

Contents

List of Figures	xiii
Abbreviations	xv
Symbols	xvii
Preface	xviii
1 Introduction	1
1.1 Interval Analysis	2
1.2 Interval-valued Function	5
1.3 Interval Optimization Problems	7
1.4 Preliminaries	11
1.4.1 Interval Arithmetic	11
1.4.2 Basic Properties of Interval Analysis	18
1.4.3 Few Elements of Convex Analysis	22
1.4.4 Some Basic Definitions and Properties of Interval-valued Functions	22
1.5 Literature Survey	24
1.5.1 Literature on Interval Analysis	24
1.5.2 Literature on Calculus of Interval-valued Functions	26
1.5.3 Literature on Interval Optimization Problem	27
1.6 Objective of the Thesis	28
1.7 Organization of the Thesis	29
2 Generalized Hukuhara Gâteaux and Fréchet Derivatives of Interval-valued Functions and their Application in Optimization with Interval-valued Functions	31
2.1 Introduction	31
2.2 Motivation	32
2.3 Contributions	32
2.4 Directional Derivative of Interval-valued Functions	33

2.5	Gâteaux Derivative of Interval-valued Functions	42
2.6	Fréchet Derivatives of Interval-valued Functions	50
2.7	Concluding remarks	60
3	Generalized Hukuhara Clarke Derivative of Interval-valued Functions and its Application in Interval Optimization	63
3.1	Introduction	63
3.2	Motivation	64
3.3	Contributions	64
3.4	Clarke Derivative of Interval-valued Functions	65
3.5	Pseudoconvex and Quasiconvex Interval-valued Functions	79
3.6	Characterization of Efficient Solutions	88
3.7	Concluding Remarks	95
4	Generalized Hukuhara Hadamard Semiderivative of Interval-valued Functions and its Application in Interval Optimization	97
4.1	Introduction	97
4.2	Motivation	98
4.3	Contributions	98
4.4	Hadamard Semiderivative of Interval-valued Function	99
4.5	Characterization of Efficient Solutions	117
4.6	Concluding Remarks	123
5	Generalized Hukuhara Hadamard Dervative of Interval-valued Functions and its Application in Interval Optimization	125
5.1	Introduction	125
5.2	Motivation	126
5.3	Contributions	127
5.4	Hadamard Derivative of Interval-valued Functions	127
5.5	Characterization of Efficient Solutions	140
5.6	Fritz John and Karush-Kuhn-Tucker Optimality Conditions	144
5.7	Concluding Remarks	152
6	Generalized Hukuhara-Dini Semiderivative of Interval-valued Functions and its Application in Interval Optimization Problems	153
6.1	Introduction	153
6.2	Motivation	154
6.3	Contributions	154
6.4	Dini Semiderivative of Interval-valued Functions	155
6.5	Characterization of Efficient Solutions	169
6.6	Concluding Remarks	173
7	Conclusions and future scopes	175

7.1	General conclusions	175
7.2	Contributions of the thesis	176
7.3	Future scopes of studies	179
7.4	Applications of derived concepts in some other fields	180
 A Appendix A		 199
A.1	Proof of the Lemma 1.4	199
A.2	Proof of the Lemma 1.5	200
A.3	Proof of the Lemma 1.6	204
A.4	Proof of the Lemma 1.7	213
A.5	Proof of the Lemma 1.10	214
 B Appendix B		 215
B.1	Proof of the Lemma 2.7	215
 C Appendix C		 227
C.1	Proof of the Lemma 3.1	227
C.2	Proof of the Lemma 3.2	228
C.3	Proof of the Lemma 3.3	229
 D Appendix D		 231
D.1	Proof of the Lemma 4.1	231
D.2	Proof of the Lemma 4.8	232
 E List of Publications		 235