(Pages : 3) V – 5928

Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree Examination, August 2025

Physics/ Physics With Specialization In Space Physics/ Physics With Specialization In Nano Science

PHSP 522/ PHNS 522/ PH 222 : THERMODYNAMICS, STATISTICAL PHYSICS AND BASIC QUANTUM MECHANICS

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 75

SECTION – A

Answer any **five** questions. Each questions carry **3** marks

1. Explain Nernest heat theorem.
2. Explain phase space.
3. What is Gibb's paradox? Explain.
4. Explain the term Bose-Einstein condensate.
5. Explain Ising model.
6. What are Hermitian operators? Explain.
7. Explain Bloch waves.
8. Discuss time-energy uncertainty.

(5 × 3 = 15 Marks)

P.T.O.

SECTION – B

Answer **all** questions. Each questions carry **15** marks.

9. Explain the term phase equilibrium. Deduce the Clausius- Clapeyron formula for phase equilibrium and comment on the formula.

Or

10. Discuss a thermodynamic system in the canonical ensemble and obtain the expression for the canonical partition function:

11. Consider an ideal gas in a quantum mechanical microcanonical ensemble and derive the Bose — Einstein distribution law.

Or

12. Apply the Fermi- Dirac distribution law for thermionic emission and obtain the Richardson- Dushman equation.

13. List out the classical observables and their quantum mechanical operators. Derive the general uncertainty relation.

Or

14. Solve the one dimensional harmonic oscillator problem using the operator method.

(3 × 15 = 45 Marks)

SECTION – C

Answer any **three** questions. Each questions carry **5** marks.

15. The internal energy U of a thermodynamic system is given by $U = \frac{aS^3}{NV}$, where a is a constant. Find the temperature and the chemical potential of the system.

16. A closed system has three non-degenerate energy levels with energies E= 0, $\pm \varepsilon$ at temperatures T. Obtain the partition function of the system.

17. Evaluate the number of ways of distributing 11 Bosons in three different energy levels.

18. Distinguish between first and second order phase transitions.

19. An electron moves in a one dimensional potential of width 8 A and depth 12 eV. Find the number of bound states present.

20. What is the probability of finding 1s electron of the hydrogen atom at distances

    (i) ao/2 and

    (ii) ao from the nucleus.

(3 × 5 = 15 Marks)
