

**2103000206021004**  
**EXAMINATION FEBRUARY-MARCH 2024**  
**BACHELOR OF SCIENCE (SIXTH SEMESTER)**  
**PHYSICS PAPER - IX (PH-609-STATISTICAL MECHANICS &**  
**SPECIAL RELATIVITY) LEVEL 2**

[Time: As Per Schedule]

[Max. Marks:50]

**Instructions:**

- 1. Fill up strictly the following details on your answer book**
  - a. Name of the Examination : **BACHELOR OF SCIENCE (SIXTH SEMESTER)**
  - b. Name of the Subject : **PHYSICS PAPER - IX (PH-609-STATISTICAL MECHANICS & SPECIAL RELATIVITY)**
  - c. Subject Code No : **2103000206021004**
2. Sketch neat and labelled diagram wherever necessary.
3. Figures to the right indicate full marks of the question.
4. All questions are compulsory.

Seat No:

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Student's Signature

**Q.1 Answer the following questions in brief.**

**10**

1. What is the value of  $C_v$  of hydrogen gas at room temperature?
2. Why is the value of thermodynamic probability being more than one?
3. What do you mean by partition function?
4. Why does the fermions and bosons behave as classical particles at high temperature?
5. What do you mean by chemical potential?
6. Give the transformation equations for the component of force.
7. Why does the hydrogen gas behave as a monatomic gas below  $60k$ ?
8. Write four or five sentences on mass in relativity.
9. Explain how the kinetic energy varies with velocity.

10. What do you mean by kinematics?

**Q.2 Answer any one question: 7**

- a) Derive the Fermi Dirac distribution law.
- b) Derive the expression for thermodynamic probability of N-distinguishable particle for a B.E. statistic.

**Q.2 Answer any one question: 3**

- a) State the properties of classical statistics.
- b) Three particles have to be accommodated in four available states. Calculate the number of ways in which this can be done if the particles obey F-D statistics.

**Q.3 Answer any one question: 7**

- a) Considering Sackur-Tetrode equation explain Gibb's paradox.
- b) Explain the terms spontaneous emission, stimulated emission and absorption.

**Q.3 Answer any one question: 3**

- a) Discuss in short, the suggestion made by Debye to explain the sp. Heat of solid.
- b) Derive the expression  $S = Nk_B \ln Z + \beta k_B U$ .

**Q.4 Answer any one question:**

Explain in detail why the redefining of momentum in relativity is required. **10**

**Q.4** 1) Prove that in relativity acceleration is not parallel to applied force. **5**

2) Explain longitudinal and transverse mass. **5**

**Q.5 Answer any one question**

1) The component of E parallel to relative velocity of the two frame is unchanged, whereas the component of E perpendicular to the relative velocity transform to mixed electric and magnetic field 'justified the statement in detail. **7**

2) Is Maxwell's equation need to be modified for relativity? **3**

**Q.5** "Whether an electromagnetic field is purely magnetic or purely electric, or electric and magnetic, depends on the inertial frame in which the sources are observed" justified the statement in detail. **10**

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