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THESIS TITLE:

Characterization of some Ricci solitons admitting contact and para contact metrics and an application of Ricci flow in prey-predator model

Abstract

The aim of this doctoral thesis is to study Characterization of some Ricci solitons admitting contact and para contact metrics and an application of Ricci flow in prey-predator model. The thesis consists of **six chapters**. An introduction of the Differential Geometry, Ricci soliton and prey-predator model in **Chapter 1**.

In the **second chapter**, we initiate the study of almost η-Ricci-Yamabe soliton and gradient almost η-Ricci-Yamabe soliton within the framework of Kenmotsu manifold and obtain some characteristics of the manifold and the potential vector field. Finally we deliberate $*$-η-Ricci soliton admitting $(\kappa, \mu)'$-almost Kenmotsu manifold and proved that the manifold is Ricci flat and is locally isometric to $\mathbb{H}^{2n+1}(-1)$. Lastly we construct two examples.

In the **third chapter**, we establish some results regarding δ-Ricci-Yamabe almost soliton within the framework of paracontact metric manifolds. Here, we study δ-Ricci-Yamabe almost soliton and gradient δ-Ricci-Yamabe almost soliton on K-paracontact and para-Sasakian manifolds. Here, we prove that if K-paracontact metric g represents δ-Ricci-Yamabe almost soliton with the non-zero potential vector field V is parallel to ξ, then g being an Einstein with Einstein constant $-2n$. Later, we initiate that if g represents a gradient almost $*$-Ricci-Bourguinon soliton on a $(2n+1)$-dimensional η-Einstein para-Kenmotsu manifold then M^{2n+1} is either Einstein or there exists a vector field V is pointwise collinear with Reeb vector field ξ. Finally, we prove that if

the para-Sasakian metric is a $*$-Ricci Bourguinon soliton on a manifold, then M^{2n+1} is either $\mathcal{D}$-homothetic to an Einstein manifold, or the Ricci tensor of M^{2n+1} with respect to the canonical paracontact connection vanishes.

In **fourth chapter**, we demonstrate that if a Kenmotsu manifold admits an almost $*$-Ricci-Bourguinon soliton, then the manifold is η-Einstein. Next, we prove that if a $(\kappa, 2)'$-nullity distribution where $\kappa < -1$ admits an almost $*$-Ricci-Bourguinon soliton, then the manifold is Ricci flat. Further, we show that if a Kenmotsu manifold endows a gradient almost $*$-Ricci-Bourguignon soliton and ξ leaves the scalar curvature r invariant, then the manifold is an Einstein manifold with constant scalar curvature $r = n(1 - 2n)$. Later, we have studied on a Sasakian manifold if g represents an almost $*$-η-Ricci-Bourguignon soliton with potential vector field V_1 is pointwise collinear with ξ, then the manifold is an η-Einstein.

In the **fifth chapter**, we study W_2 - semisymmetric and W_2- pseudosymmeric trans-Sasakian space form,W_2-locally symmetric trans-Sasakian space form,W_2- locally ϕ- symmetric trans-Sasakian space form and W_2 -ϕ-recurrent trans-Sasakian space form. Later, we find some results on trans-Sasakian manifold which are conformal η-Einstein solitons where the Ricci tensor is cyclic parallel and Codazzi type. We also consider some curvature conditions with addition to conformal η-Einstein solitons on trans-Sasakian manifold. We also use torse-forming vector fields in addition to conformal η-Einstein solitons on trans-Sasakian manifold. Finally,we constructed an example.

In the **sixth chapter**, We consider a prey–predator model with Holling type III response function incorporating a prey refuge. The purpose of the work is to offer mathematical analysis of the model and to discuss some significant qualitative results that are expected to arise from the interplay of biological forces. Some numerical simulations are carried out.

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