PROLOGUE

The present dissertation entitled "Infinitely conducting relativistic perfect fluid with shearfree flowlines", endowing the general relativistic approach explains the behaviour of infinitely conducting charged f uid (magreto-fluid) under the physically reasonable restriction of vanishing shear. The highlights of shearfree magnetofluid imparted by Einstein's field equations and associated local conservation laws are given below (chapterwise).

I. A brief historical survey of shearfree perfect fluid in context of general relativity is presented. Moreover, some basic reasons leading to the study of shearfree studies are given.

II. The energy conditions that are to be satisfied by the stress energy tensor for relativistic perfect fluid are found. The kinematical parameters associated with the timelike flowvector are introduced. The local conservation laws of energy and momentum evolving out of contracted Biarchi identities are studied with special reference to the shearfree perfect fluid distribution. The main results are

i) The matter density is conserved along the expansion-free flowlines.

ii) The spatial pressure gradient vanishes along the geodesic path.

iii) The Raychaudhari's equation describing the propogation of expansion parameter with respect to shearfree perfect fluid is derived.

III. This topic deals with the study of spacetime filled with infinitely conducting charged fluid with constant magnetic permeability (magnetofluid scheme suggested by Lichenrowiz, 1967). The characteristic features of the shearfree magnetofluid satisfying Maxwell's equations are exploited. The prominent results regardding shearfree magnetofluid are as follows

i) The magnetic lines are divergencefree if and only if these lines are normal to the 4-acceleration.

ii) The streamlines are expansionfree if and only if the magnitude of the magnetic field is preserved along the flowvector.

iii) The necessary and sufficient conditions for the conservation of matter density along the flow is that the magnitude of the magnetic field consreves along the flowvector.

iv) The pressure gradient acts in the direction of flow-vector if the magnetic field is uniform.

v) The isotropic pressure is left invariant along the magnetic field vector when and only when the magnetic field is normal to the 4-acceleration.

IV. Analogous to the electromagnetic field theory, the Weyl tensor is decomposed into electrictype and magnetic type tensors. The divergence of the Weyl tensor called as the matter current, exhibiting the source of the gravitational field of relativistic shearfree magnetofluid is studied. The necessary condition for the shearfree magnetofluid to be of constant curvature is derived. The main results of the topic are given below

i) For geodesic flow of the shearfree magnetofluid with magnetic field normal to plane of rotation we have

$$E_{ab}h^a h^b = 0 \Longleftrightarrow \omega^2 = -(k\mu h^2)$$

ii) If the spacetime of the shearfree magnetofluid is conformally flat then the matter density conserves along the magnetic lines if and only if the magnitude of the magnetic field also conserves along these lines.

iii) For shearfree magnetofluid with conformally flat spacetime the vorticity vector is orthonormal to vectors $\bar{U}$, $\bar{h}$ and $\bar{S}$ ($S_a = \omega_{ab}h^b$).

iv) For the shearfree magnetofluid if the electrictype tensor is divergencefree and the magnetic field vector is the eigenvector of both electrictype tensor and magnetic type tensor with zero eigenvalues, then the density is preserved along the magnetic lines if and only if the pressure is preserved along these lines.

v) For the divergencefree electrictype tensor of the shearfree magnetofluid the density is invariant along the flowlines if and only if the pressure remains invariant along these lines.

vi) For the shearfree magnetofluid with geodesic flow if the electrictype tensor vanishes then the divergence-free magnetic tensor implies that the vorticity vector is normal to magnetic lines.

vii) The necessary and sufficient condition for the shearfree magnetofluid with magnetic field normal to the plane of rotation be rotationfree is that the Weyl tensor be of purely electrictype.

Note :

We claim that the results obtained in this chapter are supposed to be new.