Avinashilingam Institute for Home Science and Higher Education for Women

(Deemed to be University Estd. u/s 3 of UGC Act 1956, Category 'A' by MHRD)
Re-accredited with 'A++' Grade by NAAC. Recognised by UGC Under Section 12B
Coimbatore - 641 043, Tamil Nadu, India

Continuous Internal Assessment Test II – April 2025
II SEMESTER

Class : I PG **Time: 2 hours**
Major : Physics **Max Marks: 60**

23MPHC08 Statistical Mechanics

Course Outcomes:

CO1: Establish the connection between statistics and thermodynamics
CO2: Distinguish between three types of ensembles and derive their partition functions to explain the behaviour of classical and quantum systems
CO3: Analyze the classical and quantum statistics
CO4: Compare the statistical behaviour of ideal Bose gas and Fermi gas
CO5: Discuss on heat capacities for gas, solids and understand phase transitions

Part A **6 x 1 = 6**

Choose the correct answer

1. The ensemble which allows the subsystems to allow exchange of both energy and number of particles with a reservoir is called …. ensemble CO3K1
   a. Canonical b. Microcanonical c. Grand canonical d. Microgrand canonical
2. If Z_1, Z_2, Z_3 and Z_4 are independent partition functions of a system, the total partition function of the combined system is CO3K1
   a. $Z = Z_1 + Z_2 + Z_3 + Z_4$ b. $Z = Z_1.Z_2.Z_3.Z_4$ c. $Z = \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} + \frac{1}{Z_4}$ d. $\frac{1}{Z} = \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} + \frac{1}{Z_4}$
3. Bose-Einstein statistics applies to CO4K1
   a. electrons b. molecules c. photons d. all the above
4. Quantum statistics approaches classical statistics if CO4K1
   a. $g_i e^{-\beta\varepsilon_i}$ b. $g_i e^{\beta\varepsilon_i}$ c. $\frac{g_i}{e^{\beta\varepsilon_i+1}}$ d. $\frac{g_i}{e^{\beta\varepsilon_i-1}}$
5. Conversion of boiling water at 1 atmosphere and 100C to vapour is ..... order phase transition. CO5K1
   a. zero b. first c. second d. third
6. Rush booke inequality is CO5K3
   a. $A+2\beta+\gamma \geq 2$ b. $A+2\beta+\gamma \leq 2$ c. $A+2\beta+\gamma \approx 2$ d. $A+2\beta+\gamma \geq 1$

Part B **3 x 6 = 18**

Answer ALL questions

Each answer should not exceed 400 words or two pages

7a. Compare microcanonical, canonical and grand canonical ensembles. CO3K1

(OR)

7b. Write expressions for probability density for canonical and grand canonical ensembles. CO3K1

8a. Differentiate between Fermi Dirac and Bose - Einstein statistics. CO4K1

(OR)

8b. Which of the statistics will you use for the systems having (i) electrons (ii) Photons (iii) mesons (iv) liquid He^4 (v) positrons (vi) phonons CO4K1

9a. Write a note on critical exponent. CO5K1

(OR)

9b. Give four characteristics of matter near critical point. CO5K1

Part C 3 x 12 = 36
Answer ALL questions
Each answer should not exceed 800 words or four pages

10a. Derive an expression for the partition function of a canonical ensemble made up of ideal gas molecules. Using it get the thermodynamical parameters like entropy, free energy, pressure and chemical potential of the ensemble. CO3K2

(OR)

10b. Explain grandcanonical ensemble. Write the partition function for grand canonical ensemble. Use it to calculate the thermodynamical quantities – entropy, internal energy and chemical potential. CO3K2

11a. Deduce Bose-Einstein distribution formula and explain the phenomenon of Bose-Einstein Condensation. CO4K1

(OR)

11b. State the essential requirements of Fermi-Dirac statistics. Derive the Fermi-Dirac distributions and discuss the consequences of strong and weak degeneracy. CO4K1

12a. Give a brief account of one dimensional Ising Model. CO5K1

(OR)

12b. Give Landau theory of phase transition. CO5K1

No. of Copies : 12 **Staff in-Charge: Dr.B.Nalini**