

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATION- 2023

BTech-V Semester (CSE/IT)

COURSE CODE (CREDITS): 18B1WPH532 (3)

MAX. MARKS: 15

COURSE NAME: Applied Materials Science

COURSE INSTRUCTORS: PBB, VSA, SKT, HAZ

MAX. TIME: 1 Hour

Note: (a) All questions are compulsory.

(b) Marks are indicated against each question in square brackets.

(c) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems

Q1. (a) Derive the equations for the rate of decay and rate of growth for a polar dielectrics subjected to a steady dc electric filed. [2.5 marks] [CO-2]

(b) If all the atoms of diamond are polarized alike and produce a polarization density of $1.32 \times 10^5 \text{ C/m}^2$, calculate the shift of the center of the negative cloud of 6 electrons on each atom from the nucleus. The density of carbon is 3500 kg/m^3 and its atomic weight is 12. [2 marks] [CO-3]

Q2. (a) Show that the damping coefficient is a measure of the separation between the maximum and the minimum of the dispersion curve of real electronic polarizability as a function of angular frequency for a single electron. [2.5 marks] [CO-2]

(b) There are 1.6×10^{20} molecules/ m^3 in NaCl vapour. Determine the orientational polarizability at 300 K if the vapour is subjected to a field of $5 \times 10^6 \text{ V/m}$. Assume that the NaCl molecule consists of Na^+ and Cl^- ions separated by a distance 2.5 \AA . [2 marks] [CO-3]

Q3 (a) Drive an expression for electronic polarizability for an electron subjected to an alternating field of frequency ω using the equation of motion of an electron bound harmonically to an atom. [3 marks] [CO-2]

Q4. (a) Analyze the langevin function for large temperature. [1.5 marks] [CO-1]

(b) Analyze dielectric loss at high frequencies. [1.5 marks] [CO-1]

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