PREFACE

The stress-energy tensor has its own important significance in the theory of general relativity. This is generally treated as a prime source of the gravitational force field and exhibits the dynamical properties of the space-time. The forms of the stress-energy tensor depend on the types of matter distributions permitted by the space-time. Though there exists many significant solutions of vacuum field equations there exists some important physically meaningful mathematical models of non-vacuum field equations comprising the relativistic perfect fluid distribution.

According to Lichnerowicz A. (1967) Magnetohydrodynamical system, the matter distribution consists of an infinitely conducting charged fluid with constant magnetic permeability. By relaxing the condition of constant magnetic permeability, Cissoko (1978) considered a slightly generalised scheme known as relativistic ferrofluid inscribing the condition of variable magnetic permeability. The present dissertation deals with this type of relativistic ferrofluid under the geometrical restrictions like conformal symmetries on the associated space-time. The efforts are directed towards solving this system of relativistic ferrofluid and describing the effects of variable magnetic permeability on the other dynamical variables like ρ , p , etc.

The investigations carried out in this dissertation are presented below :

CHAPTER 1 : This chapter deals with basic required mathematical aspects used in the development of the work. The types of congruences along with the kinematical parameters are given in Section 2. Section 3 tells about the geometrical symmetries like conformal symmetry, special conformal motions and Ricci collineation while Section 3 and 4 comprise the conservation law generator and the stress-energy tensor for ferrofluid along with its dynamical properties. In Section 5 a system of field equations compatible with ferrofluid is presented.

CHAPTER 2 :

Section 1 : It includes the introduction of geometrical symmetries that are used in solving the system equations.

Section 2 : The local conservation laws providing the equation of continuity and stream-lines of ferrofluid are examined. It is proved that (i) for expansion free flow of ferrofluid the matter energy density is conserved along the flow if and only if the magnetic permeability is conserved along the flow. (ii) If the 4-acceleration of the ferrofluid is normal to magnetic lines then the conservation of isotropic pressure along the magnetic lines is the direct consequence of the conservation of magnetic permeability along magnetic lines.

Section 3 : This section deals with conformal symmetry group generated by flow vector $\bar{u}$ and magnetic field vector $\bar{H}$ involved in ferrofluid system. We have shown here (1) the flow of the ferrofluid admitting conformal motions must be expanding, (2) the 4-acceleration is normal to magnetic lines if and only if M is preserved along these lines. Moreover it is proved that the variation of isotropic pressure along magnetic lines and the divergence of magnetic lines depend explicitly on potential ψ .

Section 4 : Ricci identities are re-examined under the conformal symmetry group.

Section 5 : The expression for Lie derivative of Einstein's field equation along the arbitrary vector field $\bar{X}$ generating the conformal symmetry group is evaluated.

Section 6 : This comprises a special case of conformal motions. It is proved that if the space-time of ferrofluid admits the special conformal group of motion then

$$\underset{X}{L}\ \rho + p = -\ \psi\ (\ \rho + p\ ) - \mu H^2.$$

The corresponding conservation law generators provide the results like

$$\underset{H}{L}\ H^2 = 0 \iff \rho - p - \mu H^2 = 0.$$

CHAPTER III :

Section 1 : This gives a brief history of existing spherically symmetric co smological models.

Section 2 : The Einstein field equations for spherically symmetric space-time filled with the ferrofluid admitting co-moving frame are formulated in this section.

<u>Section 3</u> : Maxwell equations are solved under the spherically symmetric background and the values of the magnetic permeability μ and the magnitude of the magnetic field are obtained as the functions of r.

<u>Section 4,5</u> : These sections deal with the space-time admitting conformal symmetry. The system of Einstein's field equations is integrated to find the value of conformal potential ψ . Thus a class of models consistent with the ferrofluid space-time admitting conformal symmetry is developed.

<u>Section 6</u> : Some particular cases like $p = 0$ and $\rho = 3p$ are discussed in this section. Also the values of kinematical parameters have worked out with reference to derived model.