

Roll No.

Exam Code : M-23

Subject Code—59328

B. Sc. EXAMINATION

(Main & Re-appear)

(Batch 2018 Onwards)

(Fourth Semester)

PHYSICS

CPL-402 (Core Course-VII)

Statistical Mechanics

Time : 3 Hours

Maximum Marks : 80

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

1. (a) What is the number of microstate for three distinguishable particle when distributed in 2-compartment ? 2
- (b) How much energy is associated with each degree of freedom for system in thermal equilibrium at temperature (T) ? 2

- (c) State 2nd law of thermodynamics in term of entropy. 2
- (d) Define Boson and Fermions. 2
- (e) What is the relationship between coefficient of viscosity and pressure of the gas ? 2
- (f) How does conduction differ from diffusion ? 2
- (g) What is the minimum volume of phase space cell in classical statistics and quantum statistics ? 2
- (h) Do electrons come to rests at zero Kelvin inside the metals ? Explain. 2

Unit I

2. (a) Distinguish between a microstate and macrostate with a suitable example. 4
- (b) Define thermodynamics probability and give a derivation for deviation from the state of maximum probability. 12

3. What is the Partition Function (Z) ? Derive the relationship of Partition function (Z) with entropy (S), Helmholtz free energy (F) and with total energy (E). 16

Unit II

4. (a) Explain degree of freedom with example of monoatomic gas molecule, diatomic gas molecule and triatomic gas molecules. 8
- (b) Find the average kinetic energy of a monoatomic and diatomic gas molecule at 20°C according to kinetic theory of gases. Boltzmann's constant $k = 1.38 \times 10^{-23} \text{ Jmol}^{-1}\text{K}^{-1}$. 8
5. (a) Using kinetic theory of gases, find out the specific heat of monoatomic, diatomic and triatomic gas. 12
- (b) Explain the law of equipartition of energy. 4

Unit III

6. (a) Explain phase space. Obtain the number of phase space cells in the momentum interval dp . 10
- (b) Give a derivation for the number of phase cells in energy range 0 to E for one dimensional Harmonic Oscillator. 6
7. What is Maxwell-Boltzmann Statistics ? Derive an expression for Maxwell Boltzmann law of distribution of molecular speed. 16

Unit IV

8. (a) What is the size of phase space cell in Quantum Statistics ? Give a derivation for number of particle per unit energy interval using Bose-Einstein distribution law. 12
- (b) Differentiate between Fermi-Dirac and Bose-Einstein statistics. 4

9. (a) Give an expression for fermion within energy range using Fermi-Dirac distribution law of energy. 12

(b) What do you mean by specific heat of metals ? Explain. 4