

M.Sc. (Part-II) Semester-III (CBCS) Examination

PHYSICS
(Statistical Mechanics)

Paper-3 PHY 2

Time : Three Hours]

[Maximum Marks : 80

Note :— All questions are compulsory and carry equal marks.

1. (A) Derive an expression for Helmholtz free energy in term of partition function. 5
 (B) Obtain relation between entropy and probability of a classical ensemble. 5
 (C) Derive an expression for total energy in terms of partition function. 6

OR

 (P) Derive an expression for specific heat at constant volume in term of partition function. 5
 (Q) Show that phase trajectory of motion of a linear harmonic oscillator in phase space is ellipse. 5
 (R) Explain partition function. Option an expression for partition function of perfect gas. 6
2. (A) What is degenerate gas ? 3
 (B) Distinguish between Bose-Einstein and Fermi-Dirac statistics. 4
 (C) Explain the Bose-Einstein condensation. 9

OR

 (P) State the Fermi function. 3
 (Q) Define fugacity. How does it represent the degeneracy of boson gas ? 4
 (R) Explain the chemical potential and energy of an ideal Bose-Einstein gas. 9
3. (A) State the condition at which electron gas is nondegenerate. 3
 (B) Explain, how Debye modified the Einstein's theory of specific heat of a solid. 5
 (C) Derive the Richardson-Dushman equation for thermionic emission. 8

OR

 (P) State the condition at which electron gas is degenerate. 3
 (Q) Derive an expression for free energy of a diatomic gas. 5
 (R) Deduce an expression for specific heat of a solid using Debye's theory. 8
4. (A) Show that the standard relative deviation from the mean value is of order of $(1/\sqrt{N})$ in energy fluctuations. Where N is the total number of particles. 8
 (B) Derive the Boltzmann's transport equation. 8

OR

 (P) What is phase transition ? Explain first and second order phase transitions. 8
 (Q) Explain the fluctuations in enthalpy. 8
5. (A) Explain the Landau's theory of liquid He-II. 12
 (B) Why He³ and He⁴ obeyed the different statistics ? 4

OR

 (P) Give the experimentally observed properties of superfluid He-II. 10
 (Q) Explain the critical velocity of superflow. 6

