K22P 0196

Reg. No. : .....

Name : .....

II Semester M.Sc. Degree (C.B.S.S. – Reg./Supple./Imp.)
Examination, April 2022
(2018 Admission Onwards)
PHYSICS
PHY2C08 : Statistical Mechanics

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **both** questions (**Either a** or **b**).

1. a) Prove Liouville's theorem and discuss its physical significance.

   OR

   b) i) Explain canonical ensemble.
   ii) Discuss the energy fluctuations in the canonical ensemble.

2. a) Discuss Bose-Einstein condensation and explain how it differs from ordinary condensation.

   OR

   b) Describe the magnetic behavior of an ideal fermi gas and explain Pauli paramagnetism. **(2×12=24)**

SECTION – B

Answer **any four**. (**One** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**)

3. a) What do you mean by phase space ?
   b) What is Gibb's paradox ? How it has been resolved ?
   c) A system has two degenerate energy levels with an energy gap of $0.1eV = 1.6\times10^{-20}$ J. What is the probability of the system being in the upper level if it is in thermal contact with a heat bath at a temperature of 300 K ? At what temperature would the probability be 0.25 ?

P.T.O.

4. a) Explain any two thermodynamic properties of a classical ideal gas.
   b) Prove the relation $S = k\ln(\Omega)$ where S is the entropy, Ω is the number of microstates in the range E to E + dE and k is the Boltzmann constant.
   c) A system consists of three energy levels which are non degenerate.

   The energy levels are $E_1 = 0$, $E_2 = 1.4\times10^{-23}$ J, $E_3 = 2.8\times10^{-23}$ J. Given that the system is at a temperature of 1K. Determine the partition function and calculate the probability that the system is in each level. (Take $K_B = 1.4\times10^{-23} JK^{-1}$)

5. a) State virial theorem.
   b) State and explain equipartition theorem.
   c) Describe density fluctuations in the grand canonical ensemble.

6. a) Write down the density matrix for canonical and grand canonical ensembles.
   b) Distinguish between BE statistics and FD statistics.
   c) Describe the behavior of an ideal gas in quantum mechanical microcanonical ensemble.

7. a) What is Fermi temperature ?
   b) Explain Planck's theory of radiation.
   c) State and explain Landau diamagnetism.

8. a) What is lattice gas ? How it is related to binary alloys ?
   b) What do you mean by "phase" and phase transition ?
   c) Describe the Ising model in one dimension. **(4×9=36)**
