ABSTRACT

This PhD Thesis entitled "A **Study on Some Bianchi Type Cosmological Models in General Theory of Relativity**" consists of nine chapters and its 7 chapters are based on the Bianchi type models of different kinds in various context, mainly devoted to the study of Bianchi type cosmological models in general theory of relativity. Also the study of string cosmological models has been carried out in other alternative theory of relativity such as in Lyra geometry.

Chapter-1 deals with the Introduction. This gives brief information which is relevant and necessary for understanding the work carried out in the subsequent chapters. In this chapter, we have highlighted the definition and history of cosmology, general relativity and Einstein's field equation, some topic-related principles and laws, the fate of the Universe, different cosmological parameters, topic-related basic terminologies, some candidates for dark energy, and so on. In addition, the objectives, methodology, and summary of the research work are presented. Also, several authors' previously completed research works on related topics have been reviewed.

Chapter-2 deals with the study of entitled "**Bulk Viscous Fluid Bianchi Type-I String Cosmological Model with Negative Constant Deceleration Parameter**". This chapter deals with the construction of a Bianchi type-I string cosmological model in GR with bulk viscosity and a constant DP. The parameters that are essential in the study of cosmological models have been procured and analyzed. The model is expanding, non-shearing, anisotropic throughout the evolution for $n \neq 1$. The existing Universe originates with Big-Bang at inceptive epoch at $t = 0$ with zero volume and then expands with acceleration rather the rate of expansion of the Universe slackens with increase of time. The impact of the bulk viscosity coefficient in the cosmological results that lead to the early Universe's accelerated expansion has been discussed. The tension density decreases faster than the particle density, indicating that particles dominate the current Universe.

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Chapter-3 is represented as entitled "**Mathematical Analysis on Anisotropic Bianchi Type-III Inflationary String Cosmological Models in Lyra Geometry**". The law of variation of Hubble parameter H is used in this chapter to obtain a new solution to the field equations obtained for Bianchi type-III universe, which yields constant DP. We make the assumption that the shear scalar and scalar expansion are proportional to each other in order to find the exact solutions of survival field equations, which leads to the equation, $b = c^n$. The geometrical as well as physical properties are examined, and the results are compared to recent observational data. The current model starts at $t = 0$ with 0 volume and expands at an accelerated rate as time passes, demonstrating that the current universe is particle dominated.

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Chapter-4 is entitled as "**Higher Dimensional Bianchi Type-I Cosmological Models with Massive String in General Relativity**". An isotropic strings model don't survive in general relativity but an anisotropic string model survive which represents an expanding Universe that starts at the time $t = 0$ with a volume $V = 0$ and expands with acceleration after an epoch of deceleration. Our model Universe is anisotropic, shearing and satisfies the energy conditions $\rho \geq 0$ and $\rho_p \geq 0$. The model Universe can represent a stage of evolution from decelerating to accelerating. The DP "q" is decelerating at the initial stage of the evolution and then accelerates after some finite time because of the cosmic recollapse, indicating inflation in the model after an epoch of deceleration which is in accordance with the present-day observational scenario of Universe as claimed by SNe Ia [Riess et al.(1998) & Perlmutter et al.(1999)].

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Chapter-5 is entitled as "**Higher Dimensional Bianchi Type-III String Universe with Bulk Viscous Fluid and Constant Deceleration Parameter (DP)**". In this chapter a 5D Bianchi type-III string Universe with bulk viscosity and constant DP in

GR has been constructed by the use of certain physically plausible conditions. The geometrical and physical features that are very important in the study of cosmological evolution are obtained and discussed. The model is expanding, non-hearing, anisotropic for $n \neq 1$ throughout in the late Universe which is in accordance to the present day observational data made by WMAP and COBE. The present model starts with 0 volume at initial epoch $t = 0$ and then expands with accelerated motion and the expansion rate slows down with increase of time. The tension density is negative quantity showing that the string phase disappears and present day Universe is particle dominated that agrees with the present day observational data.

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Chapter-6 deals with the study of the topic entitled **"Higher Dimensional LRS Bianchi Type-I String Cosmological Model with Bulk Viscosity in General Relativity".** In this chapter, a 5-dimensional LRS Bianchi type-I String cosmological model in GTR with bulk viscous fluid is presented, which is an inflationary model. The model Universe obtained in this chapter is anisotropic, accelerating and exponentially expanding. The DP "q" obtained here is decelerating at initial stage and accelerates after some finite time, indicating inflation in the model after an epoch of deceleration which is in accordance with the present day observational scenario of the accelerated expansion of our Universe as type la supernovae[A. Riess et al.(1998), S. Perlmutter et al.(1999)]. The tension density and the particle density are comparable and the model represents a matter dominated Universe in the late time which agrees with the present day observational findings.

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Chapter-7 deals with the study of the topic entitled **"Higher Dimensional Perfect Fluid Cosmological Model in General Relativity with Quadratic Equation of State (EoS)".** In this chapter, we look at a Bianchi type-V cosmology with quadratic EoS direct interaction with perfect fluid in 5-dimensional space-time. The general solutions of EFE were obtained under the assumption of quadratic EoS $p = \alpha\rho^2 - \rho$, where $\alpha \neq 0$ is an arbitrary constant when the DP is treated as a constant quantity. The resulting model expands with accelerated motion, which corresponds to the most recent observational data. The model remains isotropic, non-sharing, and free of the initial singularity throughout its evolution. Isotropic pressure (p) is a negative quantity that decreases as time t passes. Such solutions are consistent with recent observational data, such as SNe Ia. The negative pressure may be a possible cause of the accelerated expansion of the Universe.

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Chapter-8 deals with the study of the topic entitled **"Bianchi Type-I String Cosmological Model in 5-Dimensional space-time interacting with Viscous Fluid"**. In this chapter, by considering bulk viscosity as (i) constant quantity and (ii) functions of cosmic time, the Einstein's field equations, in five dimensional Bianchi type-I model in general theory of relativity have been obtained and solved by the use of certain physical assumptions, which are agreeing with the present observational findings. The model represents an exponentially expanding and accelerating Universe that starts with volume 0 and stops with infinite volume. The model has an initial singularity and will eventually approach the de-Sitter phase $(q = -1)$. It also satisfies the energy conditions $\rho \geq 0$ and $\rho_p \geq 0$. The particle density and string tension density are comparable, but the string tension density vanishes faster than the particle density, leaving only the particles, so our model represents a matter-dominated Universe that agrees with current observational data. The model is anisotropic one and shearing throughout its evolution for $n \neq 1$ but approaches to small isotropy whenever $n = 1$.

Chapter-9 deals with the Findings and Suggestions.

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