

[184]  
[184]

SEAT No. \_\_\_\_\_

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### SARDAR PATEL UNIVERSITY

M.Sc. (Semester-III) Examination

March - 2019

Wednesday, March 27, 2019

Time: 02:00 PM to 05:00 PM

Subject: Mathematics

Course No. PS03EMTH16(Relativity-I)

Note: 1. Answer to all questions to be given in the answer book only.

2. Figures on the right indicate full marks.

Q-1 Choose appropriate answer from the options given. (08)

1. A frame in uniform motion relative to a Galelian frame is \_\_\_\_\_.  
(a) a rotating frame (b) a Galelian frame  
(c) a non-inertial frame (d) Lorentz
2. Maxwell's equations are invariant under \_\_\_\_\_ transformation.  
(a) General Lorentz (b) General Galelian  
(b) Special Galelian (d) None of these
3. In special relativity \_\_\_\_\_.  
(a) space is taken as absolute (b) time is taken as relative  
(c) velocity of any object is taken as relative (d) gravitation is observer dependent
4. According to special relativity simultaneity is \_\_\_\_\_.  
(a) Absolute (b) relativistic (c) non-deterministic (d) non-relativistic
5. In special relativity, moving rod appears to be \_\_\_\_\_.  
(a) expanded (b) contracted (c) slowed down (d) inverted
6. Velocity 4-vector is \_\_\_\_\_.  
(a) space-like (b) of constant magnitude  
(c) null (d) covariant
7. Which one of the following is not correct according to Special Relativity?  
(a) Mass is equivalent to energy.  
(b) Mass increases with motion.  
(c) Mass of a particle remains constant during the motion.  
(d) A photon carries mass.
8. The type of Riemann curvature tensor is of \_\_\_\_\_ type.  
(a) (4,0) (b) (0,4) (c) (0,2) (d) (2,0)

Q-2 Attempt any SEVEN (14)

1. What is meant by general Galelian transformation?
2. State postulates of special relativity.
3. State the formula for transformation of velocities.
4. When two events are said to be simultaneous?
5. Explain the meaning of transverse Doppler effect.
6. State the expression of spacetime interval.
7. What is meant by mass-energy relation?
8. What is Minkowski structure of spacetime?
9. State the expression of transformation of a covariant vector.

(1)

(P.T.O)

Q-3

- (a) State Maxwell's equations for electrodynamics. Show that they reduce to wave equations in vacuum. (06)
- (b) Derive  $w = \frac{u+v}{1+\frac{uv}{c^2}}$ , notations being usual. (06)

OR

- (b) A rod of length 1 meter and mass 1 kg is moving with velocity  $0.6c$  along its length. Find the apparent length and mass of the rod.

Q-4

- (a) Discuss the concept of Doppler effect using special relativity. (06)
- (b) Show that spacetime interval invariant under SLT. (06)

OR

- (b) A source of wavelength  $6563 \text{ \AA}$  moving away from the observer velocity  $.1 c$ . What will be the apparent wavelength of the light?

Q-5

- (a) Define momentum 4-vector. Compute its norm and determine its type. (06)
- (b) In usual notations derive  $E = mc^2$ . (06)

OR

- (b) Rest mass of a body is 100 kg, its mass appears to be 120 kg, compute its velocity.

Q-6

- (a) Derive geodesic equation in a Riemannian space. (06)
- (b) State the transformation law for a covariant vector. Show that transformation satisfies group property. (06)

OR

- (b) Discuss the role of principle of equivalence and principle of covariance in general relativity.

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