

B.Sc. CBCS Pattern Semester-V
USMT12 - DSE-IV - Mathematics-IV (Special Relativity-I)

P. Pages : 2

Time : Three Hours



GUG/W/23/13118

Max. Marks : 60

- Notes : 1. Solve all the **five** questions.
2. All questions carry equal marks.

UNIT – I

1. a) Show that the Maxwell's equations do not remain invariant under Galilean transformation. **6**
b) Explain Fitzgerald and Lorentz contraction hypothesis. **6**

OR

- c) Show that Newton's kinematical equations of motion are invariant under Galilean transformations. **6**
d) Obtain Galilean transformations. **6**

UNIT – II

2. a) Show that the Lorentz transformations forms group. **6**
b) Show that the three dimensional volume elements $dx dy dz$ is not Lorentz invariant but the four dimensional volume elements $dx dy dz dt$ is Lorentz invariant. **6**

OR

- c) Explain length contraction in special relativity. **6**
d) Show that $x^2 + y^2 + z^2 - c^2 t^2$ is Lorentz invariant. **6**

UNIT – III

3. a) Obtain transformation equation of the Lorentz contraction factor $\left(1 - \frac{u^2}{c^2}\right)^{1/2}$. **6**
b) An observer moving along the x axis of S with velocity v observes a body of proper volume v_0 moving with velocity u along the x axis of S-show that the observer measures

the volume to be equal to $\sqrt{\frac{(c^2 - v)^2 (c^2 - u^2)}{(c^2 - uv)^2}} v_0$.

OR

- c) Obtain transformations equations for components of acceleration of a particle. **6**
d) Show that in nature no signal can move with velocity greater than the velocity of light relative to any inertial system. **6**

UNIT – IV

4. a) Prove that there exists an inertial system s' in which the two events occur at one and the same time if the interval between two events is spacelike. 6
- b) Derive Lorentz transformations in index form. 6

OR

- c) Show that $x^1 = -x_1, x^2 = -x_2, x^3 = -x_3, x^4 = x_4$ and then $x_i = (-r, ct)$ 6
- d) Show that two time-like vectors cannot be orthogonal to each other. 6
5. Solve **any six**.
- a) Define space and time in classical mechanics. 2
- b) Write Newton 1st law of motion. 2
- c) Show that the circle $x'^2 + y'^2 = a^2$ in s' is measured to be an ellipse in s if s' moves with uniform velocity relative to s . 2
- d) Define Time dilation. 2
- e) Write transformation equations of particle velocities. 2
- f) Write relativistic addition law for velocities. 2
- g) Define four tensor. 2
- h) Define proper time for the body. 2
