

23/149

B.Sc. (Part-III) Examination, 2023**PHYSICS****First Paper****(Relativity and Statistical Physics)***Time : Three Hours] [Maximum Marks : 75***Note :** Attempt questions from **all** sections as per instructions.**Section-A****(Very Short Answer Type Questions)****Note :** Attempt **all** parts of this question. Give answer of each part in about **50** words. $1\frac{1}{2} \times 10 = 15$

1. (i) Distinguish between inertial and non-inertial frame of reference.
- (ii) What is meant by Galilean invariance?
- (iii) What do you understand by micro states and macrostates?
- (iv) Define thermodynamic probability.

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(2)

- (v) State the theorem of equipartition of energy.
- (vi) Explain μ -space and σ -space.
- (vii) What do you mean by Doppler broadening of spectral lines?
- (viii) Classify the following particles on the basis of B-E and F-D statistics. Proton, neutron, electron, photon α -particle, Hydrogen atom Hydrogen molecule.
- (ix) What is zero point energy? ✓
- (x) What do you understand by negative results in Michelson-Morley experiment?

Section-B**(Short Answer Type Questions)****Note :** Attempt **all** questions. Give answer of each question in about **200** words. $8 \times 5 = 40$

2. Obtain the law of addition of velocities using Lorentz transformation equations.

ORDiscuss equivalence between mass and energy. Obtain the mass energy relation $E=mc^2$. ✓

23/149

(3)

3. What is proper time? Explain time dilation in special theory of relativity.

OR

What are the constraints? Differentiate between accessible and inaccessible microstates.

4. What is the postulate of equal priori probability? What will be the priori probability of distributing particles between two halves of a box?

OR

Explain the term phase space and phase cell. How phase space is divided into cells?

5. Derive the relation $\beta = \beta'$ for equilibrium of two systems in thermal contact. Hence derive relation between entropy and probability.

OR

Differentiate between r.m.s. speed and most probable speed. Establish a relation between them.

6. Give the explanation of free electron theory of metals by the Fermi-Dirac statistics.

OR

Compare the basic postulates of Maxwell-Boltzmann, B-E and F-D statistics.

23/149

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(4)

Section-C

(Long Answer Type Questions)

Note : Attempt any **two** questions. Give answer of each question in about **500** words.

10×2=20

7. A body moving with velocity v has a mass m . Show that:

$$m = \frac{m_0}{\sqrt{1-v^2/c^2}}$$

Where m_0 is the rest mass of the body and c , the speed of light.

8. Discuss the distribution of n particles with a given total energy into discrete set of energy states.
9. Apply the concept of phase space to the one dimensional harmonic oscillator. Draw the phase space diagram of the oscillator having a total energy E .
10. What is Fermi energy? Derive an expression for Fermi energy at temperature T . Establish a relation between mean energy of electrons and Fermi energy.
11. Write short notes on the following:
- Maxwell's velocity distribution law.
 - Planck's Oscillator and its importance.

23/149

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