AB-3119

Third Year B.Sc. (Sem. V) Examination

March/April – 2015

Physics : Paper - IX

(Relativity and Statistical Mechanics)

Time : **2** Hours] [Total Marks : **50**

Instructions : (1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **Third Year B.Sc. (Sem. V)**

Name of the Subject :

☛ **Physics : Paper - IX** *(Relativity and Statistical Mechanics)*

☛ Subject Code No. : **3 1 1 9** ☛ Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

(2) All symbols have their usual meanings.

(3) Draw neat diagram wherever necessary.

(4) Figures on the right indicate full marks of the question.

1 Answer the following in brief : 8

(1) What is an ensemble?

(2) What is macroscopic state?

(3) State principle of conservation of density in phase space.

(4) What is the difference between microcanonical and canonical ensemble?

(5) What are inertial frames?

(6) Write postulates of special theory of relativity.

(7) A rapidly moving muon, or indeed any unstable particle travels farther than one would expect because to an observer at rest in the laboratory, the unstable particle's "clock" is time dilated. How would the observer moving with the same particle explain the same effect?

(8) Photons of light have zero mass.. How is it possible that they have momentum?

2 (a) State and prove Lioville's theorem. **10**

OR

(a) What is canonical ensemble? Derive an expression for Gibbs canonical distribution. **10**

(b) A system with just two energy levels is in equilibrium with a heat reservoir at temperature 700 K. The energy gap between the levels is 0.15 eV. Find the probability that the system is in the higher energy level. Given: Boltzmann constant $k_B = 1.38 \times 10^{-23}$ JK^{-1}. **4**

OR

(b) A system with two energy levels is in equilibrium with a heat reservoir at 500 K. The energy gap between the levels is 0.1 eV. Find the temperature at which probability of the system to be in the higher energy level is 0.25. Given: Boltzmann constant $k_B = 1.38 \times 10^{-23}$ JK^{-1}. **4**

3 (a) Explain Michelson-Morley experiment and discuss its result. **10**

OR

(a) Using Lorentz transformations deduce the expressions for **10**

(i) Length contraction

(ii) Time dilation

(b) Imagine a spacecraft moving with a speed of 0.800 c past a stationary observer. If the astronaut tosses a ball in the forward direction with a speed of 0.700 c with respect to himself, what is the speed of the ball as observed by the stationary observer? **4**

OR

(b) An electron which has a mass of 9.11×10^{-31} kg moves with a speed of 0.750 c. Find its relativistic momentum and compare it with the momentum calculated from the classical expression. **4**

4 Attempt any two: **14**

(1) Postulate of equal a priori probability

(2) μ-space

(3) Relativistic variation of mass

(4) Galilean transformations.