Preface

The development of general relativity, since its inception almost 90 years ago, has not only provided a new way to understand gravity, but also heralded the dawn of an entirely new branch of science known as cosmology. The quest for understanding the geometry of our universe is one of the central aims of cosmology. The aim of this thesis is to work backgrounds by using the presently observed properties of the universe to understand what it was like at earlier times. The thesis provides exact solutions in which the relevant cosmological data seem to fit.

The present thesis entitled "Some Spatially Homogeneous and Anisotropic Cosmological Models in General Relativity and Certain Alternative Theories of Gravitation " comprises seven chapters.

In Chapter I is introductory in nature. It contains a brief account of general relativity and some modified theories of gravitation. This chapter gives a short review of our current understanding about the universe, its history and present status, and the important equations that govern its evolution. It also contains the basic concept of general relativistic cosmology, definitions of the physical and kinematical parameters of the expanding universe, which are used in succeeding chapters.

In Chapter II, a spatially homogeneous and anisotropic LRS Bianchi type-II spacetime is studied in the presence of perfect fluid with time -decaying cosmological term . Exact solutions of field equations for stiff matter are obtained by applying a special law of variation for Hubble's parameter. Anisotropic cosmological models with negative constant deceleration parameter, have been presented, which corresponds to the accelerated phase of the present universe. The physical and kinematical properties of the models are also discussed.

In Chapter III, an anisotropic Bianchi type-III cosmological model is investigated in the presence of a bulk viscous fluid within the framework of Lyra geometry with time-dependent displacement vector. It is shown that the field equations are solvable for any arbitrary function of a scale factor. To get the deterministic model of the universe, we have assumed (i) a simple power-law form of a scale factor and (ii)the bulk viscosity coefficient is proportional to the energy density of the matter. The exact solutions of the Einstein's field equations are obtained which represent an expanding, shearing and decelerating model of the universe. Some physical and kinematical behaviors of the cosmological model are discussed.

In Chapter IV, Bianchi type-VI_0 cosmological models of the universe filled with dark energy with constant and time-dependent equation of state parameters are investigated in general relativity. Exact solutions of Einstein's field equations are obtained using the condition that the shear scalar is proportional to the expansion scalar, which represent singular and non-singular cosmological models of the universe. The physical and kinematical behaviors of the models are discussed. We conclude that the universe models do not approach isotropy through the evolution of the universe.

In Chapter V, a class of non-singular bouncing cosmological models of a general class of Bianchi models filled with perfect fluid in the framework of f(R,T)gravity is presented. The model initially accelerates for a certain period of time and decelerates thereafter. The physical behavior of the model is also studied. Additionally, we discuss the field equations in f(R,T) gravity theory for the general class of Bianchi models filled with bulk viscous fluid together with a one-dimensional cosmic strings. We obtain two classes of cosmological solutions of the field equation by setting the average scale factor and one of the scale factors of the model proportional to a power function of the spatial volume. One class of solutions represent an accelerated expanding universe having singularity in the infinite past . The other class of solutions also represent an accelerated expanding cosmological model having singularity at the initial time. The physical and kinematical properties of the models are discussed. We observe that the models are compatible with the results of recent observations.

In Chapter VI, we present non-singular Bianchi types I and V cosmological models in the presence of bulk viscous fluid in the framework of f(R,T) gravity theory. Exact solutions of the field equations are obtained by using a particular choice of the function f(R,T) and a special ansatz to the average scale factor of the model, which corresponds to a time- dependent deceleration parameter. The cosmological models initially accelerate for a certain period of time and thereafter decelerates. The physical and kinematical properties of the models of the universe are discussed.

In Chapter VII, algorithms are derived for generating five dimensional Kaluza-Klein cosmological space-times in the presence of a perfect fluid source in the framework of $f(R,T)$ gravity theory, proposed by Harko et al.(Phys. Rev.D **84**,024020,2011). Starting from the solution of Reddy et al.(Int.J.Theor.Phys **51**,3222-3227,(2012)),some classes of new solutions are generated, which correspond to accelerating models of the Universe. The physical and kinematical behaviors of the models are studied.