AU–378

M.Sc. (Part-II) Semester-III (CBCS) Examination

MATHEMATICS

(General Relativity)

Paper—305

Time : Three Hours] [Maximum Marks : 80

Note :— Solve **FIVE** questions selecting **ONE** from each unit.

UNIT—I

1. (a) Obtain the expression for the symmetric energy momentum tensor T_{mn} by using the action integral $S_F = \int_{V_4} L_F \sqrt{-g}\, d_x^4$ for a mechanical system. 10

   (b) Prove that the Einstein's field equations can be written in the form :

   $$R_{mn} = k\left(T_{mn} - \frac{1}{2} g_{mn}\right).$$ 6

2. (c) Obtain the Einstein's field equations from action principle. 8

   (d) Prove that the Poisson equation :

   $$\left(\frac{g_{44}}{c^2}\right)_{\alpha\alpha} = k\rho$$

   can be recovered from the Einstein's field equations. 8

UNIT—II

3. (a) What is the isotropic form of a line element ? Obtain the isotropic form of Schwarzschild exterior solution by using a suitable transformation of co-ordinates. 8

   (b) Prove that any spherically symmetric field in vacuo is static. 8

4. (c) Prove that the equation to the planetary orbit is $u'' + u = \frac{M}{h^2} + 3Mu^2$. 8

(d) Discuss the 'bending of light rays' due to the gravitation of Sun and prove that the gravitational deflection of light ray is given by :

$$2\alpha = \frac{4\varepsilon}{3R} = \frac{4M}{R}.$$ 8

UNIT—III

5. (a) Obtain the Schwarzschild interior solution as a simple model of a star. 8

(b) Derive the Eddington's form of the Schwarzschild exterior solution. 8

6. (c) Discuss the field of charged mass point. 8

(d) Discuss the Boundary conditions in the Schwarzschild interior solution. 8

UNIT—IV

7. Explain the gravitational collapse of dust like sphere. 16

8. Explain how the gravitational collapse of a spherical body leads to the Black hole. 16

UNIT—V

9. Discuss the gravitational waves in curved space-time. 16

10. Explain the gravitational waves and give details of the weak gravitational waves in general relativity. 16