22P208 (Pages: 2) Name: ....

Reg.No: ....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2023

(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. How the physical reason for reducing the number of microstates in resolving the Gibbs paradox is explained?
2. Write the expression which shows the entropy of a physical system is solely and completely determined by the probability values of its accessible dynamical states. What conclusions can be derived from it?
3. Using equi-partition theorem, find Cv of a monoatomic ideal gas.
4. Write an expression for grand partition function and explain the terms.
5. Define Density Operator.
6. Discuss the statistics of the occupation numbers.
7. What is Stefan Boltzmann law?
8. Explain Pauli paramagnetism.

(8 × 1 = 8 Weightage)

Section B

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

9. State and prove Liouville's theorem. Discuss any one consequence of the same.
10. Obtain thermodynamics of classical ideal gas considering the system as the member of microcanonical ensemble.
11. Outline the thermodynamics of an ideal Bose gas and derive the condition for the onset of Bose -Einstein condensation.
12. Discuss in detail the thermodynamic behaviour of an ideal Fermi gas.

(2 × 5 = 10 Weightage)

Section C

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

13. Show that the pressure of a non-relativistic gas is 2/3 of its energy density.

14. For a system of independent non interacting one-dimensional quantum harmonic oscillators, what is the value of the Helmholtz free energy per oscillator, in the limit temperature tends to zero?

15. State and prove equipartition theorem by considering a phase space for a system.

16. For an electron in a maganetic field show that $\langle \sigma_z \rangle = tanh(\beta \mu_B B)$.

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

18. Derive the energy density of the black body radiation.

19. Discuss the Specific heat of the electron gas.

(4 × 3 = 12 Weightage)

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