

Examination: 2022  
Subject: Physics  
Paper: Statistical Mechanics  
MPH-C301

Max. Marks: 70  
Min. Pass %: 40

Time: 3 hrs.

### Section – A

**Note:** Attempt any five questions. All questions carry equal marks.

(5×6 = 30)

- Qn. 1 – State and explain the law of Equi-partition of Energy.
- Qn. 2 – Show that the chemical potential for a photon gas is zero.
- Qn. 3 – Give the properties of liquid He.
- Qn. 4 – Explain White dwarfs and Neutron Stars.
- Qn. 5 – Discuss the Pauli's theory of paramagnetism.
- Qn. 6 – Define phase space and discuss the Nernst Heat theorem.
- Qn. 7 – Discuss the thermodynamic function and partition function.
- Qn. 8 – State and proof of Liouville's theorem.
- Qn. 9 – Explain most probable distribution?
- Qn. 10 – Deduce and explain the Maxwell-Boltzmann law of molecules in a gas.

### Section – B

**Note:** Attempt any four questions. All questions carry equal marks.

(4×10 = 40)

- Qn. 11 – Discuss Bose-Einstein gas. Explain Bose-Einstein condensation and the superfluid behavior of  $^4\text{He}$  below  $2.19^\circ\text{K}$ .
- Qn. 12 – Define Fermi Energy and Fermi temperature. Deduce the expression for the Fermi-Energy and pressure of Fermi gas at absolute zero degree absolute.
- Qn. 13 – Obtain partition function for a Canonical ensemble, discuss the Gibbs' Paradox and Equation of state and virial coefficients.
- Qn. 14 – Discuss the Landau's theory of liquid Helium II and explain superfluidity.
- Qn. 15 – Discuss the comparison of MB, BE and FD statistics. Give the thermodynamic Interpretation of constant  $\alpha$  and  $\beta$ .
- Qn. 16 – Explain the Correlation of space-time dependent fluctuations. Discuss fluctuation dissipation theorem.
- Qn. 17 – Construct grand partition function for a Photon gas and derive the Planck's distribution Law.
- Qn. 18 – Derive Eigen of state for an Ideal gas and obtain condition for Bose-Einstein condensation. Show that the particles in the condensed state(phase) do not exert any pressure.