BACHELOR OF SCIENCE EXAMINATION, 2017

(Final Year, 1st Semester)

MATHEMATICS (Honours)

Unit - 5.6 (a)

(Mathematical Physics and Relativity - I)

Full Marks : 50   Time : Two Hours

Use a separate Answer-script for each part.

The figures in the margin indicate full marks.

Part - I

Answer any *five* questions.

1. State Coulomb's law of Electrostatics. Write an expression for the electric field for a system of point charges q_i, located at x_i, $i = 1, 2, 3, ..., n$.   5

2. Obtain the work done in moving a test charge q from one point to another point in the presence of an electric field E. Hence define the scalar potential of the field.   5

[*Turn over*]

3. Point charges of magnitude $3 \times 10^{-9} C$ are situated at each of three corners of a square whose side is 15 cm. Find the electric field at the vacant corner point of the square.   5

4. State Gauss theorem. By applying Gauss theorem find the electric field at a point due to an isolated uniformly charged sphere.   5

5. Define electric dipole. Find the electric field at a point p due to the presence of a dipole formed by the charges $+q$ and $-q$ placed at a distance l apart.   5

6. Define electrical image. Find by the method of images, the potential at a point on the surface of a sphere which is earthed due to a point charge placed near the sphere.   5

7. State Biot-Savart law and hence write the general form of the magnetic induction due to the presence of current density $J(x)$.   5

Part - II

Answer any *five* questions.   5×5=25

8. Write a short note on Relativity of Simultaneity.

9. What is Time dilation ? Give a real example of Time dilation.

[*Turn over*]

10. A circular ring moves parallel to its plane relative to an inertial frame S. Show that the shape of the ring relative to S is an ellipse.

11. Find the relativistic acceleration transformation (x - component only).

12. A particle of rest mass m_0 describes the trajectory

$$x = f(t), \ y = g(t), \ z = 0$$

in an inertial frame S. Find the four velocity components. Also show that norm of the four velocity is $-c^2$.

13. What is relativistic mass ? Find the velocity of the particle for which the relativistic mass of the particle exceeds its rest mass by a given fraction f.

14. Show that Minkowski force and four velocity vector are orthogonal to each other. Using this find the forth component of Minkowski force.

––––––––––