M.Sc DEGREE EXAMINATION,APRIL 2019
II Year III Semester
Statistical Mechanics

Time : 3 Hours **Max.marks :75**

Section A $(10 \times 2 = 20)$ Marks

Answer any **TEN** questions

1. What do you understand from Gibb's phase rule?
2. What is an order parameter?
3. Define phase space.
4. State the significance of entropy in identifying the phase transition in an isothermal process.
5. Distinguish between canonical and grand canonical ensembles.
6. What is known as fluctuation?
7. How do you characterise an ideal gas?
8. How is a density matrix in quantum statistics related to distribution function in classical statistics?
9. State the basic assumption of Ising model.
10. What is Brownian motion?
11. Distinguish between bosons and fermions.
12. What are micro-states and macro-states?

Section B $(5 \times 5 = 25)$ Marks

Answer any **FIVE** questions

13. State third law of thermodynamics. Explain why absolute zero is not attainable.
14. Establish the connection between statistics and thermodynamics by proving, $s = k \ln \Omega$.
15. Deduce grand canonical distribution in terms of fugacity.
16. Derive Planck's law of radiation from the Bose-Einstein distribution law.
17. Prove that one dimensional Ising model cannot be ferromagnetic.
18. Show that the measure of energy fluctuation of a system in the canonical ensemble is proportional to specific heat capacity.
19. Show that the phase trajectory of a harmonic oscillator is an ellipse.

Section C $(3 \times 10 = 30)$ Marks

Answer any **THREE** questions

20. Explain how phase transitions are discussed by Landau through order parameter.
21. Demonstrate Gibb's paradox with an example of mixing of
    (i) two different ideal gases and
    (ii) one ideal gas with same ideal gas. How is paradox resolved?
22. State and prove Liouville's theorem. Also demonstrate
    (i) principle of conservation of density in phase and
    (ii) principle of conservation of extension in phase.
23. Explain with necessary theory of Bose – Einstein condensation.
    Discuss the result in the limit (i) $T < T_b$ and
    (ii) $T > T_b$, where T_b is the critical temperature.
24. Discuss the Langevin theory of Brownian motion.

M.Sc DEGREE EXAMINATION,APRIL 2019
II Year III Semester
Statistical Mechanics

Time : 3 Hours **Max.marks :75**

Section A $(10 \times 2 = 20)$ Marks

Answer any **TEN** questions

1. What do you understand from Gibb's phase rule?
2. What is an order parameter?
3. Define phase space.
4. State the significance of entropy in identifying the phase transition in an isothermal process.
5. Distinguish between canonical and grand canonical ensembles.
6. What is known as fluctuation?
7. How do you characterise an ideal gas?
8. How is a density matrix in quantum statistics related to distribution function in classical statistics?
9. State the basic assumption of Ising model.
10. What is Brownian motion?
11. Distinguish between bosons and fermions.
12. What are micro-states and macro-states?

Section B $(5 \times 5 = 25)$ Marks

Answer any **FIVE** questions

13. State third law of thermodynamics. Explain why absolute zero is not attainable.
14. Establish the connection between statistics and thermodynamics by proving, $s = k \ln \Omega$.
15. Deduce grand canonical distribution in terms of fugacity.
16. Derive Planck's law of radiation from the Bose-Einstein distribution law.
17. Prove that one dimensional Ising model cannot be ferromagnetic.
18. Show that the measure of energy fluctuation of a system in the canonical ensemble is proportional to specific heat capacity.
19. Show that the phase trajectory of a harmonic oscillator is an ellipse.

Section C $(3 \times 10 = 30)$ Marks

Answer any **THREE** questions

20. Explain how phase transitions are discussed by Landau through order parameter.
21. Demonstrate Gibb's paradox with an example of mixing of
    (i) two different ideal gases and
    (ii) one ideal gas with same ideal gas. How is paradox resolved?
22. State and prove Liouville's theorem. Also demonstrate
    (i) principle of conservation of density in phase and
    (ii) principle of conservation of extension in phase.
23. Explain with necessary theory of Bose – Einstein condensation.
    Discuss the result in the limit (i) $T < T_b$ and
    (ii) $T > T_b$, where T_b is the critical temperature.
24. Discuss the Langevin theory of Brownian motion.