pi\times10^{-7}$ H/m; $e = 1.6\times10^{-19}$ C; $c=3\times10^8$ m/s; $h=6.626\times10^{-34}$ Js