

20P209

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Name.....

Reg. No.....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2021

(CUCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY2 C07 - STATISTICAL MECHANICS

(Physics)

(2019 Admission onwards)

Time: Three Hours

Maximum: 30 Weightage

Part A

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

1. What is a microcanonical ensemble?
2. How the Gibbs paradox is resolved?
3. Prove that the density of states in terms of energy of a free particle confined in a volume V is directly proportional to square root of its energy value.
4. The canonical ensemble relation connecting the entropy with the probability values of accessible states of a system is also applicable to the microcanonical ensemble. Justify.
5. Define density matrix.
6. What is occupation number?
7. Graphically represent the fugacity variation of an ideal Bose gas with temperature.
8. 'Even at absolute zero, the Fermi system is quite live'. Justify.

(8 × 1 = 8 Weightage)

Part 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. Discuss the harmonic oscillator problem by both classically and quantum mechanically using canonical ensemble formulation.
11. Discuss the Pauli paramagnetism in detail by considering it as highly degenerate Fermi gas.
12. Outline the thermodynamics of an ideal Bose gas and derive the condition for the onset of Bose-Einstein condensation.

(2 × 5 = 10 Weightage)

Part C

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

13. 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.
14. State and prove equipartition theorem by considering a phase space for a 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. Obtain the equation of motion for the density matrix in quantum statics.
17. Discuss about the statistical fluctuations in occupation number variable, n_ϵ in quantum statistics.
18. Show that a system of phonons obeys T^3 law at low temperatures.
19. Atomic weight of Lithium is 6.94 and density 0.53 g/cm^3 . Calculate Fermi energy and Fermi temperature of electrons.

(4 × 3 = 12 Weightage)
