SARDAR PATEL UNIVERSITY

M.Sc. (Semester-III) Examination
October-2018
Monday 29/10/2018
Time: 02:00 PM to 05:00 PM

Subject: Mathematics   **Course No. PS03EMTH41 (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.   In Lorentz transformation time is _____
       (a) relative   (b) absolute   (c) not defined   (d) none of these
2.   Maxwell's equations are invariant under _____ transformation.
       (a) General Galelian   (b) General Lorentz
       (c) Special Galelian   (d) None of these
3.   A frame rotating with speed relative to an inertial frame is _____
       (a) an inertial frame   (b) a Lorentzian frame
       (c) a non-inertial frame   (d) not a frame
4.   Simultaneity is_____
       (a) Absolute   (b) relativistic   (c) non-deterministic (d) non-relativistic
5.   Shape of a circular disc moving along one of its diameters appears to be _____.
       (a) hyperbolic (b) spherical   (c) elliptic   (d) circular
6.   For the momentum velocity 4-vector p_μ , which one of the following is correct?
       (a) It is Time-like   (b) It is space-like
       (c) Has constant norm   (d) None of these.
7.   Which one of the following is correct?
       (a) Mass is equivalent to momentum
       (b) Mass changes with motion
       (c) Mass of a particle remains constant during the motion.
       (d) Mass of a moving particle is not defined.
8.   The maximum number of components of Riemann tensor for a spacetime is ____.
       (a) 21   (b) 10   (c) 0   (d) 20

Q-2   Attempt any **SEVEN**   (14)
1.   State Maxwell's equations for electrodynamics .
2.   State Special Lorentz transformations connecting two frames in relative motion along Y–axis.
3.   State postulates of special relativity.
4.   State formula for time dilation.
5.   Explain the meaning of transverse Doppler effect.
6.   Define a null vector.
7.   Give an example of a covariant vector.
8.   What is meant by Minkowski structure of spacetime.
9.   Define a covariant tensor of rank-2.

Q-3

(a) Discuss the negative result of Michelson-Morley experiment. What are the possible (06) explanations for the negative results?

(b) State special Lorentz transformation and show that wave equation is invariant (06) under this transformation.

OR

(b) State the formula for relativistic composition of velocities and show that, if w is composition of velocities u<c and v<c then w<c.

Q-4

(a) Discuss the phenomenon of aberration of light using special relativity. (06)

(b) State the expression of spacetime interval and hence obtain the relation between (06) proper time and usual time.

OR

(b) Sodium light is of wave length 5896 A°. Find the change in wave length due to relativistic Doppler effect if the observer approaches with the velocity 0.8c to the source of such a light.

Q-5

(a) Describe Poincare structure of spacetime and show that special Lorentz (06) transformation is represented by rotation of axes.

(b) Derive formula for transformation of mass. (06)

OR

(b) Derive the expression of 4-velocity vector. Also find its norm.

Q-6

(a) Define a covariant vector. Show that gradient of a scalar is a covariant vector. (06)

(b) Derive geodesic equation in a Riemannian space. (06)

OR

(b) Discuss principle of equivalence and principle of covariance. Also discuss their role.

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