Abstract

The present investigation has been carried out towards the fulfilment of the requirements for the award of Ph. D. Degree in Mathematics of Bodoland University, Kokrajhar (Assam), India, under the supervision of Dr. Mukunda Dewri, Asst. Professor, Department of Mathematical Sciences, Bodoland University, Kokrajhar (Assam), India. The thesis entitled "A study on Bianchi Type-III, VI, IX cosmological models in Sen-Dunn scalar-tensor theory of gravitation" comprises of eight chapters.

Chapter - 1 is the introductory part of the work. It comprises a literature review, motivation, aims and objectives of the research work, methodology and tools, and the importance of the study.

Chapter - 2 studies the dark energy cosmological model with variable deceleration parameter in the framework of Sen-Dunn theory for Bianchi type-VI_0 space-time. By considering a particular type of scale factor, the precise solutions to the field equations are achieved, providing a variable deceleration parameter governing the transition from decelerating to the accelerating phase of the universe. The study shows the accelerating universe, which is caused due to the presence of dark energy in the universe with a negative EoS parameter, and the skewness parameter of the model is consistent with the recent observations. Furthermore, the model's various physical and geometrical properties have been discussed and compared with the standard cosmological observation.

(J. Sci. Res. (2021), Volume13(1), 137:143, https://doi.org/10.3329/jsr.v13i1.48479, ISSN: 2070-0237)

Chapter - 3 studies the Bianchi type-IX cosmological model with the presence of viscous fluid in the energy-momentum tensor in Sen-Dunn theory of gravitation. The proportionality of the shear scalar to the expansion scalar is considered to obtain the exact solution of the model. Also, a scale factor producing a variable deceleration parameter is introduced. Here it is assumed that the fluid obeys the equation of state $p = \gamma\rho$ with $0 \leq \gamma \leq 1$, to determine the fluid's viscosity coefficient. The effective pressure for the perfect fluid

remains the same as the isotropic pressure. The model follows that the early universe is highly viscous and later decreases at a late time. The energy condition and statefinder parameter are also discussed, along with the various physical and kinematic properties which is consistent with the recent cosmological observations.

Chapter - 4 studies the Bianchi type-VI_0 cosmological model filled with an electromagnetic field. The exact solution of the model is obtained by considering an intermediate scale factor producing variable deceleration parameter. The behaviour of the intermediate inflationary universe expands at the rate intermediate between that of power law and exponential inflation. Thus, the model represents an expanding universe from zero volume to an infinite volume as time increases. The characteristic behaviour of the model is studied by observing the physical and geometrical properties with cosmological observation. The model represents the presence of dark energy, which accelerates the universe's expansion favouring the dark energy paradigm.

Chapter - 5 is the study of the viscous Bianchi type-III cosmological model with bilinear varying deceleration parameter $q(t) = \frac{\alpha(1-t)}{1+t}$ with $\alpha \geq 0$ in Sen-Dunn theory of gravitation. Here, in this chapter, to obtain the exact solution, the shear scalar proportional to the expansion scalar is induced, and the power law relation between the gauge function and scale factor is taken into account. It is also considered that the fluid obeys the equation of state $p = \gamma\rho$ with $0 \leq \gamma \leq 1$, to determine the fluid's viscosity coefficient. The model's energy density and pressure decrease as time tend to infinity, describing an empty space in the late time. And the coefficient of viscosity also decreases as time increases, showing that the early universe is highly viscous and later reduces at late time. It is observed that the study in this chapter shows similar characteristics that have been discussed in the previous chapter 3.

Chapter - 6 is the study of the magnetized Bianchi type-IX cosmological model with another form of bilinear varying deceleration parameter $q = -\frac{\alpha t}{1+t}$ where $\alpha \geq 0$. Here in this chapter, the magnetic field is introduced in the energy-momentum tensor. The exact solution of the field equation is solved considering the bilinear deceleration parameter

showing the transit from decelerating to accelerating phase. Also, some plausible condition are considered for the simplicity to obtain the exact solution of the model. The model's various physical parameters are studied and found to be consistent with the recent observations. The energy condition in this chapter is quite different from the previous chapter. The energy conditions are satisfied only for a certain period, which is later violated.

Chapter - 7 is the study of the magnetized Bianchi type-III cosmological model. The exact solution of the model is acquired by considering the time-dependent deceleration parameter proposed by Banerjee and Das (2005) defining an exponential expansion of the universe. Also, assesing the expansion scalar propotional to shear scalar and power-law relation the model's various physical and geometrical properties are discussed with the recent observation. The energy condition for the model is discussed along with the statefinder parameter to study the stability and dynamic behaviour of the universe's accelerated expansion. The model here tends to be the standard ΛCDM model.

(Indian J. Sci. Technol.(2022), Volume 15(35),1703-1711, https://doi.org/10.17485/IJST/v15i35.1000, ISSN: 0974-6846)

Chapter - 8 is the summary and concluding remarks of the research work that is mentioned chapter wise and also the future aspects of the work is also mentioned in this chapter.