

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST -3 EXAMINATIONS-2022

B.Tech-V Semester (IT)

COURSE CODE (CREDITS): 18B1WPH531 (3)
COURSE NAME: Science and Technology of Materials
COURSE INSTRUCTORS: PBB

MAX. MARKS: 35

MAX. TIME: 2 Hours

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

- Q1. (a) Derive an expression for acceptance angle of an optical fiber. Calculate the numerical aperture for the same [3-marks] [CO-1]
- (b) A glass fiber has a core material of refractive index of 1.45 and cladding material of refractive index 1.40. If it is surrounded by air, compute the critical angle at (a) core-cladding boundary (b) cladding-air boundary. [2-marks] [CO-3]
- Q2. (a) A step index fiber has core refractive index 1.566 and cladding refractive index 1.56. If the operating wavelength of the rays is 0.84 micron, calculate the cut off parameter and the number of modes supported by this fiber. Given diameter of core is 50 micron. [3-marks] [CO-3]
- (b) At what temperature do we get critical field 0.1 times $H_c(0)$ for lead having $T_c = 7.2$ K. [2-marks] [CO-3]
- Q3. (a) Derive London equations for a superconductor. [3-marks] [CO-2]
- (b) For a sample the critical fields are 0.176 Tesla and 0.528 Tesla at 14 K and 13 K respectively. Calculate the transition temperature and the critical fields at 0 K and 4.2 K. [2-marks] [CO-3]
- Q4. (a) What are thermoelectric materials? Write any two of their applications [3-marks] [CO-4]
- (b) Discuss the applications of ceramics in the field of gas sensors. [2-marks] [CO-5]
- Q5. (a) Derive an expression for the static value of electronic polarizability for a dielectric material. [3-marks] [CO-2]
- (b) A dielectric material has dielectric constant of 5 and square of refractive index 2.5. Calculate the ratio of ionic to electronic polarizabilities. [2-marks] [CO-3]
- Q6. (a) Derive an expression to show the atomic origin of magnetic moment in a magnetic material. [3-marks] [CO-2]
- (b) In hydrogen atom, an electron revolves around the nucleus in an orbit of radius 0.53 Å. If the frequency of revolution of an electron is 6.6×10^{15} Hz, find the magnetic moment of the orbiting electron and calculate the numerical value of Bohr magneton. [2-marks] [CO-3]
- Q7. (a) Differentiate between addition and step growth polymerization. [3-marks] [CO-1]
- (b) The density of amorphous polyethylene is 920 kg/m^3 and that of crystalline polythene is 961.97 kg/m^3 . Calculate the % crystallinity of a high density polyethylene whose density is 938 kg/m^3 . [2-marks] [CO-2]

$k_B = 1.38 \times 10^{-23} \text{ J/K}$; $m_e = 9.11 \times 10^{-31} \text{ kg}$; $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$; $e = 1.6 \times 10^{-19} \text{ C}$; $c = 3 \times 10^8 \text{ m/s}$; $h = 6.626 \times 10^{-34} \text{ Js}$