DECEMBER 2014 **P/ID 40006/PPHF**

Time : Three hours Maximum : 100 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Show that $G = H - TS$.

2. Give few examples for system displaying critical behaviour.

3. What is meant by 'Ergodic Surface'?

4. Define 'Symmetric' and 'Antisymmetric' wave functions.

5. Write down the minimum and maximum value of partition function.

6. How does the fluctuation in energy vary for a system of N particles and at large temperature?

7. What are bosons?

8. Give the time development of density matrix.

9. What is Markoff process?

10. Define 'Power Spectrum' of a fluctuating quantity.

PART B — (5 × 6 = 30 marks)

Answer ALL questions.

11. (a) Demonstrate that the state of adiabatic equilibrium is characterized by an absolute maximum of the entropy.

Or

(b) Explain the condition on the chemical potential for equilibrium.

12. (a) Demonstrate the extensive property of entropy.

Or

(b) Show that for an ideal gas $PV = \frac{2}{3}E$.

13. (a) Show that the phase space of a linear harmonic oscillator is an ellipse.

Or

(b) If the partition function of the molecule is $\left[2\sinh\left(\frac{\beta h\gamma}{2}\right)\right]^{-1}$, calculate the Helmholtz free energy of a system of N distinguishable molecules.

14. (a) Find the number of microscopic state of a system containing N distinguishable particles.

Or

(b) Demonstrate that the density matrix plays the role analogous to that of the probability density.

15. (a) Outline cluster expansion for a classical gas.

Or

(b) Describe power spectrum with a theory.

PART C — (5 × 10 = 50 marks)

Answer ALL questions.

16. (a) Explain Landau theory of phase transition.

Or

(b) Discuss the various critical exponents that come across in critical phenomena.

17. (a) Show that :

(i) $\sigma = -\left(\frac{\partial F}{\partial \tau}\right)$ (ii) $V = \left(\frac{\partial H}{\partial \pi}\right)_{\sigma}$

(iii) $V = \left(\frac{\partial G}{\partial P}\right)_{\tau}$.

Or

(b) Calculate the entropy of mixing of :

(i) Two different ideal gases

(ii) Same ideal gases and hence explain Gibb's paradox.

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

Or

(b) For the phase space representing a single particle of mass 'm' in a volume V, find the number of phase cells in the energy range 0 to E. Also find the number of accessible microstates in this energy range.

19. (a) Discuss the phenomenon of Bose-Einstein condensation.

Or

(b) Find an expression of Fermi-Energy of an ideal electron gas.

20. (a) Discuss the motion due to a fluctuating force.

Or

(b) Give the theory of Brownian movement.

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