

**DEPARTMENT OF MATHEMATICS,
UNIVERSITY OF KARACHI,**

Course Outline

MATH 671: Relativity I

Course contents:

Section A: Contribution of muslims towards conceptual development of principles of relativity (Sadruddin Shirazi, Ibn-é-Sina, Naseeuruddin Tusi), contribution of Vigot and Lorentz towards mathematical formulation of relativity, role of Einstein in combining theoretical framework with mathematical formulation, transformation theory (canonical, gauge and coördinate transformations), review of coördinate transformations, homogeneous, isotropic and anisotropic systems and their mathematical description in terms of scalars, vectors and tensors, etc., principle of general covariance, postulates of relativity, weak, medium strong and strong principles of equivalence

Section B: Lorentz transformations (including rotations and velocity in arbitrary direction) and consequences, constancy of velocity of light in free space derived from covariance of Maxwell equations, Poincaré transformations

Section C: Review of modern differential geometry, curvature tensor, Ricci tensor, Bianchi identity, Weyl tensor

Section D: Geodesics, geodesic deviation, calculation of geodesic indicating direction of Qibla (Makka)

Section E: Acceleration in terms of curvature tensor, Einstein field equation, Schwarzschild solutions, predictions of general relativity

Books Recommended:

1. Golab, S., Tensor Calculus, North Holland, Amsterdam, 1974.
2. Lawden, D. F., An Introduction to Tensor Calculus, Relativity and Cosmology, John Wiley, New York, 1982.
3. Patharia, R. K., The Theory of Relativity, Second Edition, Pergamon, London, 1976.
4. Synge, J. L., Relativity: the Special Theory, North Holland, Amsterdam, 1976.
5. Synge, J. L., Relativity: the General Theory, North Holland, Amsterdam, 1980.

