M.Sc. Mathematics

Semester-IV | paper-14 Relativity-II -3475

Total Marks-70 | Oct- 2015 | Time: 2 Hours

Q-1 (a) Prove that for a Euclidean space referred to rectangular coordinates geodesic are straight lines. (7)

(b) Define the following term. (7)

i. Christoffel's symbols of type-I and type-II.
ii. Geodesic.
iii. Null geodesics.

OR

Q-1 (a) Show that covariant derivatives of fundamental tensor vanish. (7)

(b) In usual notation prove that $t^{i}{}_{;k}t^{k}=0$ (7)

Q-2 (a) If A_{ik} is an antisymmetric tensor of second order prove that (7)

$$A_{ik;m}+A_{km;i}+A_{mi;k}=A_{ik,m}+A_{km,i}+A_{mi,k}$$

(b) Define Riemann's symbols of the second kind and first kind also prove that $R_{hijk}= -R_{ihjk}$ (7)

OR

Q-2 (a) Prove that $R_{hijk} + R_{hjki} + R_{hkij} = 0$ (7)

(b) Prove that $R^{l}_{ijk}+R^{l}_{jki} + R^{l}_{kij}= 0$ (7)

Q-3 (a) If $g_{ij}=0$ for $i\neq j$ and i,j,k are unequal suffixes then show that (7)

(i) $\Gamma_{jk,i} = 0$ (ii) $\Gamma^{i}_{jk} =0$ (iii) $\Gamma_{ij,i} =\frac{1}{2}g_{ii,j}$

(b) Obtain the non vanishing 3 index symbols for the metric $ds^2= -dx^2 - dy^2 - dz^2 +f(x,y,z)dt^2$ (7)

OR

Q-3 Prove that Geodesic equations are reducible to Newtonian equations of motion in case of weak static field. (14)

Q-4 (a) State and prove Birkhoff's theorem. (7)

(b) Find Christofell symbols for (7)

$$ds^2 = a^2d\theta^2+a^2\sin 2\theta d\varphi^2$$

OR

Q-4 Discuss with all details Nordstrom solutions. (14)

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Q-5 (a) (i) Discuss Weyl's Postulate. (7)

(ii) Discuss Cosmological principle.

(b) What are the Crucial tests in Relativity? Discuss one of them. (7)

OR

Q-5 Derive the space time metric for F-R-W Cosmological models also derive: (14)

(i) $\dot{s}^2 = \frac{8\pi\rho}{3} s^2 - k$

(ii) $\frac{d}{ds}(\rho s^3) = -3 p s^2$

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