MAY 2016 **P/ID 40006/PPHF**

Time : Three hours Maximum : 100 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. State the third law of thermodynamics.

2. What is meant by critical exponent?

3. Why are molecules in a gas at NTP treated as classical particles?

4. How is thermodynamic entropy connected with statistical entropy?

5. Explain the term 'ergodic surface'.

6. Define 'partition function of a system'.

7. What are symmetric and anti symmetric wave functions?

8. Give the criteria for Bose-Einstein condensation.

9. Write down the energy in the one-dimension Ising model for the chain in a ring.

10. Define the term 'fluctuation'.

PART B — (5 × 6 = 30 marks)

Answer ALL questions.

11. (a) Obtain Gibb's – Helmholtz equation.

Or

(b) Explain the third law of thermodynamics.

12. (a) Explain the principle of increase of entropy.

Or

(b) Show that $G = N\mu$, where G is the Gibb's free energy, μ is the chemical potential and N is the number of particles.

13. (a) State and prove Liouville's theorem.

Or

(b) Obtain the phase space for a linear harmonic oscillator.

14. (a) Distinguish between bosons and fermions.

Or

(b) Derive the expression for classical distribution function.

15. (a) What is cluster expansion? Explain the same for a three-molecule system.

Or

(b) Discuss the mean field theories of the Ising model in two and three dimensions.

PART C — (5 × 10 = 50 marks)

Answer ALL questions.

16. (a) Discuss in detail the Landau theory of phase transitions.

Or

(b) Write notes on:

(i) scaling hypothesis

(ii) critical indices.

17. (a) What is Gibb's paradox? Demonstrate it by (i) mixing of two different ideal gases (ii) mixing of one ideal gas with the same ideal gas.

Or

(b) Derive an expression for entropy of an ideal classical gas.

18. (a) Obtain an expression for the distribution function for grand canonical ensemble and find the grand canonical partition function for the same.

Or

(b) Derive Planck's radiation formula using BE (Bose-Einstein) statistics.

19. (a) Calculate the electronic heat capacity for a metal using Fermi-Dirac statistics.

Or

(b) Find an expression for the energy of an ideal Bose-Einstein gas.

20. (a) Obtain the Fokker – Planck equation.

Or

(b) Find an equation for spectral density of a fluctuating quantity. Also find the correlation function for the same.

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