

Contents

1	Introduction	1
1.1	Fractional Calculus: An Overview	1
1.2	Preliminaries	2
1.2.1	Special Functions	3
1.2.2	Some Fundamental Properties of Fractional Calculus	5
1.3	Perturbed Differential Equations	9
1.3.1	Classifications of Perturbations	10
1.4	Functional Differential Equations	12
1.5	Nonlocal Condition	13
1.6	Methods	14
1.6.1	Measure of Noncompactness	15
1.6.2	Topological Degree Theory	15
1.6.3	Fixed Point Theorems	16
1.6.4	Semigroup of Bounded Linear Operator	18
1.7	Stability	19
1.7.1	Hyers-Ulam Stability	19
1.7.2	Hyers-Ulam-Rassias Stability	20
1.8	Controllability	20
1.9	Literature Review	21
1.10	Motivation	24
1.11	Overview of the Thesis	25
2	Study of a Nonlinear Hybrid Functional Fractional Differential Equation with Nonlocal Conditions	27
2.1	Introduction	27
2.2	Preliminaries	28
2.3	Existence Result	29
2.3.1	Hypotheses	30
2.3.2	Main Result	30

3	Study of a Nonlinear Volterra-Fredholm Type Hybrid Fractional Differential Equation	36
3.1	Introduction	36
3.2	Preliminaries	37
3.3	Existence Result	39
3.3.1	Hypotheses	39
3.3.2	Main Result	40
3.4	Example	45
4	A Study on an Implicit Hybrid Fractional Differential Equation with p-Laplacian Operator	48
4.1	Introduction	48
4.2	Preliminaries	50
4.3	Existence and Uniqueness Result	51
4.3.1	Hypotheses	54
4.3.2	Main Results	55
4.4	Hyers-Ulam Stability	60
4.5	Example	61
5	Study of an Impulsive Hybrid Fractional Differential Equation with p-Laplacian Operator	66
5.1	Introduction	66
5.2	Preliminaries	67
5.3	Main Results	71
5.4	Stability Results	78
5.4.1	Hyers-Ulam Stability	78
5.4.2	Hyers-Ulam-Rassias Stability	80
5.5	Example	81
6	Existence and Exact Controllability of a Hybrid Evolution Inclusion	83
6.1	Introduction	83
6.2	Preliminaries	84
6.3	Existence Result	86
6.3.1	Hypotheses	86
6.3.2	Main Result	87
6.4	Controllability Result	94
6.5	Example	99

7	Results on a Hybrid Type of Multipoint BVP using Topological Degree Theory	100
7.1	Introduction	100
7.2	Existence Result	102
7.2.1	Hypotheses	102
7.2.2	Main Results	103
7.3	Analytical Example	108
7.4	Example with Numerical Results	109
7.5	Observation	122
8	Conclusion and Future Study	123
	Bibliography	125