25P208 (Pages: 2) Name: .....

Reg.No: .....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2026

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19PPHY2C07 - STATISTICAL MECHANICS

(Physics)

(2019 Admission onwards)

Time : 3 Hours Maximum : 30 Weightage

Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. Write a short note on statistical ensembles.
2. Define micro canonical ensemble.
3. Write down the partition function of a two level system of energies 0 and ϵ.
4. Explain virial theorem.
5. Derive the equation of motion for the density matrix.
6. Explain the postulate of random phases.
7. Compare Debye theory of specific heat capacity of solids with that of Einstein.
8. 'Even at absolute zero, the Fermi system is quite live'. Justify.

(8 × 1 = 8 Weightage)

Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. Explain Gibb's paradox using the idea of entropy of mixing. How is the paradox resolved? Will there be Gibbs paradox if we use quantum statistics for ideal gas.
10. Discuss the extend of fluctuation in energy and number density in Grand canonical ensemble and deduce the empirical relation for rms fluctuations in number density and energy. How is their value during phase transition?
11. Explain Bose Einstein condensation. Deduce the expression for critical temperature.
12. Discuss the Landau diamagnetism in detail.

(2 × 5 = 10 Weightage)

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

13. Find the number of microstate accessible to a system of particles of mass m each occupying a volume V in the energy interval E and E+dE.

14. Consider a system of independent 1-D quantum harmonic oscillators in canonical ensemble with the partition function QN (β) $=e^{-}N\beta\hbar\omega/2 \quad (1-e^{-}\beta\hbar\omega)^{-}N$ .Calculate the Helmholtz free energy, entropy, pressure and chemical potential for this system.

15. How can an essential link be provided between the thermodynamics of a given system and the statistics of the corresponding grand canonical ensemble.

16. Show that the most probable no of particles per energy level $\frac{n_i^*}{g_i} = \frac{1}{e^{\alpha+\beta\varepsilon_i+a}}$

17. Discuss the statistics of occupational number for the three distributions and show that they converge the same value in the classical limit.

18. Show that radiation pressure exerted by the photons is equal to one third of its energy density.

19. Derive the expression for Susceptibility holds for all temperatures.

(4 × 3 = 12 Weightage)

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