**Progressive Education Society's**
**Modern College of Arts, Science & Commerce Ganeshkhind, Pune – 16**
**(Autonomous)**
**End Semester Examination: MAR / APR 2025**
**Faculty: Science and Technology**

**Program: B.Sc. (Gen03)** **Semester: VI** **SET: A**
**Program (Specific): General B.Sc.** **Course Type: DSC**
**Class: T.Y.B.Sc.** **Max. Marks: 35**
**Name of the Course: Thermodynamics and Statistical Physics**
**Course Code: 24-PHY-363** **Time: 2Hr**
**Paper: III**

**Instructions to the candidate:**

1) *All Questions are compulsory.*
2) *Figures to the right indicate full marks.*
3) *Draw a well labeled diagram wherever necessary.*
4) *Use of a scientific calculator and log table is allowed.*

**Q1) Answer the following:** **5**

i) Define mean free path for molecules of gas.
ii) Write an equation for Gibbs function.
iii) Define probability.
iv) What is the entropy of a system?
v) What are accessible microstates?

**Q2) Answer the following (Any four):** **4**

i) What is meant by an ensemble?
ii) What are distinguishable particles?
iii) What are Fermions?
iv) What do you mean by partition function?
v) Define microcanonical ensemble.
vi) What is meant by the distribution function?

**Q3) Answer the following (Any four):** **8**

i) Calculate change in internal energy when 0.004 kg of air is heated from 0 to 2 $^{o}$C. The specific heat of air at constant volume being 0.172 kcal/kg $^{o}$C.

ii) Calculate mean free path of the gas molecule of diameter 3.2 Å. The number of molecule per unit volume is $2.2 \times 10^{25}$ $m^{-3}$.

iii) When a card is drawn from a well shuffled pack of 52 cards, what is the probability of getting either a king or a queen?

iv) What is the postulate of equal a priori probability?

v) In a random walk problem, what is the root mean square deviation?

vi) What are classical and quantum particles?

**Q4) Answer the following (Any two): 8**

i) According to the Fermi-Dirac statistics, in how many ways three particles can be distributed in four energy states?

ii) Four molecules are to be distributed in two cells. Find the possible number of macrostates and corresponding number of microstates.

iii) When we throw a die 3 times and obtain 3 numbers, what is the probability that these three numbers are 6, 4 and 2 precisely in that order?

iv) What is transport phenomenon? Explain in brief viscosity, conductivity and self-diffusion on the basis of kinetic theory of gases.

**Q5) Answer the following (Any two): 10**

i) Obtain the expression for Bose-Einstein distribution law.

ii) The first vibrational energy of a diatomic molecule is 600 $cm^{-1}$ and above the ground state. Calculate the relative population of the molecules in these two levels at T = 400 K.

iii) Derive Gaussian probability distribution equation.

iv) Establish Clausius-Clapeyron equation from Maxwell's thermodynamic relations.

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