

# CONVEX ANALYSIS AND VARIATIONAL PROBLEMS

IVAR EKELAND

*Associate Professor of Mathematics, University of Paris IX*

ROGER TEMAM

*Professor of Mathematics, University of Paris XI*



1976

NORTH-HOLLAND PUBLISHING COMPANY—AMSTERDAM · OXFORD  
AMERICAN ELSEVIER PUBLISHING COMPANY, INC. — NEW YORK

# CONTENTS

## PART ONE

### FUNDAMENTALS OF CONVEX ANALYSIS

Chapter I. Convex functions . . . . .	3
Chapter II. Minimization of convex functions and variational inequalities . . . . .	34
Chapter III. Duality in convex optimization . . . . .	46

## PART TWO

### DUALITY AND CONVEX VARIATIONAL PROBLEMS

Chapter IV. Applications of duality to the calculus of variations (I)	75
Chapter V. Applications of duality to the calculus of variations (II): problems of the type minimal hypersurfaces . . . . .	116
Chapter VI. Duality by the minimax theorem . . . . .	165
Chapter VII. Other applications of duality . . . . .	186

## PART THREE

### RELAXATION AND NON-CONVEX VARIATIONAL PROBLEMS

Chapter VIII. Existence of solutions for variational problems . . . . .	231
Chapter IX. Relaxation of non-convex variational problems (I) . . . . .	263
Chapter X. Relaxation of non-convex variational problems (II) . . . . .	297
Appendix I. An <i>a priori</i> estimate in non-convex programming . . . . .	357
Appendix II. Non-convex optimization problems depending on a parameter . . . . .	375
Comments . . . . .	385
Bibliography . . . . .	391
Index . . . . .	402