Chapter 7

CONCLUDING REMARKS AND FUTURE WORK

Inflation became established as the standard model of the very early universe as the outcome of the research in cosmology during the last 28 years and it is now considered to be one of the most important developments in our cosmological understanding. The inflationary scenario has already gone through several stages of development during its short history. Soon after the seminal paper by Guth, taken to mark the birth of the inflation paradigm, several versions of inflation were came up, considering its profound importance in cosmological model building. It is interesting to note that there are now a large number of observations that seem to support the idea of inflation and indicate that it is on the right track. The recent progress in precision observations in astronomy and their predictions are remarkably changed our ideas about the universe. The present decade is witnessing a promotion of cosmology from an area of speculative to an area of experimental science. The precise measurement of the parameters one day will help us to pick up a correct theory while ruling out the others in near future (possibly Planck's Satellite experiment can throw some light).

There are a number of new emerging cosmological phenomena which are in search of an explanation. The existing theories seem incapable of explaining some observed phenomenon or experimental results. There are also some theoretical ideas which are in search of experimental evidence. First of all, inflationary scenario is still changing with new ideas of particle theory. In particular from theoretical point of view, the question of when and how the universe enters into inflationary phase remains to be answered. It remains to be understood what was before inflation and if it is believed that inflation occurred at planck time then a quantum theory of gravity is important, which is yet to emerge. Recent astronomical data when analyzed in the framework of FRW universe some interesting prediction emerge which demands that the present universe is passing through an accelerating phase. One of the attempt to incorporate an accelerating universe is to consider dark energy. However, the nature and its origin are not known in the standard model of particle physics. This demands a new physics with theoretical and experimental research work. Still inflationary models are most acceptable cosmological models of the early universe. Every inflationary model can be tested and many of them have been already ruled out by comparison of their predictions with observational data. However, it is difficult to reject the basic idea of inflation. In this thesis studies on some specific issues related to cosmological models are presented in chapter 2 to 6.

In chapter 2, we have studied the probability of an inflationary universe with or without a pair of primordial black holes(an important astrophysical object)in the modified theory of gravity. If this type of black holes have formed due to quantum fluctuations of matter distribution in the early universe then it is possible to explain

the phenomenon of extra-galactic gamma-rays burst, the presence of ultra high energy cosmic rays etc. because the source of these astrophysical phenomenon might be the mini black holes. In addition to that, these black holes might contribute to the energy density of the present universe and may solve the dark matter problem moreover the choice of the universe determines the existence of PBH in the universe which is evaluated here as a first step.

The present astrophysical observations can be explained fairly well if we consider that the universe is made up of exotic kind of matters. Tachyon is one such exotic matter. In chapter 3, we have studied inflationary universe with tachyon field. It is noted that the tachyonic inflation is permitted for a restricted domain of the values of the field. Our study may provide a little contribution to the cosmological model building of the universe in the presence of tachyonic field.

In chapter 4, we have studied cosmological models with another type of exotic field, called phantom field in an anisotropic Bianchi-I universe with or without a cosmological constant. The exercise reveals that a late accelerating universe is obtained if the kinetic energy of the phantom exceeds a lower limit determined by the anisotropy of an anisotropic universe. A better treatment with phantom field may not be possible until the appearance of phantom field becomes clear. For this purpose we should have a much better handle on quantum gravity.

We have studied inflation in the brane-world model with hyperbolic potential in chapter 5. In the brane-world scenario the prospects of inflation are enhanced on the brane. The inverse coshyperbolic potential was previously considered by some cosmologists to build inflationary model and got good results is taken up here. The

inflationary parameter that are predicted in the model are in good agreement with the current observations. More study will be required in this sector to build a viable cosmological model, which will be taken up in future.

The effects of the bulk viscosity on the dynamics of the brane-world is studied in chapter 6. In the evolution of the early universe, viscosity may play an important role because of considerable effect of viscosity at high matter densities and pressure. It is also observed that the effect of extra-dimensions with viscous fluid increases the rate of expansion of the universe. It is well known that the inclusion of Gauss-Bonnet (GB) term in the Randall-Sundrum type II (RS) brane-world scenario influences inflationary cosmology. Therefore, The effect of viscosity both in the GB regime and in the RS regime are explored here and found a satisfactory description of the late universe. The outcome from this investigation may help in the further study on this property of matter for a cosmological model building of the early universe, with other causal theories for imperfect fluid.

The growing interest on high energy Physics has a positive sign in cosmological model building of the early universe. Perhaps experiment at LHC will reveal some of its predictions. The inflationary model of the universe is 28 years old and it is still very much alive. It is the only theory which explains why our universe is homogeneous, flat and isotropic. It explains the galaxy formation fairly well seems to be in a good agreement with observational data. Thus, let us hope that future studies will offer a much better understanding of the origin and the physical structure of the universe.