2018

MATHEMATICS

MAT–204

SPECIAL THEORY OF RELATIVITY

Full Marks: 80

Time: 3 Hours

The figures in the margin indicates full marks for the questions

(All questions are compulsory)

1. Answer the followings :

   (a) Derive the Lorentz transformation equations. 7

   (b) Derive the equation for force and mass-energy relation. 6

   Or,

   Deduce the transformation equation for velocity. A rod has length 100cm when the rod is in a satellite moving with velocity 0.8c relative to the laboratory. What is the length of the rod as determined by an observer in the satellite ?

   (c) Prove that no velocity can exceed the velocity of light. The half life of a certain particle is 7 10. second, when it is at rest. What will be its half life when it is travelling with a speed of 0.99c ? 7

2. Answer the followings :

   (a) Discuss about the transformation of energy and momentum in relativistic mechanics. 6

   (b) Deduce the transformation equation for force in relativistic mechanics. 7

(c) Discuss about the relativistic Lagrangian. 7

Or,

Calculate the velocity at which the rest mass of the particle becomes ten times its rest mass. A frame S' moves with speed with respect to a frame S in the direction of x-axis. If a particle moves with velocity u' in S' frame in the y' direction then find the velocity of the particle with respect to the S frame.

3. Answer any two : $10 \times 2 = 20$

(a) Define space-time continuum. Discuss the different characteristics of Minkowski space diagrammatic representation.

(b) What do you mean by Minkowski space ? Discuss about space like and time like intervals.

(c) Write notes on :

(i) Proper time

(ii) Null cone

(iii) Position four vector

4. Answer any two : $10 \times 2 = 20$

(a) Write down the Maxwell's electromagnetic equations. Establish the Lorentz invariance of Maxwell's equations.

(b) Define D' Alembert's operator. Deduce the transformation equations of differential operator.

(c) Deduce the Lorentz transformations of the magnetic and electric field components.

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