

Total number of printed pages-4

3 (Sem-6/CBCS) PHY HC 2

2023

PHYSICS

(Honours Core)

Paper : PHY-HC-6026

(Statistical Mechanics)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : $1 \times 7 = 7$

(a) What is the number of microstates if 8 distinguishable particles are distributed in two compartments ?

(b) What is ensemble in statistical mechanics ?

(c) Define phase space.

(d) What is the importance of Kirchhoff's law of radiation ?

(e) Give one example of bosons.

Contd.

(f) What is Chandrasekhar mass limit ?
(g) Under what condition quantum statistics approaches the classical statistics ?

2. Answer the following questions : $2 \times 4 = 8$

- (a) Write two properties of thermal radiation.
- (b) Black body radiation is white. Explain.
- (c) To what temperature must an ideal black body be raised in order to double the total radiation if original temperature is 127°C ?
- (d) Write one similarity and one difference between B-E and F-D statistics.

3. Answer any three questions from the following : $5 \times 3 = 15$

- (a) State law of equipartition of energy. Using this law find an expression of the ratio of two specific heat of a gas. $1+4=5$
- (b) 6 distinguishable particles are to be arranged in 3 compartments of a box. Find the total number of microstates corresponding to the macrostate (0,2,4) and (2,3,1). [There is no restriction of number of particles that can go into any compartment]. $2^{1/2} + 2^{1/2} = 5$

(c) In a metal there are 3.14×10^{27} free electrons per cubic metre. Calculate the Fermi energy.

(d) Write a note on Bose-Einstein condensation.

(e) Write the Saha's ionisation formula. Write the assumptions considered to derive the formula. $2+3=5$

4. Answer the following : $10 \times 3 = 30$

(a) Write the statistical definition of entropy. What is its unit ? State the physical significance of entropy giving one example. Derive the relation between entropy and thermodynamic probability. $2+1+2+5=10$

Or

Derive Maxwell-Boltzmann law of energy distribution. 10

(b) What is radiation pressure ? Prove that the diffuse radiation exerts a pressure on the walls of the container, equal to $\frac{1}{3}$ rd of its energy density. $2+8=10$

Or

From Planck's law of blackbody radiation, derive : 3+7=10

(i) Rayleigh-Jeans law

(ii) Wien's displacement law

(c) Derive Bose-Einstein's distribution law. 10

Or

Derive the expression of total internal energy of a Fermi-Dirac gas.