

M.SC. MATHEMATICS  
THIRD SEMESTER  
SPECIAL THEORY OF RELATIVITY  
MSM - 304A  
[USE OMR FOR OBJECTIVE PART]

2024/11

**SET  
A**

Duration: 1:30 hrs.

Full Marks: 35

**(Objective)**

Time: 15 mins.

Marks: 10

**1×10=10**

*Choose the correct answer from the following:*

1. The four-dimensional space-time length element is given by
  - a.  $ds^2 = -dx^2 - dy^2 - dz^2 + c^2 dt^2$
  - b.  $ds^2 = -dx^2 - dy^2 - dz^2 - c^2 dt^2$
  - c.  $ds^2 = dx^2 + dy^2 + dz^2 + c^2 dt^2$
  - d. none of the above
2. The Fresnel drag coefficient is
  - a.  $\left(1 + \frac{1}{n^2}\right)$
  - b.  $\left(1 - \frac{1}{n^2}\right)$
  - c.  $\left(1 - \frac{1}{n}\right)$
  - d. none of the above
3. The two postulates of special theory of Relativity are
  - a. Galilean Transformation & Lorentz transformation
  - b. Electromagnetic law & Newton's law
  - c. All laws of Physics must be same in all Inertial frame & speed of light
  - d. Principle of Relativity & Universal constancy of speed of light  $c$  in Vacuum
4. The value of  $\sqrt{1 - \frac{v^2}{c^2}}$  what?
  - a.  $\sqrt{1 - \frac{v^2}{c^2}} = 1$
  - b.  $\sqrt{1 - \frac{v^2}{c^2}} > 1$
  - c.  $\sqrt{1 - \frac{v^2}{c^2}} < 1$
  - d. none of the above

5. If  $t'$  is the time measured with respect to  $S'$  and  $t$  is the time w.r.to frame, the which one of the following is correct

- a.  $\Delta I' = \Delta I$   
c.  $\Delta I' \neq \Delta I$

6. In Michelson-Morley Experiment time difference was found

- a.  $\Delta t = \frac{dv^2}{c^3}$       b.  $\Delta t = \frac{dv^3}{c^3}$   
c.  $\Delta t = -\frac{dv^2}{c^3}$       d.  $\Delta t = \frac{dv^2}{c^2}$

7. Lorentz transformation equations are

$$x' = x - vI$$

$$y' = y$$

$$z' = z$$

$$t' = t$$

$$x' = \frac{x - vt}{\sqrt{1 + \frac{v^2}{c^2}}}$$

$$y' = y$$

c.  $z' = z$

$$t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1 + \frac{v^2}{c^2}}}$$

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$y' = y$$

b.  $z' = z$

$$t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$x' = x + vt$$

$$y' = y$$

$$Z' = Z$$

$$t' = t$$

8. Faraday's law of Electromagnetic Induction is

a.  $\text{Curl} B = -\mu_0 \epsilon_0 \frac{\partial E}{\partial t}$

b.  $\text{Curl} E = -\frac{\partial B}{\partial t}$

c.  $\text{Curl} E = \frac{\partial B}{\partial t}$

d.  $\text{Curl} B = \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$

9. "A train moving in a certain direction with a certain speed relative to trees, houses etc". This motion is known as

a. Uniform Motion

b. Non-uniform motion

c. Relative Motion

d. Absolute Motion

10. The Velocity of a particle measured by an inertial observer is

a.  $u = \left( \frac{dx}{dt}, \frac{dy}{dt}, \frac{dz}{dt} \right)$

b.  $u = \left( -\frac{dx}{dt}, -\frac{dy}{dt}, -\frac{dz}{dt} \right)$

c.  $u = \left( -\frac{dx}{dt}, \frac{dy}{dt}, \frac{dz}{dt} \right)$

d.  $u = \left( \frac{dx}{dy}, \frac{dy}{dt}, \frac{dz}{dt} \right)$

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**( Descriptive )**

Time : 1 hr. 15 mins.

Marks: 25

*[ Answer question no.1 & any two (2) from the rest ]*

1. What are the three consequences of Lorentz Transformation.

2+3=5

Prove That  $l' = l \sqrt{1 - \frac{v^2}{c^2}}$

2. " Ether is a Mistry behind the reason Earth velocity can be neglected". Prove it by an experiment.

6+4=10

Also prove that  $\Delta D = 2d \frac{v^2}{c^2}$

3. What do you mean by Inertial and Non Inertial frame. Prove that Newton's laws of Mechanics are invariant under Galilean Transformation.

4+6=10

4. What is Minkowski's Diagram. What are three types of particle. Write two difference between time-like region and Space-like region.

2+3+5  
=10

5. Define

2×5=10

- a. Doppler's Effect
- b. Proper time
- c. Tolman's Statement
- d. Einstein's Velocity Addition Theorem
- e. Maxwell's Electromagnetic Theory

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