

Contents

Preface	vii
1 Introduction and Problem Formulation	1
2 Existence Theorems for Minimal Points	7
2.1 Problem Formulation	7
2.2 Existence Theorems	8
2.3 Set of Minimal Points	18
2.4 Application to Approximation Problems	19
2.5 Application to Optimal Control Problems	23
Exercises	29
3 Generalized Derivatives	31
3.1 Directional Derivative	31
3.2 Gâteaux and Fréchet Derivatives	37
3.3 Subdifferential	49
3.4 Quasidifferential	57
3.5 Clarke Derivative	67
Exercises	75
4 Tangent Cones	79
4.1 Definition and Properties	79
4.2 Optimality Conditions	88
4.3 A Lyusternik Theorem	95
Exercises	103
5 Generalized Lagrange Multiplier Rule	105
5.1 Problem Formulation	105

5.2	Necessary Optimality Conditions	108
5.3	Sufficient Optimality Conditions	126
5.4	Application to Optimal Control Problems	136
	Exercises	156
6	Duality	159
6.1	Problem Formulation	159
6.2	Duality Theorems	164
6.3	Saddle Point Theorems	168
6.4	Linear Problems	172
6.5	Application to Approximation Problems	175
	Exercises	184
7	Application to Extended Semidefinite Optimization	187
7.1	Löwner Ordering Cone and Extensions	187
7.2	Optimality Conditions	202
7.3	Duality	207
	Exercises	210
8	Direct Treatment of Special Optimization Problems	213
8.1	Linear Quadratic Optimal Control Problems	213
8.2	Time Minimal Control Problems	221
	Exercises	238
A	Weak Convergence	241
B	Reflexivity of Banach Spaces	243
C	Hahn-Banach Theorem	245
D	Partially Ordered Linear Spaces	249
	Bibliography	253
	Answers to the Exercises	275
	Index	289