PREFACE

The omnipresence of the intense magnetic field in the astronomical systems like magnetic variable stars, neutron stars, sun spots etc., is justified by the recent observational and phenomenal discoveries. Even the intergalact medium is supposed to be comprised of self-gravitating magnetofluid (Yodzis, 1971). These astronomical systems also possess strong gravitational field. This has prompted the researcher to do comprehensive study in the field of relativistic magnetohydrodynamics (RMHD).

A self-consistent scheme incorporating electromagnetic field interacting with matter field furnished by Maugin (1972) is supposed to be the progressive generalization of Lichnerowicz's scheme (1967), which encompasses the effects of magnetization and polarization of electromagnetic field on the internal structure of the relativistic magnetofluid. This formalism established with the help of ascertained action principle has enlightened the author to contemplate the relativistic magnetofluid.

The observational phenomena always possess uncertainties and errors. Hence the appropriate source of persuing the realistic information about the real universe is the cosmological models constructed with the help of general theory of relativity (Tolman, 1934). The endowed motivation behind the dissertation work is the Maugin's scheme enriched with powerful physical applications.

The intrisic properties of the self-gravitating magneto-fluid describable through the constitutive field equations are examined. An attempt is made to provide an appropriate cosmological model for the space-time of magnetofluid compatible with spherical symmetry.

The salient features of the dissertation work are as follows :-

CHAPTER I : PRECURSORY NOTIONS AND CONCEPTS

Section 1.1. Sectionwise reconnaissance.

Section 1.2. Conventions.

Section 1.3. The study of congruences.

Section 1.4. Geometrical symmetries.

Section 1.5. Evolution of the stress-energy tensor for the relativistic magnetofluid.

Section 1.6. Several aspects of the stress-energy tensor for the magnetofluid.

CHAPTER II : THE CONSEQUENCES OF THE LOCAL CONSERVATION LAWS IN MAGNETOFLUID

Section 2.1. A survey of investigations is presented.

Section 2.2. The form of Raychoudhari's (1955) equation for the magnetofluid is found. Maxwell equations and associated deducations are explored. A thermodynamical relation governing the heat transfer in the magnetofluid is developed.

Section 2.3. The following are shown to be true -

(i) For the magnetofluid with $\mu \neq 1$, the energy density is left invariant along the expansion free flow if and only if the magnitude of the magnetic field conserves along the flow vector.

(ii) The necessary and sufficient condition for the conservation of the hydrodynamic pressure of the magnetofluid (with $\mu \neq 1$) along the divergence free magnetic lines is that the magnitude of the magnetic field is invariant along the magnetic lines.

Section 2.4. A general relativistic equation of finite amplitude sound propogation through magneto-fluid is derived.

Section 2.5. For the magnetofluid admitting

(A) <u>groups of motion along the flow vector we have</u>

(i) the stream lines are expansion free and shear-free.

(ii) the magnetic lines are divergence free.

(iii) the magnitude of the magnetic field is conserved along the flow.

(iv) the dynamic part of energy density of the relativistic magnetofluid is conserved along the flow.

(v) the isotropic pressure of the fluid is conserved along the magnetic lines if and only if the magnitude of the magnetic field conserves along the magnetic lines.

(vi) the spetial pressure gradient is due to magnetic field only.

(B) groups of motion along magnetic lines we have,

(i) the magnetic lines are divergence free.

(ii) the stream lines are expansion free.

(iii) the magnitude of the magnetic field is uniform along itself.

(iv) the energy density conserves along the flow vector if and only if the magnitude of the magnetic field conserves along the flow vector.

(v) the isotropic pressure of the fluid is conserved along the magnetic lines.

Section 2.6. For the magnetofluid it is proved that groups of conformal motion along the flow vector (as well as along magnetic field vector) degenerate into groups of motion along the flow vector (along magnetic field vector).

CHAPTER III : RELATIVISTIC MAGNETOFLUID AND SPHERICAL SYMMETRY

Section 3.1. Sectionwise exposition of results.

Section 3.2. For the space-time of the magnetofluid admitting spherical symmetry, static models are designed in accordance with the Einstein's field equations.

Section 3.3. A class of non-static cosmological models compatible with the spherically symmetric space-time of the magnetofluid is found. The associated dynamical properties are utilized to formulate the law of thermodynamics in the magnetofluid coupled with the magnetic field effects.

The end of the dissertation is graced with references that have been used throughout the subject matter. The additional reference work is cited in the Bibliography.