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SARDAR PATEL UNIVERSITY
M.Sc. (Semester-III) Examination (NC)
April – 2018
Monday, April 16, 2018
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.   Total Marks : 70
2. Figures on the right indicate full marks.

Q-1 Choose appropriate answer from the options given.   (08)
1. Rotating frame can be taken as _____ frame.
        (a) inertial   (b) Galelian   (c) non-inertial   (d) Lorentz
2. Maxwell's equations are not invariant under _____ transformation.
        (a) Special Lorentz   (b) General Lorentz
        (c) Special Galelian   (d) None of these
3. In special relativity _____.
        (a) time is taken as absolute   (b) time is taken as relative
        (c) velocity of light 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. Momentum 4-vector is _____.
        (a) space-like (b) of constant magnitude (c) null   (d) contravariant
7. Which one of the following is correct according to Special Relativity?
        (a) Mass is equivalent to energy.
        (b) Mass decreases with motion.
        (c) Mass of a particle remains constant during the motion.
        (d) Rest mass and moving mass of a photon are equal.
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. State special Galelian transformation in matrix form.
2. State postulates of special relativity.
3. State the formula for relativistic composition of velocities.
4. Explain the meaning of aberration of light.
5. When two events are said to be simultaneous?
6. Define a spacelike vector.
7. State the expression of transformation of a contravariant vector.
8. What is Poincare structure of spacetime?
9. Define covariant vector.

(P.T.O.)

Q-3
(a) Show that wave equation is not invariant under Galelian transformation. (06)
(b) Derive special Lorentz transformation. (06)

OR

(b) A rod of length 1 meter is moving with velocity 0.6c along the direction making an angle $\frac{\pi}{3}$ with its length. Find the apparent length of the rod.

Q-4
(a) Discuss the concept of Doppler effect using special relativity. (06)
(b) Define spacetime interval and show that it is invariant under SLT. (06)

OR

(b) A source of red signal (wavelength 7500 A°) moves with velocity 1×10^8 meters per second. What will be the apparent wavelength of the light?

Q-5
(a) Define velocity 4-vector. Compute its norm and determine its type. (06)
(b) Derive the relation between rest mass and apparent mass of a particle. (06)

OR

(b) Rest mass of a body is 100 kg, it is moving with velocity 0.6c. Calculate its kinetic energy.

Q-6
(a) State geodesic equation and hence obtain geodesics in three dimensional Euclidean space. (06)
(b) State the transformation law for a tensor of type (1,1). Show that transformation satisfies group property. (06)

OR

(b) Discuss principle of equivalence and principle of covariance.

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