M.Sc. SEM – 03   Seat No. _____

Mathematics: Paper – 10 Code: 3471

Subject Title – Relativity – I

Time: 2 ½ Hours]   [Total Marks: 70

Q.1 (A) In usual notation prove that $F^{ij}{}_{,j} = \dfrac{4\pi}{c} J^i$ [14]

OR

Q.1 (A) (i) Discuss Guaje transformations   [7]

(ii) Derive $\nabla \times \bar{H} - \dfrac{1}{c}\dfrac{\partial \bar{E}}{\partial t} = \dfrac{4\pi}{c}\bar{J}$.   [7]

Q.1 (B) Attempt any four out of six.   [4]
- (1) Define magnetomotive force.
- (2) Define magnetic flux.
- (3) Give an expression for e.m.f.
- (4) Write an equation of continuity.
- (5) Define current density.
- (6) What is the value of $\nabla \times \bar{H}$? , in the case of steady current.

Q.2 (A) Discuss with all details Electric dipole.   [14]

OR

Q.2 (A) (i) Prove that equipotential surfaces cut lines of force at right angle.   [7]

(ii) Discuss Principle of superposition for electrostatic potential.   [7]

Q.2 (B) Attempt any four out of six.   [4]
- (1) What is equipotential surfaces?
- (2) Write Coulomb's Law.
- (3) Define electrostatic intensity.
- (4) State Gauss flux theorem.
- (5) Define lines of force.
- (6) Write second set of Maxwell's equation.

Q.3 (A) Derive Lorentz's transformation equations.   [14]

OR

Q.3 (A) (i) Obtain Galilean transformations equations.   [7]

(ii) Prove that $x^2 + y^2 + z^2 - c^2 t^2$ is invariant.   [7]

Q.3 (B) Attempt any three out of five.   [3]
- (1) What is inertial frame?
- (2) Is distance between any two points is invariant under Galilean transformations?
- (3) Write first postulate of special theory of relativity.

(4) Is three dimensional volume element $dx\,dy\,dz$ is invariant Lorentz's transformation ?

(5) Is four dimensional volume element $dx\,dy\,dz\,dt$ is invariant?

Q.4 (A)   Write short note on (I) Time dilation (II) Clock paradex.   [14]

OR

Q.4 (A) (i) Derive the law of composition of two velocity.   [7]

(ii) Show that resultant of two velocities each of which is less than C is also less than C.   [7]

Q.4 (B)   Attempt any three out of five.   [3]

(1) Write inverse Lorentz's transformations.

(2) What is Proper time?

(3) Under which condition Lorentz's transformations reduces to Galilean transformations?

(4) Write formula for relativistic law of addition of two velocities.

(5) Give formula for Lorentz's force.

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