D2APH2403 **(2 Pages)** **Name.....**
Reg.No.....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2025
(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. Discuss the advantages of grand canonical ensemble formalism over other formalisms.
2. Illustrate "microstate" with example.
3. Write Boltzmann formula for entropy and explain terms.
4. Explain the importance of critical temperature in Bose-Einstein condensation.
5. Write the expressions for partition functions of degenerate classical and quantum systems.
6. Discuss the relation between isothermal compressibility and density fluctuation.
7. Explain the significance of partition function.
8. Write a note on Debye's theory of the specific heat.

(8 × 1 = 8 weightage)

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

9. Discuss the theory of canonical ensemble and its energy fluctuation.
10. Illustrate the theory of Landau diamagnetism.
11. Develop the thermodynamics of the black body radiation and obtain the Stefan-Boltzmann law.
12. Explain quantum mechanical ensemble theory and obtain density matrices in microcanonical, canonical and grand canonical ensemble.

(2 × 5 = 10 weightage)

(P.T.O.)

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

13. Obtain Liouville's theorem.
14. Calculate entropy of a one-dimensional simple harmonic oscillator using microcanonocal ensemble theory.
15. Using occupation number concept obtain expression for partition function of a Bose and a Fermi gas.
16. Obtain chemical potential of a Bose gas at low temperature.
17. Calculate high temperature susceptibility of a paramagnetic material (classical treatment).
18. Obtain an expression for the Fermi temperature.
19. Find an expression for chemical potential of an ideal gas with and without resolving Gibbs paradox.

(4 × 3 = 12 weightage)