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Nota di contenuto	1 The Hahn-Banach Theorem Optimization Problems -- 1.1 The Hahn-Banach Theorem -- 1.2 Applications to the Separation of Convex Sets -- 1.3 The Dual Space C[a,b]* -- 1.4 Applications to the Moment Problem -- 1.5 Minimum Norm Problems and Duality Theory -- 1.6 Applications to ?ebyšev Approximation -- 1.7 Applications to the Optimal Control of Rockets -- 2 Variational Principles and Weak Convergence -- 2.1 The nth Variation -- 2.2 Necessary and Sufficient Conditions for Local Extrema and the Classical Calculus of Variations -- 2.3 The Lack of Compactness in Infinite-Dimensional Banach Spaces -- 2.4 Weak Convergence -- 2.5 The Generalized Weierstrass Existence Theorem -- 2.6 Applications to the Calculus of Variations -- 2.7 Applications to Nonlinear Eigenvalue Problems -- 2.8 Reflexive Banach Spaces -- 2.9 Applications to Convex Minimum Problems and Variational Inequalities -- 2.10 Applications to Obstacle Problems in Elasticity -- 2.11 Saddle Points -- 2.12 Applications to Duality Theory

-- 2.13 The von Neumann Minimax Theorem on the Existence of Saddle Points -- 2.14 Applications to Game Theory -- 2.15 The Ekeland Principle about Quasi-Minimal Points -- 2.16 Applications to a General Minimum Principle via the Palais-Smale Condition -- 2.17 Applications to the Mountain Pass Theorem -- 2.18 The Galerkin Method and Nonlinear Monotone Operators -- 2.19 Symmetries and Conservation Laws (The Noether Theorem) -- 2.20 The Basic Ideas of Gauge Field Theory -- 2.21 Representations of Lie Algebras -- 2.22 Applications to Elementary Particles -- 3 Principles of Linear Functional Analysis -- 3.1 The Baire Theorem -- 3.2 Application to the Existence of Nondifferentiable Continuous Functions -- 3.3 The Uniform Boundedness Theorem -- 3.4 Applications to Cubature Formulas -- 3.5 The Open Mapping Theorem -- 3.6 Product Spaces -- 3.7 The Closed Graph Theorem -- 3.8 Applications to Factor Spaces -- 3.9 Applications to Direct Sums and Projections -- 3.10 Dual Operators -- 3.11 The Exactness of the Duality Functor -- 3.12 Applications to the Closed Range Theorem and to Fredholm Alternatives -- 4 The Implicit Function Theorem -- 4.1 m-Linear Bounded Operators -- 4.2 The Differential of Operators and the Fréchet Derivative -- 4.3 Applications to Analytic Operators -- 4.4 Integration -- 4.5 Applications to the Taylor Theorem -- 4.6 Iterated Derivatives -- 4.7 The Chain Rule -- 4.8 The Implicit Function Theorem -- 4.9 Applications to Differential Equations -- 4.10 Diffeomorphisms and the Local Inverse Mapping Theorem -- 4.11 Equivalent Maps and the Linearization Principle -- 4.12 The Local Normal Form for Nonlinear Double Splitting Maps -- 4.13 The Surjective Implicit Function Theorem -- 4.14 Applications to the Lagrange Multiplier Rule -- 5 Fredholm Operators -- 5.1 Duality for Linear Compact Operators -- 5.2 The Riesz-Schauder Theory on Hilbert Spaces -- 5.3 Applications to Integral Equations -- 5.4 Linear Fredholm Operators -- 5.5 The Riesz-Schauder Theory on Banach Spaces -- 5.6 Applications to the Spectrum of Linear Compact Operators -- 5.7 The Parametrix -- 5.8 Applications to the Perturbation of Fredholm Operators -- 5.9 Applications to the Product Index Theorem -- 5.10 Fredholm Alternatives via Dual Pairs -- 5.11 Applications to Integral Equations and Boundary-Value Problems -- 5.12 Bifurcation Theory -- 5.13 Applications to Nonlinear Integral Equations -- 5.14 Applications to Nonlinear Boundary-Value Problems -- 5.15 Nonlinear Fredholm Operators -- 5.16 Interpolation Inequalities -- 5.17 Applications to the Navier-Stokes Equations -- References -- List of Symbols -- List of Theorems -- List of Most Important Definitions.

Sommario/riassunto

A theory is the more impressive, the simpler are its premises, the more distinct are the things it connects, and the broader is its range of applicability. Albert Einstein There are two different ways of teaching mathematics, namely, (i) the systematic way, and (ii) the application-oriented way. More precisely, by (i), I mean a systematic presentation of the material governed by the desire for mathematical perfection and completeness of the results. In contrast to (i), approach (ii) starts out from the question "What are the most important applications?" and then tries to answer this question as quickly as possible. Here, one walks directly on the main road and does not wander into all the nice and interesting side roads. The present book is based on the second approach. It is addressed to undergraduate and beginning graduate students of mathematics, physics, and engineering who want to learn how functional analysis elegantly solves mathematical problems that are related to our real world and that have played an important role in the history of mathematics. The reader should sense that the theory is being developed, not simply for its own sake, but for the effective solution of concrete problems. viii Preface Our introduction to applied

functional analysis is divided into two parts: Part I: Applications to Mathematical Physics (AMS Vol. 108); Part II: Main Principles and Their Applications (AMS Vol. 109). A detailed discussion of the contents can be found in the preface to AMS Vol. 108.