24803831

INTEGRATED MSC DEGREE EXAMINATION, JULY 2024

Fourth Semester

INTEGRATED MSC BASIC SCIENCE-PHYSICS

CORE - IPH4CR02 - STATISTICAL MECHANICS - I

2021 Admission Onwards

76A79DE3

Time: 3 Hours   Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Find the number of combinations of n distinguishable particles by taking r at a time.

2. Describe the concept of an accessible state in thermodynamics..

3. Find the expression for the accessible microstates for a single particle in the energy range E to E+dE.

4. Discuss the characteristics and implications of the microcanonical ensemble in statistical mechanics.

5. Under what conditions can two systems be considered to be in thermal equilibrium?

6. Provide the mathematical expression used to calculate entropy in statistical mechanics.

7. What is the mean energy corresponding to each term in the energy expression ?

8. Expalin the need for introducing quantum statistics.

9. Discuss the thermodynamic probability in M.B. statistics.

10. Discuss the thermodynamic probability in B.E. statistics

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. A system has 3 different macrostates under which there are 5, 10 and 15 microstates. The property x regarding the system has the values 2, 4 and 6 respectively. Calculate the average value of x, x^2 and $\sqrt{x}$.

12. Determine the smallest size of a phase space cell according to classical and quantum statistics.

13. How can you apply the fundamental postulates of statistical Mechanics to a system of gas molecules?

14. Define the density of states in the context of quantum mechanics. How does it relate to the number of available quantum states for a particle within a given energy range?

15. Explain in detail the statistical interpretation of second law of thermodynamics.

16. Derive the expression for the Maxwell-Boltzmann law of distribution of momentum.

17. At what temperature will the average speed of molecules of hydrogen gas be double the average speed of oxygen at $300K$?

18. What are the limitations of Maxwell-Boltzmann method?

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Discuss the basic rules of probability theory.

20. Briefly explain partition function and discuss its relation with various thermodynamic quantities.

21. What are Classical particles? Write down the postulates of Maxwell-Boltzmann statistics. Derive an expression for the probability distribution of particles governed by Maxwell-Boltzmann statistics.

22. What are fermions? Write down the postulates of Fermi-Dirac statistics. Derive an expression for the probability distribution of particles governed by Fermi-Dirac statistics.

(2×5=10 weightage)