STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted during the academic year 2009 – 10 & thereafter)

SUBJECT CODE : MT/PE/TS33

M. Sc. DEGREE EXAMINATION, NOVEMBER 2011
BRANCH I - MATHEMATICS
THIRD SEMESTER

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

SECTION – A (5 X 8 = 40)
ANSWER ANY FIVE QUESTIONS

1. A covariant tensor has components $xy,\ zy - z^2, xz$ in rectangular coordinates. Find its covariant components in spherical coordinates.
2. Show that any inner product of the tensors A_r^p and B_t^{qs} is a tensor of rank three.
3. Find the covariant derivative of $A_k^j\ B_n^{lm}$ with respect to x^q.
4. Express the divergence of a vector A^p interms of its physical components for cylindrical coordinates.
5. Explain Longitudinal Contraction in Lorentz transformation.
6. Explain Proper Time and Proper Distance.
7. Obtain addition of velocities in Lorentz transformation.

SECTION – B (3 X 20 = 60)
ANSWER ANY THREE QUESTIONS

8. Derive transformation laws for the Christoffel symbols of
   (a) the first kind (b) the second kind
9. a) Prove that a necessary condition that $I = \int_{t_1}^{t_2} F(t_1\ x_1\ \dot{x})\ dt$ be an extremum [maximum or minimum] is that $\frac{\partial F}{\partial x} - \frac{d}{dt}\left[\frac{\partial F}{\partial \dot{x}}\right] = 0$.
   b) Show that the geodesic in Riemannian space are given by $\frac{d^2x^r}{ds^2} + \left\{ {r \atop pq} \right\} \frac{dx^p}{ds}\ \frac{dx^q}{ds} = 0$.
10. Obtain the covariant derivative of A_p and A^p with respect to x^q.
11. Obtain Lorentz Transformation Equations.
12. a) Explain Galilean transformation
    b) Explain Time dilation

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