SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN
(AUTONOMOUS)
(Affiliated to the University of Madras and Re-accredited with 'A+' Grade by NAAC)
Chromepet, Chennai - 600 044.
M.Sc.Physics - END SEMESTER EXAMINATIONS - NOV' 2024
SEMESTER - III

22PPHCT3008 - Statistical Mechanics

Total Duration : 2 Hrs. 30 Mins. Total Marks : 60

Section B

Answer any **SIX** questions $(6 \times 5 = 30$ Marks)

1. Explain the three general conditions of equilibrium (thermal, mechanical, and particle equilibrium) in a thermodynamic system.
2. Explain the connection between macroscopic thermodynamic properties and microscopic states. Discuss the role of the partition function.
3. Discuss the role of the order parameter in Landau theory. How does it help in describing phase transitions?
4. Differentiate between a first-order phase transition and a second-order phase transition with suitable examples. Discuss the characteristics of each.
5. Define microstates and macrostates in the context of statistical mechanics. Provide an example.
6. What is the density of states? Why is it important in calculating thermodynamic properties?
7. Derive the Maxwell-Boltzmann distribution for molecular energies in an ideal gas.
8. Extend the discussion to how mean-field theory applies to two-dimensional and three-dimensional systems.

Section C

I - Answer any **TWO** questions $(2 \times 10 = 20$ Marks)

9. Consider a thermodynamic system that undergoes a reversible isothermal expansion. Derive the expression for the change in entropy of the system.
10. Derive the Clausius-Clapeyron equation for a first-order phase transition and explain its significance.
11. Derive an expression for the chemical potential in terms of the grand canonical partition function.

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12. Describe the phenomenon of Bose-Einstein condensation in an ideal Bose gas. How does the condensation temperature depend on the particle density?

II - Compulsory question $(1 \times 10 = 10$ Marks)

13. Explain how the Langevin theory describes the velocity and displacement of a Brownian particle.

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