D2APH2303 **(2 Pages)** **Name.....**
Reg.No.....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2024
(Regular/Improvement/Supplementary)

PHYSICS
FPHY2C07: STATISTICAL MECHANICS

Time: 3 Hours **Maximum Weightage: 30**

Part A: Short answer questions. Answer *all* questions. Each carries 1 weightage.

1. Explain Einstein's theory of specific heat of solid.
2. Obtain the quantum mechanical analogue of the classical equation of Liouville.
3. Give the significance of Fermi energy.
4. Discuss the formulation of microcanonical ensemble.
5. Find the number of microstates available for a classical system with number of particles 3 and energy states 0 and ε with total energy 2ε.
6. Give an expression for the partition function of classical ideal gas.
7. Explain the importance of phase space concept in ensemble theory.
8. State the postulate of equal a priori probabilities.

(8 × 1 = 8 weightage)

Part B: Essay questions. Answer any *two* questions. Each carries 5 weightage.

9. Explain the theory of Pauli paramagnetism using quantum statistical mechanics.
10. Discuss the energy and density fluctuation in the grand canonical ensemble.
11. Explain Bose Einstein condensation and give an expression for phase transition.
12. Explain Gibbs paradox and its resolution.

(2 × 5 = 10 weightage)

Part C: Problems. Answer any *four* questions. Each carries 3 weightage.

13. State and prove equipartition theorem.
14. Obtain the expectation value of a physical quantity G in quantum mechanical ensemble theory in terms of density matrix.

(P.T.O.)

15. Show that entropy of a system, S= k ln Ω.
16. Obtain the expectation value of σ_z for an electron placed in a magnetic field (along positive Z direction).
17. Derive Wien's displacement law.
18. Show that pressure exerted by a collection of classical harmonic oscillator is zero.
19. Find the expression for entropy of highly non-degenerate Fermi system.

(4 × 3 = 12 weightage)