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

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[208/A-50]

### 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. 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)
- A frame in uniform motion relative to an inertial frame is \_\_\_\_\_ frame.  
 (a) inertial (b) ether (c) non-inertial (d) rest
  - Maxwell's equations are invariant under \_\_\_\_\_ transformation.  
 (a) General Galelian (b) General Lorentz  
 (c) Special Galelian (d) None of these
  - In special relativity \_\_\_\_\_.  
 (a) time is taken as absolute (b) time is taken as relative  
 (c) velocity of light is taken as zero (d) inertial frames do not exist
  - Two events simultaneous in one frame then \_\_\_\_\_.  
 (a) they are simultaneous in any other frame  
 (b) there exists a frame in which they are simultaneous  
 (c) they may not be simultaneous in any other frame  
 (d) None of above holds
  - In Special Relativity, moving rod appears to be \_\_\_\_\_.  
 (a) longer (b) tilted (c) heavier (d) stopped
  - Velocity 4-vector is \_\_\_\_\_.  
 (a) of constant magnitude (b) space-like (c) null (d) contravariant
  - 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.
  - The condition for empty space is \_\_\_\_\_.  
 (a)  $R_{hijk} = 0$  (b)  $R_{ij} = 0$  (c)  $R = 0$  (d)  $g_{ij} = 0$

- Q-2 Attempt any SEVEN (14)
- What was the purpose of Michelson-Morley experiment?
  - State postulates of special relativity.
  - Explain the meaning of time dilation.
  - State the formula for relativistic composition of velocities.
  - Give classification of the spacetime interval.
  - Define a null vector.
  - State the expression of transformation of a contravariant tensor of rank-2.
  - What is meant by Minkowski structure of spacetime.
  - State the geodesic equation.

(P.T.O)

Q-3

- (a) State Maxwell's equations and show that they reduce to wave equation in vacuum. (06)  
(b) Show that composition of two special Lorentz transformations is a special Lorentz transformation. (06)

**OR**

- (b) A rocket ship has to reach a distant star  $10^5$  light years away in 10 years. Find the velocity of so that either by length contraction or by time dilation this is possible.

Q-4

- (a) Discuss the phenomenon of aberration of light in the framework special relativity. (06)  
(b) Show the spacetime interval is invariant under SLT. Is it invariant under SGT? (06)

**OR**

- (b) Calculate the Doppler shift in wavelength for a light of wavelength  $6000\text{\AA}$  when the source moves transversely to observer with a velocity  $0.6c$ .

Q-5

- (a) Define velocity 4-vector. Find its norm. (06)  
(b) Derive the expression of relativistic kinetic energy of a particle. (06)

**OR**

- (b) Calculate the velocity at which the mass of a particle becomes 6 times its rest mass. If the proper length of a rod is  $l_0$ , find its length at this speed.

Q-6

- (a) Explain the meaning of a covariant vector with example. (06)  
(b) State geodesic equation and obtain the form of this equation for motion on a sphere. (06)

**OR**

- (b) Discuss principle of equivalence and its role.

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