

# Table of contents

<b>List of figures</b>	<b>xv</b>
<b>List of tables</b>	<b>xix</b>
<b>1 Introduction</b>	<b>1</b>
1.1 The Big Bang cosmology . . . . .	2
1.2 Inflationary Universe . . . . .	2
1.3 Gravitational Action . . . . .	4
1.4 Modified Einstein Field Equations . . . . .	7
1.4.1 Modification of the Matter sector . . . . .	7
1.4.2 Modification of the Gravitational sector . . . . .	11
1.5 Aim of the Work . . . . .	17
1.6 Methodology: . . . . .	18
1.6.1 Field equations in $f(R)$ -gravity . . . . .	18
1.6.2 Field equations in $f(R, \mathcal{G})$ -gravity . . . . .	18
1.6.3 System of autonomous differential equations . . . . .	19
1.6.4 The Energy Conditions . . . . .	20
<b>2 EU model with viscosity and observational constraints</b>	<b>21</b>
2.1 Introduction . . . . .	21
2.2 Cosmological Solutions with Viscosity . . . . .	23
2.2.1 TIS Theory: . . . . .	24
2.3 Observational constraints on the model parameters . . . . .	26
2.3.1 <b>Stern (<math>H(z) - z</math>) Data Set :</b> . . . . .	27
2.4 Observation of Redshift - Distance modulus data from Supernova Type Ia .	30
2.5 Results obtained . . . . .	32
<b>3 Higher dimensional cosmology with RHDE</b>	<b>37</b>
3.1 Introduction . . . . .	37

3.2	Rényi Holographic Dark Energy models in KK framework . . . . .	38
3.2.1	General idea of Rényi entropy . . . . .	38
3.2.2	Cosmology in KK framework and RHDE correspondence . . . . .	39
3.2.3	Cosmological model of the Universe in KK framework . . . . .	42
3.2.4	Diagnostics and Stability of the cosmological model . . . . .	44
3.2.5	Interacting fluids with RHDE . . . . .	45
3.2.6	Results obtained . . . . .	49
3.3	RHDE Models in Higher Dimensional flat FRW Universe . . . . .	51
3.3.1	General idea of Rényi entropy and RHDE density in Higher Dimen- sions: . . . . .	51
3.3.2	Field equations in Higher Dimensions . . . . .	52
3.3.3	Generalised IR cut-off for RHDE . . . . .	53
3.3.4	Evolution of the Universe with RHDE in different dimensions . . . . .	55
3.3.5	Classical Stability of the model and Diagnostics . . . . .	57
3.3.6	Results obtained . . . . .	59
<b>4</b>	<b>Interacting cosmological models in <math>f(R, \mathcal{G})</math> gravity</b>	<b>61</b>
4.1	Introduction . . . . .	61
4.2	Field equations in $f(R)$ -modified gravity with scalar field coupled to Gauss- Bonnet terms . . . . .	62
4.3	Conservation equations for interacting cosmic fluid components . . . . .	65
4.3.1	Model-I . . . . .	67
4.3.2	Model-II . . . . .	75
4.4	Results obtained . . . . .	79
<b>5</b>	<b>MT wormholes in modified gravity</b>	<b>84</b>
5.1	Introduction . . . . .	84
5.2	Gravitational field equations in $f(R, T)$ modified theory . . . . .	86
5.3	Wormhole Solutions . . . . .	87
5.3.1	Physical Analysis . . . . .	92
5.3.2	Physical Analysis . . . . .	97
5.4	Results obtained . . . . .	99
5.4.1	<b>Model-I : <math>f(R, T) = R + \alpha R^{\frac{1}{2}} + \lambda T</math> gravity:</b> . . . . .	100
5.4.2	<b>Model-II : <math>f(R, T) = R + \alpha R^2 + \lambda T^{\frac{1}{2}}</math> gravity:</b> . . . . .	104
<b>6</b>	<b>Evolution of PBHs in modified <math>f(Q)</math> gravity</b>	<b>106</b>
6.1	Introduction . . . . .	106

---

6.2	Gravitational field equations in $f(Q)$ gravity . . . . .	108
6.3	Evolution of Primordial Black Holes . . . . .	111
6.4	Results obtained . . . . .	117
<b>7</b>	<b>Concluding Remarks and Future Prospective</b>	<b>120</b>
7.1	Summary and Concluding Remarks . . . . .	120
7.2	Future scope of work . . . . .	124
	<b>References</b>	<b>126</b>