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INVARIANT SUBMANIFOLDS OF CODIMENSION 2 OF A MANIFOLD WITH (F, G, u, v, λ)-STRUCTURE

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An almost complex manifold, an almost contact manifold and a manifold with a structure tensor f satisfying $f^3+f=0$, all admit a tensor field of type (1, 1). A submanifold of these manifolds is said to be invariant when the tangent space at each point of the submanifold is left invariant by the endomorphism defined by this tensor field.

It is known that the invariant submanifolds of almost complex and contact manifolds inherit properties of the enveloping manifold. For example, an invariant submanifold of a Kählerian manifold is Kählerian and an invariant submanifold of a normal contact manifold is normal [1, 2, 3].

Yano and Okumura [4] have recently introduced the so-called (F, G, u, v, λ)-structure in an even-dimensional manifold and given a characterization of an even-dimensional sphere in terms of this structure.

The purpose of the present paper is to study invariant submanifolds of codimension 2 of a manifold with (F, G, u, v, λ)-structure.

We recall in §1 the definition and properties of (F, G, u, v, λ)-structure and in §2 the fundamental formulas for submanifolds of codimension 2 of a Riemannian manifold. In §3, we obtain fundamental formulas for submainfolds of codimension 2 of a Riemannian manifold with (F, G, u, v, λ)-structure. In the last §4, we get a theorem stating that invariant submanifolds of codimension 2 of a manifold with (F, G, u, v, λ)-structure are also manifolds with (f, g, u, v, λ)-structure and a corollary stating that invariant submanifolds of codimension 2 of an even-dimensional sphere are also spheres.

§1. (F, G, u, v, λ)-structures.

Let M be an m-dimensional differentiable manifold of class C^∞. If there exist in M a tensor field $F_\lambda{}^\kappa$ of type (1, 1), two contravariant vector fields U^λ, V^λ, two covariant vector fields u_λ, v_λ, and a function λ such that[1)]

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1) (x^λ) are local coordinates of M and $F_\lambda{}^\kappa$, U^λ, V^λ, u_λ, v_λ and λ are components of F, U, V, u, v and λ with respect to this local coordinate system respectively. The indices $\lambda, \kappa, \mu, \nu, \cdots$ run over the range $\{1, 2, \cdots, m\}$ and the so-called Einstein summation convention is used with respect to this system of indices.