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Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree Examination, November 2023

Physics

PH 222 : THERMODYNAMICS, STATISTICAL PHYSICS AND BASIC QUANTUM MECHANICS

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **five** questions. Each question carries **3** marks.

1. What is Ehrenfest criteria for phase transition.
2. What is the role of chemical potential in chemical equilibrium.
3. What is Liouville's theorem
4. What is planks radiation law
5. Explain Hilbert space.
6. Write three points to differentiate between first and second order phase transitions.
7. Derive Geiger Nuttal Law.
8. Write a short note on duterion.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **all** questions. Each question carries **15** marks.

9. State and derive Liouville's theorem.

OR

10. Define partition function of a system and deduce the relation with thermo dynamical quantities.

11. Using the analogy of a lattice with up and down spins derive an expression for the energy and partition function in Ising model.

OR

12. Derive Maxwells Boltzmans distribution law.

13. Compare Three evolution pictures in quantum mechanics.

OR

14. Solve harmonic oscillator problem using the method of operators.

(3 × 15 = 45 Marks)

PART – C

Answer any **three** of the following questions. Each question carries **5** marks.

15. Consider a system with three energy levels $E_1 = 0$; $E_2 = 1.4 \times 10^{-23}$J and $E_3 = 2.8 \times 10^{-23}$ J and E_2 is two fold degenerate. Calculate the partition function and probability of being in the state E_2, if the system is at a temperature of 1K.

16. Prove that for irreversible process $TdS - du - dW > 0$.

17. Calculate the Fermi energy in electron volts for sodium assuming it has one free electron per atom. Given the density of sodium is 0.97 gm/cm^3. Atomic weight of sodium is 23.

18. Compare Maxwell Boltsman, Bose Einstein and Fermi Dirac Statistics.

19. Explain how the barrier penetration could explain the phenomenon of alpha decay.

20. Show that the probability density of the linear harmonic oscillator in an arbitrary superposition state is periodic with the period equal to the period of the oscillator.

(3 × 5 = 15 Marks)
