## **CONTENTS**

Prefac	ce .		•	•		•	•	•		•	•	•	•	•		•	•	•			v
Basic	notation				•	•	•	•	•	•	•	•	•	•		٠	•	•	•	٠	viii
	TRODU																				1
0.1	Function	al ana	ysis																		12
0.2	Different	tial cal	culus																		22
0.3	Convex a	malvsi	s ·																		44
0.4	Differen	tial equ	atior	ıs ·			•								•					•	50
CHA	PTER 1.	NEC	CESS	SAI	RY	' C	10	۷D	IT	O	NS	FO	R	ΑN	١E	ХI	RI	ΞМ	UN	Л	65
1.1	Statemen	nts of t	he pr	oble	ms	and	d fo	rmu	lati	ons	of b	asic	the	ore	ms						65
1.2	Smooth	proble	ms. T	he l	ag	ran	ge n	nult	ipli	er ru	le										77
1.3	Convex	oroble	ms. P	roof	of	the	Ku	hn-	Tuc	ker	the	orei	n								80
1.4	Mixed p	oblem	s. Pro	of c	of th	he e	xtre	ema	l pr	incij	ole	•	•						•	٠	84
CHA	PTER 2.	NEC IN T CUL TRO	THE US	C Ol	L <i>A</i> F	ASS V	SIC AR	CAI IA	L I	PRO ON	OB S	LE AN	M	S C	OF P7	T IM	HE [A]	L L	CC	L- N-	93
2.1	Statemen		_							•											93
2.1	Element	115 01 1	ne pr	COLE	of of	•	•	•			· one	for	· on				· · in	cit	nnle	· ·ct	,,
2.2	problem	ary uc	alace	ion ion	on!	aub		ary Seve	riot	ione	0113	101	an		illei	1141		311	iipic		101
2 2	The Lagi	s or the	e ciass	oicai	The	a E	uso	n va	ara	nae	ean	· atio	'n	•	•	•	•	•	•	Ĭ.	124
2.3	The Pon	talige	movi	5111. 	2 111	rine	uici cinl	-La	orm	nge mlat	ion	and	ni Lalie	cue	· cior		Ċ	•	·		132
2.5	Proof of	the ma	ximu	m p	rin	cipl	e		•												147
CHA	PTER 3.	ELF	EME	NT	S	OF	C	ON	IVI	EΧ	Αì	۱A	LY	/SI	S						161
	Convex																				161
3.2	Convex	functio	ns																		167
3.3	Conjuga	te fund	tions	. Th	e F	enc	hel	-Mo	orea	u th	eor	em									171
3.4	Duality t	heore	ms																		178
3.5	Convex	analysi	s in fi	nite	-diı	mer	ısio	nal	spa	es								•		•	184
СНА	PTER 4.	LOG	CAL	CO	ΟN	[V]	ΕX	A	NA	LY	/SI	S									191
4.1	Homoge	neous	funct	ions	an	d d	ігес	tior	ial d	leriv	ativ	es									191
	Subdiffe																				19€

xii CONTENTS

4.3 Cones of supporting functionals	205
4.4 Locally convex functions	208
4.5 The subdifferentials of certain functions	216
MAXIMUM PRINCIPLE FOR PROBLEMS WI	HE TH
PHASE CONSTRAINTS	224
5.1 Locally convex problems · · · · · · · · · · · · · · · · · · ·	224
5.2 Optimal control problems with phase constraints	233
5.3 Proof of the maximum principle for problems with phase constraints.	
CHAPTER 6. SPECIAL PROBLEMS	255
6.1 Linear programming	255
6.2 The theory of quadratic forms in Hilbert space	258
6.3 Quadratic functionals in the classical caculus of variations	266
6.4 Discrete optimal control problems	277
CHAPTER 7. SUFFICIENT CONDITIONS FOR AN EXTREMU	J <b>M</b> 284
7.1 The perturbation method	284
7.2 Smooth problems	
7.2 Convey problems	299
7.3 Convex problems	303
7.4 Sufficient conditions for an extremum in the classical calculus of variations	303
CHAPTER 8. MEASURABLE MULTIMAPPINGS AND CONV	EX
ANALYSIS OF INTEGRAL FUNCTIONALS .	321
8.1 Multimappings and measurability	321
8.2 Integration of multimappings	334
8.3 Integral functionals	340
CHAPTER 9. EXISTENCE OF SOLUTIONS IN PROBLE	MS
CHAPTER 9. EXISTENCE OF SOLUTIONS IN TROBLE	1410
OF THE CALCULUS OF VARIATIONS AND OP	TI-
OF THE CALCULUS OF VARIATIONS AND OP MAL CONTROL	TI- 354
OF THE CALCULUS OF VARIATIONS AND OF MAL CONTROL	TI- 354 pact-
OF THE CALCULUS OF VARIATIONS AND OF MAL CONTROL	PTI- 354 pact- 354
OF THE CALCULUS OF VARIATIONS AND OF MAL CONTROL	PTI- 354 bact- 354 369
OF THE CALCULUS OF VARIATIONS AND OF MAL CONTROL	PTI- 
OF THE CALCULUS OF VARIATIONS AND OP MAL CONTROL	PTI
OF THE CALCULUS OF VARIATIONS AND OP MAL CONTROL	PTI
OF THE CALCULUS OF VARIATIONS AND OP MAL CONTROL	PTI
OF THE CALCULUS OF VARIATIONS AND OP MAL CONTROL	PTI
OF THE CALCULUS OF VARIATIONS AND OP MAL CONTROL	PTI
OF THE CALCULUS OF VARIATIONS AND OP MAL CONTROL	PTI