A–087

Total Pages : 3 **Roll No. .....**

MSCPH–504

M.Sc. PHYSICS (MSCPH)

(Statistical Mechanics)

1st Semester Examination, 2024 (June)

Time : 2:00 Hrs. Max. Marks : 70

Note* :–** This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

Section–A

(Long Answer Type Questions) 2×19=38

***Note* :–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. Deduce Maxwell-Bvoltzmann law for the distribution of molecules in a gas. Express Helmholtz free energy and entropy in terms of partition function.

2. Derive the Fermi-Dirac distribution formula and show that the specific heat of a strongly degenerate Fermi-Dirac gas is directly proportional to its absolute temperature. Discuss the importance of this results.

3. Deduce Bose-Einstein distribution law. Use it to deduce the Planck's law for black body radiation.

4. Write a short notes on the following :

   (i) Ising model

   (ii) SeconcI order phase transitions

5. Obtain the Fermi-Dirac distribution law. Show that the pressure of a weakly degenerate Fermi-Dirac gas is greater than that for classical ideal gas.

Section–B

(Short Answer Type Questions) 4×8=32

***Note* :–** Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. State and Prove Liouville's theorem.
2. What is meant by an ensemble ? Discuss micro canonical, canonical and grand canonical 'ensembles.
3. The Gibbs paradox is resolved only within the framework of quantum mechanics. Comments on it.
4. What is meant by Black-body radiation ? Derive the Planck's law of black-body radiation.
5. How do the degeneracies of Bose-Einstein and Fermi-Dirac gas differ ? Discuss the phenomenon of condensation in momentum space.
6. What is the energy spectrum of Liquid helium II proposed by Landau ? How does this spectrum explain many properties of liquid helium ?
7. Write short note on Ergodic hypothesis.
8. Explain in brief Pauli theory of paramagnetism.

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