

## JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST-II Examination, April 2018

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

COURSE CODE: 10B11PH611

MAX. MARKS: 25

COURSE NAME: MATERIALS SCIENCE

MAX. TIME: 1.5 HRS

COURSE CREDITS: 04

*Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. Scientific calculators are allowed.*

1. At low temperature and large field discuss the paramagnetism using quantum theory. (5)  
[CO-1]
2. Analyze the difference between **Curie law** and **Curie-Weiss law** for magnetic materials. [2]  
[CO-2]
3. An atom contains **10** electrons revolving in a circular path of radius **0.01 nm**. Assuming homogeneous charge distribution. Calculate the orbital dipole moment of the molecule in terms of Bohr magneton. (4)  
[CO-3]
4. A paramagnetic material has body centred cubic structure with an elementary edge of **0.25 nm**. Calculate the paramagnetic susceptibility and magnetization produced in a uniform magnetic field of  **$10^6$  A/m** at **300 K**. Assume a magnetic moment of one Bohr magneton. (4)  
[CO-3]
5. A gas has  **$10^{27}$  molecules/m<sup>3</sup>**. Calculate the dipolar polarizability at **300 K** if the gas is subjected to an electric field of  **$10^6$  V/m**. The dipole moment of gas molecule is  **$3.46 \times 10^{-30}$  C-m**. Also Show that at this temperature and for such a high field, the value of a ( **$pE/k_B T$** ) is very much smaller than unity. (3)  
[CO-3]
6. A random copolymer of  **$C_3H_6-C_4H_6$**  has an average molecular weight of **250000 g/mol** and degree of polymerization **3420**. Calculate the fraction of each building block. [2]  
(CO-4)
7. Calculate numerical aperture, acceptance angle for a step index fibre having core diameter **50  $\mu$ m**. Consider the guided ray travelling at the steepest angle with respect to the fibre axis. How many reflections per metre are there? Also calculate the number of propagating modes at an operating wavelength of **850 nm**. Given core refractive index = **1.5** and cladding refractive index = **1.49** [5]  
(CO-5)

$$\mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}; m_e = 9.1 \times 10^{-31} \text{ kg}; e = 1.6 \times 10^{-19} \text{ C}; \epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}; k_B = 1.38 \times 10^{-23} \text{ J/K}, \\ h = 6.6 \times 10^{-34} \text{ Js}$$