

QP Code : **76180**

(3 Hours)

[Total Marks : 75

N.B. : (1) All questions are compulsory.

(2) Use of non-programmable scientific calculator is allowed.

Useful constants:-

$$\begin{aligned}C &= 2.998 \times 10^8 \text{ ms}^{-1} & \mu_B &= 9.274 \times 10^{-24} \text{ JT}^{-1} \\N_A &= 6.023 \times 10^{23} \text{ mol}^{-1} & h &= 6.625 \times 10^{-34} \text{ JS} \\1\text{eV} &= 1.602 \times 10^{-19} \text{ J} & R &= 8.314 \text{ JK}^{-1} \text{ mol}^{-1} \\m_e &= 9.11 \times 10^{-31} \text{ Kg} & e &= 1.602 \times 10^{-19} \text{ C} \\k &= 1.38 \times 10^{-23} \text{ JK}^{-1} \text{ molecule}^{-1} & m_p &= 1.673 \times 10^{-27} \text{ Kg} \\\mu_N &= 5.051 \times 10^{-27} \text{ JT}^{-1}\end{aligned}$$

1. Attempt any **five** of the following:-

15

- (a) How are solids classified?
- (b) Show that the critical radius-ratio for a triangular coordination is 0.155.
- (c) Distinguish between ferromagnetism and anti ferromagnetism.
- (d) Explain optical fibers. Give their importance in telecommunication
- (e) Explain the terms
 - (i) Statistical weight factor
 - (ii) Occupancy number
- (f) Three particles are to be distributed in four energy levels in such a way that no two particles will be present in the same energy level. In how many ways can this be done?
- (g) Explain the second law of thermodynamics.
- (h) With a suitable example, explain in brief photo dissociation reaction.

2. (a) What are vapour phase transport methods? How and where are they used? 5

OR

- (a) Describe the single crystal method for characterization of solids. 5
- (b) What are the factors that affect diffusion in solids? What is steady state diffusion? 5

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OR

- (b) What are the different types of defects in solids? What are their characteristics? How do they affect the properties of solids? 5
- (c) Calculate the distance between two adjacent ions of KCl crystal having F.C.C. structure. Given the density of KCl = $1.99 \times 10^3 \text{ kg/m}^3$ and molar mass of KCl = 74.6 5

3. (a) Define the terms (i) Valence band (ii) Conduction band (iii) Forbidden gap. Hence classify the solids into Conductors, Semiconductors and insulators. 5

OR

- (a) What is Nano technology? Describe in brief Three dimensional nano materials. 5
- (b) With the help of Fermi-Dirac statistics prove that the Fermi level in Intrinsic semiconductors lies exactly at the middle of the forbidden gap. 5

OR

- (b) What is Piezoelectricity? Describe in brief Ultrasonic echo sounding. 5
- (c) If the ratio of A^{3+} to A^{2+} in a non-stoichiometric sample of ionic crystal AO were 0.15, what fraction of cation sites would be occupied by vacancies? 5

4. (a) Derive the Bose-Einstein distribution law for bosons from statistical consideration. Which particles obey this statistics? 5

OR

- (a) Derive relation between internal energy and partition function. 5
- (b) For diatomic molecule, derive the expression for vibrational partition function. 5

OR

- (b) Derive the relation between Helmholtz function and partition function. 5
- (c) Calculate the translational partition function for one mole of nitrogen at 2 atmospheres and 300K assuming the gas to behave ideally. 5

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5. (a) Explain the principle of Microscopic Reversibility. 5
- OR**
- (a) Give a brief account of 5
- (i) Photo oxidation (ii) Flash photolysis.
- (b) Explain entropy production due to flow in a close system. 5
- OR**
- (b) With suitable examples explain the concept of coupled and uncoupled reactions. 5
- (c) Explain photochemical reactions with suitable examples. 5
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