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Research Article

Some types of f-biharmonic and bi-f-harmonic curves

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Abstract

In this paper, we determine necessary and sufficient conditions for a non-Frenet Legendre curve to be f-harmonic, f-biharmonic, bi-f-harmonic, biminimal and f-biminimal in three-dimensional normal almost paracontact metric manifold. Besides, we obtain some nonexistence theorems.

Mathematics Subject Classification (2020). 53D15, 53C25, 53C43, 58E20

Keywords. non-Frenet Legendre curves, f-harmonic curves, f-biharmonic curves, bi-f-harmonic curves, biminimal curves, f-biminimal curves, normal almost paracontact metric manifolds

1. Introduction

Theory of curves is one of the most important subject of differential geometry and it keeps up to date from past to present. The most popular curves in this theory are Frenet curves since these curves can be studied in many different manifolds. In particular, Legendre curves have an important role in geometry and topology of almost contact manifolds. In the literature, the most basic papers about Legendre curves studied in contact manifolds can be listed as, [2, 4, 5, 30].

On the other hand, studies on Frenet Legendre curves are more recent in the literature. The latest studies which are a source of motivation for us can be briefly listed as, [23, 31]. In the mentioned Frenet Legendre curve studies, the authors focused especially on curvature and torsion of the curve. However, in this study, different from previous studies, we handled properties of the maps, which briefly mentioned below.

Harmonic maps, which were defined by Sampson and Eells in [9], have a wide range of application areas such as physics, mathematics and engineering.

Jiang obtained biharmonic maps between Riemannian manifolds by generalizing harmonic maps, in [13]. The definition of biharmonic maps for Riemannian immersions into Euclidean space coincides with the Chen's definition of biharmonic submanifold given by using bienergy functional. In recent years, there has been a growing interest in the theory of biharmonic maps which can be divided into two main research directions. On the one side, constructing the examples and classifing results have become important from

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