

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST-III Examination, May 2018

B.Tech. VI Semester (CSE, IT, ECE)

COURSE CODE: 10B11PH611

COURSE NAME: MATERIALS SCIENCE

COURSE CREDITS: 04

MAX. MARKS: 35

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.

1. (a) Obtain the expression of electric field within the Lorentz cavity only for an isotropic dielectric. [CO-2] [3]
 (b) Assuming a complete transfer of electron from hydrogen atom to chlorine atom, when the separation between the atoms is **128 pm**. Determine the dipole moment and polarizability for an applied electric field of **10^6 V/m**. [CO-3] [2]
2. (a) What are hard and soft magnetic materials? Give their uses. [CO-1] [3]
 (b) Consider a He atom in its ground state. The mean radius of He atom is **0.529 \AA** . Density of He is **0.178 kg/m^3** . Calculate the diamagnetic susceptibility of He atom. Given atomic number and mass number of He are **2** and **4** respectively. [CO-3] [3]
3. How piezoelectric properties can be induced in ferroelectric ceramics? Also, discuss the synthesis of such a material. [CO-4] [3]
4. Explain the two fluid model of a superconductor and hence obtain the London equations. [CO-2] [5]
5. What does the equation $\frac{d\vec{E}}{dt} = 0$ tell us? Is this equation adequate to explain superconductivity? If not why? [CO-5] [3]
6. Estimate the London penetration depth for Sn at **0 K** from the following data: $T_c = 3.7 \text{ K}$, Density = **7300 kg/m^3** , atomic weight = **118.7** [CO-3] [2]
7. What is Cooper pair? Discuss its significance with reference to BCS theory of superconductivity. [CO-1] [3]
8. Calculate the critical current density for **1 mm** diameter wire of Pb at **4.2 K**. Given T_c (for Pb) = **7.18 K** and H_0 for Pb = **$6.5 \times 10^4 \text{ A/m}$** . [CO-3] [2]
9. What is twisted Nematic? Discuss its significance in the working of display device. [CO-4] [3]
10. What is the significance of nanoscale with respect to bulk counterparts? Explain. [CO-5] [3]

$$\mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}; m_e = 9.1 \times 10^{-31} \text{ kg}; e = 1.6 \times 10^{-19} \text{ C}; \epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{N}^{-1} \text{m}^{-2}; k_B = 1.38 \times 10^{-23} \text{ J/K},$$

$$h = 6.6 \times 10^{-34} \text{ Js}; N_A = 6.02 \times 10^{23}$$