Roll No. ..... Total Pages : 03

GSM/M-21 **1620**

PHYSICS

Statistical Physics

Paper : VII

Time : Three Hours] [Maximum Marks : 40

Note : Question No. **1** is compulsory. Attempt *four* more questions, selecting *one* question from each Unit. Use of scientific (non-programmable) calculator is allowed.

1. (a) Explain the meaning of thermodynamic probability of a macrostate in system of particles by taking an example. **2**

(b) Discuss the limits on volume of a cell in phase space in classical and quantum statistics. **2**

(c) Discuss the limitations of Einstein's model for specific heat of a solid. **2**

(d) Distinguish between Bose-Einstein and Fermi-Dirac statistics. **2**

Unit I

2. (a) Derive a relation for probability of a macrostate having a deviation '*x*' from the probability of most

probable macrostate of a distribution of 'n' distinguishable particles into two identical compartments and analyse it graphically. **5**

(b) What are laws of addition and multiplication of probabilities ? Explain with examples. **3**

3. (a) Discuss the general distribution of 'n' distinguishable particles into 'R' compartments of unequal sizes and derive relation for thermodynamic probability of a macrostate of the system. **4**

(b) Derive condition for thermal equilibrium of two systems of particles in thermal contact. Derive relation between entropy and thermodynamic probability of a system of particles. **4**

Unit II

4. Using Maxwell-Boltzmann law of distribution of speeds, derive expressions for most probable, average and root mean square speeds of molecules of a gas. Obtain relation between these. **8**

5. Derive Maxwell distribution law of speeds for 'n' molecules of a gas enclosed in a chamber at temperature 'T'. Depict the relation graphically. Explain the peak in the graph. **8**

Unit III

6. (a) Derive an expression for the most probable distribution of particles for a system obeying Bose-Einstein statistics. **6**

   (b) Show that Maxwell-Boltzmann distribution is a limiting case of Bose-Einstein distribution. **2**

7. What is Fermi gas ? Obtain a relation for the energy of this gas at absolute zero temperature. Give its physical significance. **8**

Unit IV

8. (a) Discuss Dulong-Petit law of specific heat of solids and the experimental observations for the variation of specific heat of a solid with temperature. Also, derive the relation for the specific heat of a solid on the basis of classical theory. **6**

   (b) What are the assumptions of Einstein's theory of specific heat of solids ? **2**

9. Discuss Debye theory and obtain a relation for specific heat of solids on the basis of this theory. Also, discuss the result at high and low temperature conditions as obtained from this theory. **8**