KAMARAJ COLLEGE (Autonomous)

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(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

(4 Pages) **Reg. No:……**

Question Code: 26O03302 **Course Code : 24PMPH21**

PG Degree - End Semester Examinations, November 2026

Second Semester

M.Sc. PHYSICS

Statistical Mechanics

(For those who joined in July 2024 onwards)

Time : 3Hours **Maximum : 75 Marks**

PART – A (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer :

CO:1 K:2 1. Statistical thermodynamics provide an additional interpretation of concept of

(a) Entropy (b) Thermodynamical probability

(c) Probability of macrostate (d) Energy of system

CO:1 K:1 2. The space that represents all possible positions and momenta of particles in a system is called

(a) Real space (b) Phase space

(c) Configuration space (d) Coordinate space

CO:2 K:2 3. The grand canonical ensemble allows the exchange of

(a) Energy (b) Volume

(c) Energy and particles (d) Neither energy nor particles

CO:2 K:2 4. Which quantity is used to describe the probability of different states in the grand canonical ensemble?

(a) Grand partition function (b) Pressure

(c) Volume (d) Kinetic energy only

CO:3 K:1 5. The ensemble average of a physical quantity is equal to its time average. This is true for

(a) Microcanonical ensembles
(b) Canonical ensembles
(c) Grand canonical ensembles
(d) All the above cases

CO:3 K:1 6. In which statistics number of particles are limited?

(a) MB
(b) FD
(c) BE
(d) Both (a) and (c)

CO:4 K:2 7. The temperature of the substance falls during the process of adiabatic demagnetization if

(a) $T_f < T_i$
(b) $T_f > T_i$
(c) $T_f = T_i$
(d) $T_f \geq T_i$

CO:4 K:2 8. Brownian motion of a particle suspended in a fluid is mainly caused by

(a) Gravitational attraction between particles
(b) Random collisions with the molecules of the surrounding fluid
(c) Uniform motion of the fluid
(d) Magnetic forces acting on the particle

CO:5 K:1 9. The constant volume hydrogen thermometer can be used to measure temperatures upto

(a) -100°C
(b) -550°C
(c) -268°C
(d) -250°C

CO:5 K:2 10. When a paramagnetic substance is magnetized,certain amount of work is done on the molecules to align them. This effect is

(a) Maneto-caloric effect
(b) Joule-Heating effect
(c) Adiabatic desorption
(d) Adiabatic expansion

PART – B (5 X 5 = 25 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 250 words.

CO:1 K:3 11. (a) Prove that the law of equipartition of energy in statistical mechanics.

(OR)

(b) Obtain a general expression for Stiriling's formula.

CO:2 K:4 12. (a) What is Gibb's paradox? How it has been resolved?

(OR)

(b) Express Helmholtz free energy and entropy in terms of partition function.

CO:3 K:4 13. (a) Compare three types of ensembles.

(OR)

(b) Distinguish between the MB, BE and FD statistics.

CO:4 K:4 14. (a) Analyze any three methods of producing low temperature.

(OR)

(b) Examine the different types of thermometers used for measuring low temperatures.

CO:5 K:3 15. (a) Explain Landau's theory of phase transition.

(OR)

(b) Show that one dimensional Ising model cannot be ferromagnetic.

PART – C (5 X 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 600 words.

CO:1 K:3 16. (a) Derive Liouville's theorem for the change of density of distribution with time.

(OR)

(b) Obtain the relationship between entropy and probability of a distribution.

CO:2 K:3 17. (a) Calculate the entropy of a perfect gas using microcanonical ensemble.

(OR)

(b) Obtain the Sakur-Tetrode equation for the entropy of a perfect gas in grand canonical ensemble.

CO:3 K:3 18. (a) Apply BE statistics to photon gas and hence derive Planck's law for the spectral distribution of energy in black body radiation.

(OR)

(b) Derive the Fermi-Dirac distribution formula.

CO:4 K:4 19. (a) Analyze the theory of adiabatic demagnetization method for the production of very low temperature near absolute zero.

(OR)

(b) Discuss Brownian motion as an example of fluctuating force using Fokker-Plank equation.

CO:5 K:5 20. (a) Determine the spontaneous magnetic moment as a function of T in Brag-Williams approximation.

(OR)

(b) Interpret First and Second order Phase transition with a suitable example.