



- 1.** Either
- a) Define Microcanonical ensemble and derive the expression for the entropy of an perfect gas in microcanonical ensemble. **8**
- b) State the postulates of classical and quantum statistical mechanics. **8**

**OR**

- e) Explain the concept of microstate and macrostate. Calculate the number of microstate, macrostate and thermodynamic probability for distribution of three distinguishable particles in two compartments of equal size. **8**
- f) Obtain an expression for relative fluctuation of energy in canonical ensemble. **8**
- 2.** Either
- a) Discuss the specific heat of liquid  $\text{He}^4_2$  by comparing with that of ideal Bose system. **8**
- b) Define mean occupation number. Obtain an expression for mean occupation number for bosons in BE statistics. **8**

**OR**

- e) Compare the basic postulates of B.E. and F.D. statistics. Hence, comment about the probabilities of particles coming together according to B.E. & F.D. statistics. **8**
- f) Obtain an expression for thermodynamical function of total energy, specific heat at constant volume and entropy of ideal Bose gas at temperature less than Bose temperature. **8**
- 3.** Either
- a) Discuss the behaviour of ideal fermi gas below fermi temperature. **8**
- b) What are Mayer F- functions. Obtain canonical partition function for classical real gas in terms of cluster integral. **8**

**OR**

- e) Apply ideal fermi gas model to free electron gas in metal for the determination of  $T_F$  of electron. **8**
- f) Show that the measure of degeneracy of ideal fermi system is given by **8**

$$Z = \frac{1}{D} = \frac{\rho}{g} \left( \frac{h^2}{2\pi m k T} \right)^{3/2}$$

4. Either
- a) Explain Landau theory of phase transition. 8
  - b) What is Brownian motion? Explain Langevin theory of Brownian motion of particles. 8

**OR**

- e) Explain Fluctuation- Dissipation theorem. Derive an expression for the damping constant. 8
  - f) Obtain Fokker- Planck equation for Brownian motion. 8
5. Attempt all the following questions. 4
- a) Explain the terms.
    - i) Phase space.
    - ii) Stationary ensemble.
  - b) Explain liquid helium as bosons in brief. 4
  - c) Explain Fermi energy and fermi temperature. 4
  - d) What is phase transition. Explain how two phases are in equilibrium. 4

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