M.Sc. - II (Mathematics) (New CBCS Pattern) Semester-III

PSCMTH14B - General Relativity-I

P. Pages : 2 **GUG/W/24/13759**

Time : Three Hours * 5 4 3 6 * Max. Marks : 100

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

UNIT – I

1. a) State and prove the Bianchi identity. **10**

b) Prove that $\frac{\delta T^r}{\delta u}$ is a contravariant vector. **10**

OR

c) 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 the 2^{nd} order. **10**

d) Derive the equation of geodesic deviation. **10**

UNIT – II

2. a) Explain two postulates of general theory of relativity. **10**

b) Obtain the relation between g_{44} and v. **10**

OR

c) Show that the Poisson's equation can be recovered to field equation of general relativity. **10**

d) If L_F does not contain $g_{mn,k}$ explicitly, then show that $T_{mn} = 2\frac{\partial L_F}{\partial g^{mn}} - L_F\, g_{mn}$ **10**

UNIT – III

3. a) Compute all the non-vanishing Christoffel symbols of the metric **10**
$ds^2 = -e^A dr^2 - r^2\ d\theta^2 - r^2 \sin^2\theta\ d\phi^2 + e^B dt^2$

b) Derive the mathematical formulation of advance of perihelion of Mercury. **10**

OR

c) Derive the equation for planetary motion. **10**

d) Obtain the Schwarzschild solution in isotropic coordinates. **10**

UNIT – IV

4. a) Derive Weyl solution. **10**

b) Derive the linearized field equation. **10**

OR

c) Derive the line element for the interior Schwarzschild solution. **10**

d) Derive the gravitational field equations for non-empty space. **10**

5. a) Prove that $g_{mn,r} = [mr, n] + [nr, m]$. **5**

b) Prove that $\delta\sqrt{-z} = -\frac{1}{2}\sqrt{-z}\; g_{mn}\, \delta g^{mn}$ where, $g = \det g_{mn}$. **5**

c) Write short note on bending of light rays. **5**

d) Discuss : **5**

i) Associated Weyl solution.

ii) Lorenz-guage.

****