GSM/M-22 **1619**

STATISTICAL PHYSICS

Paper—VII

Time Allowed : 3 Hours] [Maximum Marks : 40

Note : Attempt **five** questions in all, selecting **one** question from each Unit. Question No. 1 is compulsory. All questions carry equal marks. Use of scientific (non-programmable) calculator is allowed.

Compulsory Question

1. (a) What are microstates and macrostates of a system of particles? Explain with an example.

   (b) What are limitations of Maxwell-Boltzmann distribution of particles of a system?

   (c) Derive a relation for the number of cells in phase space with momentum in range 'p' and (p + dp).

   (d) Distinguish between electron gas and photon gas. How does electron gas differ from an ordinary gas?

   2×4=8

UNIT–I

2. (a) When 'n' similar coins are tossed together, show that the probability of getting 'r' heads is given by the relation

$$P = \frac{n!}{r!(n-r)!} \times \frac{1}{2^n}$$

Hence calculate the probability for most probable and least probable distribution. 5

   (b) Explain the meaning of thermodynamic probability of a macrostate. Why is it so named? 3

3. (a) Derive a relation between entropy and thermodynamic probability of a system of particles. 3

   (b) What are the postulates of statistical physics? 2

   (c) One card is drawn at random from a well shuffled pack of 52 cards. Without replacing it, another card is then drawn. Find the probability that both are kings. 3

UNIT–II

4. Obtain an expression for the probability of a molecule of an ideal gas to have speed in the range 'v' to (v + dv). Discuss its significance. https://www.kuonline.in 8

5. Derive an expression for Maxwell-Boltzmann law of distribution of energies giving the number of molecules of a gas having energies in the range 'u' to (u + du) for an ideal gas enclosed in a chamber at temperature T. 8

UNIT–III

6. (a) What is black body radiation? Using Bose-Einstein distribution, derive Planck's radiation law for black body radiation. 6

   (b) If Fermi energy of Ag at Zero Kelvin is 5.5eV, find its mean energy per electron. 2

7. Discuss Bose-Einstein condensation and derive expression for the temperature at which condensation starts. 8

UNIT–IV

8. Explain Einstein's theory of specific heat of solids and derive relation for the specific heat of a solid. Briefly discuss its success and shortcomings. 8

9. Explain Debye model of specific heat of solids giving the assumptions on which it is based. Derive T^3 law from this theory. 8