

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI**END-OF-SEMESTER EXAMINATIONS : DECEMBER – 2022****M.Sc.- Physics****MAXIMUM MARKS: 50****I SEMESTER****TIME : 3 HOURS****STATISTICAL MECHANICS****SECTION – A****(10 X 1 = 10 MARKS)****ANSWER THE FOLLOWING QUESTIONS.****(Objective Questions with four Multiple Choices)****(K1)**

1. Phase space is a _____

- a) 3 Dimensional Space
- b) 4 Dimensional Space
- c) 5 Dimensional Space
- d) 6 Dimensional Space

2. The ratio of root mean square velocity to most probable velocity is _____

- a) $\sqrt{3} : \sqrt{2}$
- b) $\sqrt{2} : \sqrt{3}$
- c) 3 : 2
- d) 2 : 3

3. In which of the following statistics the number of particles are limited?

- a) Maxwell-Boltzmann statistics
- b) Fermi-Dirac statistics
- c) Bose-Einstein statistics
- d) Pauli's statistics

4. According to Debye theory, the atoms in a solid do not vibrate independently with _____

- a) Different energy levels
- b) Different wavelength
- c) Same frequency
- d) Same amplitude

5. The second order phase transitions are usually associated with the abrupt changes in various properties characterizing the _____

- a) Different energy levels of system
- b) Transition possibilities of the particles
- c) Symmetry of the body
- d) Change state of matter

(CONTD.....2)

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES.

(K2)

6. Define ensemble in statistical mechanics.

7. What is the difference between a macrostate and a microstate?

8. In what way quantum and classical statistical mechanics differ from one another?

9. Highlight any basic drawback of Einstein theory of specific heat.

10. Why is there no phase transition in the one dimensional Ising model?

SECTION – B

(5 X 3 = 15 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.**(Qn. No. 11 to 15) Questions for Short Answers with internal choices.**

(K3)

11. a) What are the postulates of statistical mechanics?

(OR)

b) Discuss the Connection between statistical and thermo dynamical quantities.

12. a) Write a brief note on partition function and their properties.

(OR)

b) Give an account of equipartition theorem from canonical distribution.

13. a) Discuss the evaluation of constants α and β using Maxwell-Boltzmann statistics.**(OR)**

b) What is the condition for statistical equilibrium? Explain with an example.

14. a) State and explain Pauli's theory of paramagnetism.

(OR)

b) What is meant by blackbody radiation? State Planck's law of blackbody radiation.

15. a) What do you mean by fluctuations in statistical mechanics? Write a short note on fluctuations in energy and enthalpy of a system.

(OR)

b) Write an essay on Bragg-Williams theory of phase transitions.

SECTION – C

(5 X 5 = 25 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.**(Qn. No. 16 to 20 Questions for Long Answers with internal choices. (K4 (Or) K5)**

16. a) What is entropy and Gibbs free energy? Explain and deduce an expression for Gibbs free energy.

(OR)

b) Give an account of number of phase cells in a given energy range of harmonic oscillator and three dimensional free particle.

17. a) What is Gibbs paradox in thermodynamics? Discuss how it can be resolved.

(OR)

b) What is Maxwell-Boltzmann distribution law? Deduce expressions for most probable speed and root mean square speed using Maxwell distribution.

18. a) Compare and contrast the results of Bose – Einstein, Fermi – Dirac and Maxwell-Boltzmann statistics.

(OR)

b) Write a brief note on (i) the density matrix in quantum statistical mechanics (ii) Indistinguishability in quantum statistics.

19. a) What do you mean by Bose-Einstein condensation? Explain and deduce an expression for Bose-Einstein condensate.

(OR)

b) With relevant theory explain the free electron model of quantum statistics and highlight its significance.

20. a) Explain the Ising statistical model on phase transitions. Highlight its importance.

(OR)

b) Write a brief note on Brownian movement and Onsager solutions.
