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Certain contributions to differential geometry of contact manifolds with Riemannian and Lorentzian metric

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The trend of modern mathematics is abstractions, generalizations and applications. In the present thesis we introduce some new concepts, some generalizations and applications which play an important role in modern mathematics. The object of the present thesis is to investigate various aspects of Contact metric manifolds. Contact metric manifolds are smooth manifolds having a contact metric structure \((\phi, \xi, \eta, g)\). We study four major types of contact metric manifolds namely Kenmotsu manifolds, Trans-Sasakian manifolds, \(LP\)-Sasakian manifolds and \(LP\)-Sasakian manifolds with a coefficient \(\alpha\). We study various curvature properties in the context of these manifolds.

In Kenmotsu manifolds we study some properties of concircular curvature tensor. Also we investigate some properties of conharmonic curvature tensor of Kenmotsu manifolds. Among the geometric properties of manifolds symmetry plays an important role. Next we study \(\phi\)-symmetry in 3-dimensional Kenmotsu manifolds with respect to the quater-symmetric metric connection. We also study \(\eta\)-parallel Ricci tensor and cyclic parallel Ricci tensor in these manifolds. Moreover \(\beta\)-Kenmotsu manifolds with quasi-conformal curvature tensor, second order parallel tensor field and Ricci solitons has been studied. Next we study conformally flat, \(\eta\)-Einstein, \(\xi\)-projectively flat and \(\phi\)-projectively flat 3-dimensional Trans-Sasakian manifolds. Then we apply D-homothetic deformation on \(LP\)-Sasakian manifolds and verify the invariance of some properties under this deformation. Moreover \(LP\)-Sasakian manifolds with quasi-conformal curvature tensor and pseudosymmetric \(LP\)-Sasakian manifolds has been studied. We also study concircular curvature tensor and semi-symmetric metric connection in \(LP\)-Sasakian manifolds with a coefficient \(\alpha\). Finally, we study Lorentzian para-Sasakian type space time in \(LP\)-Sasakian manifolds with a coefficient \(\alpha\). Geometric results become more acceptable if these can be verified with illustrative examples. So, we construct many examples to verify some important results.

This work is entirely theoretical without any apparent direct application to the field like industry. This, however, does not cease our hope that in near future it may enrich the field of Differential Geometry.