Title: Study of Cosmological Solutions in Different Modified Gravity Theories and Their Properties Using Noether Symmetry Analysis

Index No.: 97/22/Maths./27

Abstract : The thesis consists of seven chapters. The first chapter contains a brief introductory overview of the modern cosmology, symmetry approaches, particularly the Noether symmetry, in the context of solving non-linear differential equations. Also in this introductory chapter, minisuperspace in quantum cosmology have been discussed in a particular way.

Chapter two deals with a multi-field cosmological model in a spatially flat FLRW spacetime geometry. Cosmological solutions are obtained using symmetry analysis. The classical solutions are determined after simplifying the Lagrangian using cyclic variables. Finally, Wheeler-DeWitt (WD) equation in quantum cosmology has been formulated and conserved momenta corresponding to Noether symmetry will show the periodic part of the wave function and hence to have the complete integral for the wave function.

In chapter three, we work on the Einstein aether scalar-tensor gravity. The cosmological solutions are analyzed from the observational point of view. Finally, solution of WD equation has been formulated by identifying the periodic nature of the wave function using conserved (Noether) charge.

We have studied the classical and quantum cosmologies for teleparallel dark energy (DE) model in the fourth chapter. Using Noether symmetry analysis, we have determined not only the symmetry vector but also the potential function. Also the symmetry analysis have determined a transformation in the augmented space so that evolution equations become solvable. Finally, WD equation has been formulated in quantum domain.

Chapter five presents scalar tensor and the scalar torsion theories. Noether symmetry analysis has been used to determine the classical cosmological solution. Finally, the nature of the classical solution has been discussed from the observational point of view and the cosmological singularity has been examined both classically and quantum mechanically.

Chapter six deals with $f(T, T_G)$ gravity in the background of homogeneous and isotropic flat FLRW space-time model. The main aim of this work is to examine whether the model supports the observational data or not. Then the solutions are analyzed from the cosmological point of view.

Finally, a brief summary of the work presented in the thesis and a discussion about some possible future prospects has been given in chapter seven.

Dipankar Laya

Dipankar Laya

Sourav Dutta

Dr. Sourav Dutta

(Ph.D. thesis Co-supervisor)

Head, Department Of Mathematics
Dr. Meghnad Saha College

Subenoy Chakraborty 24/06/24

(Ph.D. thesis Supervisor)

Professor
DEPARTMENT OF MATHEMATICS
Jadavpur University
Kolkata – 700 032, West Bengal