

M.Sc. (Mathematics) (NEP Pattern) Semester-III
03NEPMATH04.3 - General Relativity

P. Pages : 2

Time : Three Hours



GUG/S/25/16018

Max. Marks : 80

- Notes : 1. Solve all **five** questions.
2. Each question carries equal marks.

UNIT – I

1. a) Let A^r, B^r be arbitrary contravariant vectors and a_{rs}, A^r, B^r be an invariant. Then show that a_{rs} are the components of a covariant tensor of 2nd order. 8
- b) State & prove Bianchi Identity. 8

OR

- c) Prove that the divergence of Einstein tensor Vanishes i. e $G^m_n{}_{;m}=0$. 8
- d) Prove that $\text{div } T^r = \frac{1}{\sqrt{g}} \left(T^r \sqrt{g} \right)_{,r}$. 8

UNIT – II

2. a) Obtain the Relation g_{44} and V 8
- b) Explain Mach principal. 8

OR

- c) Obtain the energy momentum tensor for electromagnetic field. 8
- d) Show that the Poisson equation is recovered from the field equations of general relativity. 8

UNIT – III

3. a) Obtain an equation to the planetary orbits. 8
- b) Compute all the non-vanishing Christoffel symbols of the metric. 8

OR

- c) Obtain R_{33} and R_{44} for the line element $ds^2 = -e^A dr^2 - r^2 (d\theta^2 + \sin^2 \theta d\phi^2) + e^B dt^2$ where A & B are functions of r alone. 8
- d) Derive the mathematical formulation of bending of light rays. 8

UNIT – IV

4. a) Obtain the Weyl solution. 8
- b) Derive the linearized field equation. 8

OR

- c) Derive the static spherically symmetric solutions of Linearized field equations. 8
- d) Explain Associated Weyl solution. 8
5. a) Show that any tensor of the second order (covariant) may be expressed as the sum of a symmetric tensor & a skew symmetric tensor. 4
- b) $\delta\sqrt{-g} = \frac{-1}{2} \sqrt{-g} g_{mn} \delta g^{mn}$, where $g = \det g_{mn}$ 4
- c) Define Schwarzschild Singularity. 4
- d) Write short note on gravitational waves. 4
