

CERTAIN GRADIENT SOLITONS ON THREE-DIMENSIONAL TRANS-SASAKIAN MANIFOLDS

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ABSTRACT. The aim of the present paper is to study some solitons on three dimensional trans-Sasakian manifolds. I study gradient Yamabe solitons on three dimensional trans-Sasakian manifolds. It is proved that if the metric of a three dimensional trans-Sasakian manifold is gradient Einstein soliton then the characteristic functions are equal. Moreover, I study gradient almost Ricci soliton on trans-Sasakian manifolds.

REFERENCES

- [1] A. Ghosh: *Certain contact metric as Ricci almost solitons*, Results Math., **65** (2014), 81-94.
- [2] A. Ghosh and D.S. Patra: *The k -almost Ricci solitons and contact geometry*, J. Korean Math. Soc., **55**(2018), 161-174.
- [3] A. Sarkar, A. Sil and A.K. Paul: *Ricci almost solitons on three diemensional quasi-Sasakian manifolds*, Proc. Nat. Acad. Sci. India Sect. A, **89**(2019), 705-710.
- [4] A. Sarkar, A.K. Paul and R. Mandal: *On α -para Kenmotsu 3-manifolds with Ricci solitons*, Balkan J. Geom. Appl., **23**(2018), 100-112.
- [5] A. Sarkar and G.G. Biswas: *Ricci solitons on three-dimensional generalized Sasakian space forms with quasi-Sasakian metric*, Afr. Mat., **31**(2020), 455-463.
- [6] A. Sarkar and G.G. Biswas: *Ricci solitons on three-dimensional trans-Sasakian manifolds*, Math. Student, **88**(2019), 153-164.
- [7] A. Sarkar and P. Bhakta: *Ricci almost soliton on (κ, μ) space forms*, Acta Univ. Apulensis Math. Inform., **57**(2019), 75-85.
- [8] A. Sarkar and P. Bhakta: *On certain soliton and Ricci tensor of generalized (κ, μ) manifolds*, J. Adv. Math. Stud., **12**(2019), 314-323.
- [9] A. Sarkar and R. Mandal: *On $N(\kappa)$ -para contact 3-manifolds with Ricci solitons*, Math. Student, **88**(2019), 137-145.
- [10] D.E. Blair and J.A. Oubina: *Conformal and related changes of metric on the product two almost contact metric manifolds*, Publ. Math., **34**(1990), 199-207.
- [11] G. Catino and L. Mazzieri: *Gradient Einstein soliton*, 29 Nov 2013, arXiv:1201.6620v5 [math.DG], 30 pages.
- [12] G. Perelman: *The entropy formula for the Ricci flow and its geometric applications*, 11 Nov 2002, arXiv:0211159 [math.DG], 39 pages.
- [13] J.A. Oubina: *New class of almost contact metric structures*, Publ. Math. Debrecen, **32**(1985), 187-193.
- [14] J.C. Marrero: *The local structure of trans-Sasakian manifolds*, Ann. Mat. Pura Appl. (4), **162**(1992), 77-86.
- [15] P. Majhi and G. Ghosh: *Certain results on generalized (κ, μ) -contact manifolds*, Bol. Soc. Parana. Mat. (3), **37**(2019), 131-142.
- [16] R. Sharma: *Almost Ricci solitons and K -contact geometry*, Monatsh. Math., **175**(2014), 621-628.

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- [17] H. Yamabe: *On a deformation of Riemannian structures on compact manifolds*, Osaka J. Math., **12**(1960), 21-37.
- [18] S. Deshmukh and Al-Solamy: *A note on compact trans-Sasakian manifolds*, Mediterr. J. Math., **13**(2016), 2099-2104.
- [19] S.K. Hui: *Almost conformal Ricci solitons on f -Kenmotsu manifolds*, Khayyam J. Math., **5**(2019), 89-104.
- [20] S. Pigola *et al.*: *Ricci almost solitons*, Ann. Sc. Norm. Super. Pisa Cl. Sci. (5) , **5**(2011), 757-799.
- [21] U.C. De and A. Sarkar: *On three-dimensional trans-Sasakian manifolds*, Extracta Math., **23**(2008), 265-277.
- [22] R.S. Hamilton: *Ricci flow on surfaces*, Contemp. Math., **71**(1988), 237-261.

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