24P208 (Pages: 2) Name: .....

Reg.No: .....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2025

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY2 C07 - STATISTICAL MECHANICS

(Physics)

(2019 Admission onwards)

Time : 3 Hours Maximum : 30 Weightage

Section A

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

1. Give statistical definition of Entropy.
2. Write down the partition function of a two level system of energies 0 and ϵ.
3. Using equi-partition theorem, find Cv of a monoatomic ideal gas.
4. How is fugacity of a system related to q potential?
5. What is meant by density operator?
6. Explain the statistics of occupation number.
7. State Debyes law for specific heat.
8. Give the expression for specific heat for a metallic solid.

(8 × 1 = 8 Weightage)

Section B

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

9. (a) Explain the concept of microcanonical ensemble.
   (b) State liouville's theorem and discuss its consequences.
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. Outline the thermodynamics of an ideal Bose gas and derive the condition for the onset of Bose-Einstein condensation.
12. Show that absolute zero, paramagnetic susceptibility is density dependent and temperature independent for a fermi gas.

(2 × 5 = 10 Weightage)

Section C

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

13. What is mean by Gibbs paradox how it is resolved.
14. Prove that the phase space area equivalent to one Eigen state of a linear harmonic oscillator is h.
15. Derive the canonical partition function of a classical ideal gas consisting of N identical monatomic molecules confined to a volume V and in equilibrium at temperature T and hence obtain an expression for its entropy.
16. Obtain the general expression for the distribution function of Bose Einstein and fermi dirac statistics.
17. Show that $\bar{N} = \sum_{\varepsilon}\langle n_{\varepsilon}\rangle$ and $\bar{E} = \sum_{\varepsilon}\langle n_{\varepsilon}\rangle\,\varepsilon$
18. Derive the energy density of the black body radiation.
19. 'Even at absolute zero, the Fermi system is quite live'. Explain.

(4 × 3 = 12 Weightage)

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