STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted from the academic year 2011-12 & thereafter)

SUBJECT CODE : 11MT/PE/TS24

M. Sc. DEGREE EXAMINATION, APRIL 2015
BRANCH I – MATHEMATICS
SECOND SEMESTER

COURSE : ELECTIVE
PAPER : TENSOR ANALYSIS AND SPECIAL THEORY OF RELATIVITY
TIME : 3 HOURS MAX. MARKS : 100

SECTION –A

Answer all the questions: 5×2=10

1. Write down the value of $A^p . q$
2. Define Quotient Law.
3. Evaluate $\delta_q^p \delta_r^q$.
4. State the two basic postulates of special theory of relativity.
5. Define space like interval.

SECTION –B

Answer any five questions: 5×6=30

6. Show that $\frac{\partial A_p}{\partial x^q}$ is not a tensor even though A_p is a covariant tensor of rank one.
7. Show that any inner product of the tensor A_r^p and B_t^{qs} is a tensor of rank three.
8. Determine the metric tensor in cylindrical and spherical coordinates.
9. Find the covariant derivative of $A_k^j B_n^{lm}$ with respect to x^q.
10. If the covariant force acting on a particle is given by $F_R = \frac{-\partial V}{\partial x^x}$ where $V(x^1, \dots, x^N)$ is the potential energy, then obtain the Lagrange's Equations.
11. Obtain Galilean transformation equation for velocity components and acceleration components.
12. Explain Longitudinal Contraction.

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SECTION –C

Answer any three questions: **3×20=60**

13. A quantity $A(p,q,r)$ is such that in the coordinates system x^i, $a(p,q,r)B_r^{qs} = C_p^s$ where B_r^{qs} is an arbitrary tensor and C_p^s is a tensor. Prove that $A(p,q,r)$ is a tensor and show that every tensor can be expressed as the sum of two tensor, one of which is symmetric and the other skew-symmetric in a pair of covariant a center variance indices.

14. a) Prove that $g_{21}G(3,1) + g_{22}G(3,2) + g_{23}G(3,3) = 0$.
    b) Derive the transformation laws for the Christoffel symbols of the second kind.

15. a) Show that the geodesics in a Riemannian space are given by
    $$\frac{d^2x^r}{ds^2} + \left\{ \begin{matrix} r \\ pq \end{matrix} \right\} \frac{dx^p}{ds} \frac{dx^q}{ds} = 0.$$
    b) Show that $A^p, q = \frac{\partial A^p}{\partial x^q} + \left\{ \begin{matrix} p \\ qs \end{matrix} \right\} A^s$ is tensor if A^p and is a tensor.

16. Obtain Lorentz Transformation Equations.

17. Explain Addition of Velocities and Time Dilation.

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