South East Asian J. Math. & Math. Sc.
Vol.6 No.1(2007), pp.79–84

HARMONIC MORPHISMS ON ALMOST *GF-r* CONTACT METRIC STRUCTURE MANIFOLDS

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(*Received: January 14, 2006*)

Abstract: In this paper we have studied almost morphisms on an almost contact metric structure manifolds in almost GF-r contact metric manifolds. Some other interesting result on cartesian product manifold $M \times R^r$ have also been established where M is an almost GF-r contact metric manifold of dimension $(2m + r)$.

Keywords and Phrases: Almost r-contact structure, GF-structure, harmonic morphisms, cartesian product manifold
2000 AMS Subject Classification: 53D15, 53B35

1. Preliminaries

Let (M, g) and (N, h) be two C^∞ manifolds and $F : M \to N$ be a C^∞ map. Let ∇ and $\bar{\nabla}$ be Levi-Civita connections on M and N respectively. The second fundamental form α_F of F given by

$$\alpha_F(X, Y) \;=\; \bar{\nabla}_x dF(Y) - dF(\nabla_x Y) \tag{1.1}$$

for all X, Y tangents to M. Here $\bar{\nabla}$ is the connection induced by F on the bundle $F^{-1}(TN)$, TN denotes the tangents bundle of N.

The tension field $\tau(F)$ of F is defined as trace of second fundamental form α_F, i.e.,

$$\tau(F) \;=\; \sum_{i=1}^{m} \alpha_F(e_i, e_i)_p \tag{1.2}$$

where $\{e_1, e_2, \cdots, e_m\}$ is an orthonormal basis for the tangent space $T_p(M)$ of M at $p \in M$. We say that a map $F : (M, g) \to (N, h)$ between two manifolds M and N is harmonic if and only if $\tau(F) = 0$ [2,3,6].

A map $F : (M, g) \to (N, h)$ is called harmonic morphism if it maps germs of the harmonic function to germs of the harmonic function, i.e, $\Delta f = 0$ implies that $\Delta(f \circ F) = 0$ for all functions f defined on an open set $V \subset N$ [1,4].