(8 pages) **Reg. No. :** .....

Code No. : 5780 **Sub. Code : WPHM 21**

M.Sc. (CBCS) DEGREE EXAMINATION,
APRIL 2024

Second Semester

Physics – Core

STATISTICAL MECHANICS

(For those who joined in July 2023 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. Landau's theory of phase transaction is based on the expansion of a free energy of a thermodynamics system interms of an order parameter which is ———— in a disordered phase.

   (a) non zero

   (b) zero

   (c) both zero and non zero

   (d) none

2. ———— order phase transition in which discontinuous change occurs in heat capacity, thermal expansively and compressibility.

   (a) Zeroth (b) First

   (c) Second (d) Third

3. Micro canonical ensemble is sometimes called ———— ensemble.

   (a) NVE (b) NOE

   (c) NZE (d) NEZ

4. Landau's theory provides the basis for Ehrenlest's ———— order phase transition.

   (a) First (b) Second

   (c) Third (d) Fourth

5. Gibbs paradox implied that the ———— of a given gas depends on the history of gas.

   (a) Temperature (b) Volume

   (c) Entropy (d) None

6. For an N-particle system the phase-space has ———— dimensions.

   (a) 2N (b) 4N

   (c) 6N (d) 8N

7. An ensemble in which both energy and the number of particles can be exchanged with the reservoir is called Grand canonical ensemble.

(a) True

(b) False

(c) Neither true nor false

(d) None

8. In the micro canonical ensemble the choice of density ρ = constant for ————————.

(a) $2E = E_0$ (b) $E \neq E_0$

(c) $E = 2E_0$ (d) $E = E_0$

9. Canonical ensemble the system can exchange energy but not ————————.

(a) position

(b) momentum

(c) coordinates

(d) particles

10. Maxwells Boltzmann statistics can not be applied to ————————.

(a) atoms (b) molecules

(c) photons (d) lattice

11. Fermi Dirac statistics is for the ————————,

(a) distinguishable particles

(b) symmetrical particles

(c) Particles with half integral spin

(d) Particles with integral spin

12. The Bose Einstein statistics is given by the expression ————————.

(a) $\frac{1}{e^{\beta(\epsilon_0-\mu)}-1}$

(b) $\frac{1}{e^{-\beta(t_0-\mu)}-1}$

(c) $\frac{1}{e^{\beta(t_0+\mu)}-1}$

(d) $\frac{1}{e^{\beta(t_0-\mu)}+1}$

13. Brownian motion is an example of motion under ————————.

(a) fluctuating force

(b) gravitational force

(c) nuclear force

(d) electromagnetic force

14. Foker Plancks equation is a partial differential equation ————————.

(a) for a probability P concerning in the time dependence

(b) for a probability P concerning its mass dependence

(c) for entropy at equilibrium

(d) for probability at absolute zerow

15. One dimensional Ising model can not be ————————.

(a) diamagnetic (b) paramagnetic

(c) ferromagnetic (d) none

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

16. (a) Write and explain Ehrentest Classification of phase transition.

Or

(b) Derive the conditions under which different phases can exist in equilibrium.

17. (a) Explain the concept of phase-space in statistical mechanics.

Or

(b) What is meant by Entropy of mixing? Write the basis of the Entropy mixing equation.

18. (a) Explain what are microcanonical and canonical ensembles.

Or

(b) Explain the fluctuations in density of Grand canonical ensemble.

19. (a) Disucss the Bose Einstein condensation in the high energy limit at a fixed temperature as V is reduced?

Or

(b) Explain the basic difference between Bose Einstein and Fermi Dirac statistics.

20. (a) Write short notes on Brownian motion.

Or

(b) State and explain fluctuation dissipation theorem.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

21. (a) Disucss Landau's theory of phase transition.

Or

(b) Explain Dimensional analysis and its application in statistical mechanics.

22. (a) What is Gibbs paradox? How this paradox is resolved?

Or

(b) Disucss the Entropy of an ideal gas using microcational ensemble.

23. (a) State and explain Liouville's theorem. Also explain its importance and applications.

Or

(b) Explain partition function. Discuss how thermodynamic functions are calculated from it.

24. (a) Derive Fermi-Dirac distribution function. Write a brief note on phase-space.

Or

(b) Derive the total number of particle in an ideal Bode Einstein Gas and hence discuss the Bose Einstein Condensation.

25. (a) Derive Fokker Planck equation.

Or

(b) Derive the exact solution for Ising model for one dimension.

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