

Graduate Texts in Mathematics

Barbara D. MacCluer

Elementary Functional Analysis

 Springer

Elementary Functional Analysis

Marat V. Markin



Elementary Functional Analysis:

Elementary Functional Analysis Marat V. Markin, 2018-10-08 While there is a plethora of excellent but mostly tell it all books on the subject this one is intended to take a unique place in what today seems to be a still wide open niche for an introductory text on the basics of functional analysis to be taught within the existing constraints of the standard for the United States one semester graduate curriculum fifteen weeks with two seventy five minute lectures per week The book consists of seven chapters and an appendix taking the reader from the fundamentals of abstract spaces metric vector normed vector and inner product through the basics of linear operators and functionals the three fundamental principles the Hahn Banach Theorem the Uniform Boundedness Principle the Open Mapping Theorem and its equivalents the Inverse Mapping and Closed Graph Theorems with their numerous profound implications and certain interesting applications to the elements of the duality and reflexivity theory Chapter 1 outlines some necessary preliminaries while the Appendix gives a concise discourse on the celebrated Axiom of Choice its equivalents the Hausdorff Maximal Principle Zorn's Lemma and Zermelo's Well Ordering Principle and ordered sets Being designed as a text to be used in a classroom the book constantly calls for the student's actively mastering the knowledge of the subject matter It contains 112 Problems which are indispensable for understanding and moving forward Many important statements are given as problems a lot of these are frequently referred to and used in the main body There are also 376 Exercises throughout the text including Chapter 1 and the Appendix which require of the student to prove or verify a statement or an example fill in necessary details in a proof or provide an intermediate step or a counterexample They are also an inherent part of the material More difficult problems are marked with an asterisk many problem and exercises being supplied with existential hints The book is generous on Examples and contains numerous Remarks accompanying every definition and virtually each statement to discuss certain subtleties raise questions on whether the converse assertions are true whenever appropriate or whether the conditions are essential The prerequisites are set intentionally quite low the students not being assumed to have taken graduate courses in real or complex analysis and general topology to make the course accessible and attractive to a wider audience of STEM science technology engineering and mathematics graduate students or advanced undergraduates with a solid background in calculus and linear algebra With proper attention given to applications plenty of examples problems and exercises this well designed text is ideal for a one semester graduate course on the fundamentals of functional analysis for students in mathematics physics computer science and engineering Contents Preliminaries Metric Spaces Normed Vector and Banach Spaces Inner Product and Hilbert Spaces Linear Operators and Functionals Three Fundamental Principles of Linear Functional Analysis Duality and Reflexivity The Axiom of Choice and Equivalents

Elementary Functional Analysis Barbara MacCluer, 2008-10-20 Functional analysis arose in the early twentieth century and gradually conquering one stronghold after another became a nearly universal mathematical doctrine not merely a new area of mathematics but a new mathematical

world view Its appearance was the inevitable consequence of the evolution of all of nineteenth century mathematics in particular classical analysis and mathematical physics Its original basis was formed by Cantor's theory of sets and linear algebra Its existence answered the question of how to state general principles of a broadly interpreted analysis in a way suitable for the most diverse situations A M Vershik 45 p 438 This text evolved from the content of a one semester introductory course in functional analysis that I have taught a number of times since 1996 at the University of Virginia My students have included first and second year graduate students preparing for thesis work in analysis algebra or topology graduate students in various departments in the School of Engineering and Applied Science and several undergraduate mathematics or physics majors After a first draft of the manuscript was completed it was also used for an independent reading course for several undergraduate and graduates preparing for graduate school

Elementary Functional Analysis Georgi E. Shilov, 2013-04-15 Introductory text covers basic structures of mathematical analysis linear spaces metric spaces normed linear spaces etc differential equations orthogonal expansions Fourier transforms and more Includes problems with hints and answers Bibliography 1974 edition

Functional Analysis Markus Haase, 2014-09-17 This book introduces functional analysis at an elementary level without assuming any background in real analysis for example on metric spaces or Lebesgue integration It focuses on concepts and methods relevant in applied contexts such as variational methods on Hilbert spaces Neumann series eigenvalue expansions for compact self adjoint operators weak differentiation and Sobolev spaces on intervals and model applications to differential and integral equations Beyond that the final chapters on the uniform boundedness theorem the open mapping theorem and the Hahn Banach theorem provide a stepping stone to more advanced texts The exposition is clear and rigorous featuring full and detailed proofs Many examples illustrate the new notions and results Each chapter concludes with a large collection of exercises some of which are referred to in the margin of the text tailor made in order to guide the student digesting the new material Optional sections and chapters supplement the mandatory parts and allow for modular teaching spanning from basic to honors track level

Elementary Functional Analysis Georgii Evgen'evich Shilov, 1974 **Elementary Functional Analysis**, 1974 *Mathematical Analysis* G.E. Shilov, R.A. Silverman, 1974 **Mathematical Analysis: Elementary functional analysis** Georgii Evgen'evich Shilov, 1973 *Elementary Functional Analysis* Charles W Swartz, 2009-07-13 This text is an introduction to functional analysis which requires readers to have a minimal background in linear algebra and real analysis at the first year graduate level Prerequisite knowledge of general topology or Lebesgue integration is not required The book explains the principles and applications of functional analysis and explores the development of the basic properties of normed linear inner product spaces and continuous linear operators defined in these spaces Though Lebesgue integral is not discussed the book offers an in depth knowledge on the numerous applications of the abstract results of functional analysis in differential and integral equations Banach limits harmonic analysis summability and numerical integration Also

covered in the book are versions of the spectral theorem for compact symmetric operators and continuous self adjoint operators

Elementary Functional Analysis, Engl Georgij E. Šilov, 1974 *Applied Functional Analysis* Eberhard Zeidler, 1995-08-30 The second part of an elementary textbook which combines linear functional analysis nonlinear functional analysis and their substantial applications The book addresses undergraduates and beginning graduates of mathematics physics and engineering who want to learn how functional analysis elegantly solves mathematical problems which relate to our real world and which play an important role in the history of mathematics The books approach is to attempt to determine the most important applications These concern integral equations differential equations bifurcation theory the moment problem Cebyshev approximation the optimal control of rockets game theory symmetries and conservation laws the quark model and gauge theory in elementary particle physics The presentation is self contained and requires only that readers be familiar with some basic facts of calculus

Functional Analysis Sergei Ovchinnikov, 2018-06-29 This concise text provides a gentle introduction to functional analysis Chapters cover essential topics such as special spaces normed spaces linear functionals and Hilbert spaces Numerous examples and counterexamples aid in the understanding of key concepts while exercises at the end of each chapter provide ample opportunities for practice with the material Proofs of theorems such as the Uniform Boundedness Theorem the Open Mapping Theorem and the Closed Graph Theorem are worked through step by step providing an accessible avenue to understanding these important results The prerequisites for this book are linear algebra and elementary real analysis with two introductory chapters providing an overview of material necessary for the subsequent text Functional Analysis offers an elementary approach ideal for the upper undergraduate or beginning graduate student Primarily intended for a one semester introductory course this text is also a perfect resource for independent study or as the basis for a reading course

Functional Analysis Michel Willem, 2013-08-13 The goal of this work is to present the principles of functional analysis in a clear and concise way The first three chapters of Functional Analysis Fundamentals and Applications describe the general notions of distance integral and norm as well as their relations The three chapters that follow deal with fundamental examples Lebesgue spaces dual spaces and Sobolev spaces Two subsequent chapters develop applications to capacity theory and elliptic problems In particular the isoperimetric inequality and the Plya Szeg and Faber Krahm inequalities are proved by purely functional methods The epilogue contains a sketch of the history of functional analysis in relation with integration and differentiation Starting from elementary analysis and introducing relevant recent research this work is an excellent resource for students in mathematics and applied mathematics

Functional Analysis Joseph Muscat, 2014-07-23 This textbook is an introduction to functional analysis suited to final year undergraduates or beginning graduates Its various applications of Hilbert spaces including least squares approximation inverse problems and Tikhonov regularization should appeal not only to mathematicians interested in applications but also to researchers in related fields Functional Analysis adopts a self contained approach to Banach spaces and operator theory that covers the main topics

based upon the classical sequence and function spaces and their operators. It assumes only a minimum of knowledge in elementary linear algebra and real analysis; the latter is redone in the light of metric spaces. It contains more than a thousand worked examples and exercises which make up the main body of the book.

Basic Methods of Linear Functional Analysis John D. Pryce, 2011-01-01. An introduction to the themes of mathematical analysis; this text is geared toward advanced undergraduate and graduate students. Topics include operators, function spaces, Hilbert spaces, and elementary Fourier analysis. The author has a delightfully lively style which makes the book very readable, and there are numerous interesting and instructive problems. Edinburgh Math Society, 1973 edition.

Essential Results of Functional Analysis Robert J. Zimmer, 1990-01-15. Functional analysis is a broad mathematical area with strong connections to many domains within mathematics and physics. This book, based on a first-year graduate course taught by Robert J. Zimmer at the University of Chicago, is a complete, concise presentation of fundamental ideas and theorems of functional analysis. It introduces essential notions and results from many areas of mathematics to which functional analysis makes important contributions, and it demonstrates the unity of perspective and technique made possible by the functional analytic approach. Zimmer provides an introductory chapter summarizing measure theory and the elementary theory of Banach and Hilbert spaces, followed by a discussion of various examples of topological vector spaces, seminorms defining them, and natural classes of linear operators. He then presents basic results for a wide range of topics: convexity and fixed point theorems, compact operators, compact groups, and their representations, spectral theory of bounded operators, ergodic theory, commutative C^* -algebras, Fourier transforms, Sobolev embedding theorems, distributions, and elliptic differential operators. In treating all of these topics, Zimmer's emphasis is not on the development of all related machinery or on encyclopedic coverage, but rather on the direct, complete presentation of central theorems and the structural framework and examples needed to understand them. Sets of exercises are included at the end of each chapter. For graduate students and researchers in mathematics who have mastered elementary analysis, this book is an entrance and reference to the full range of theory and applications in which functional analysis plays a part. For physics students and researchers interested in these topics, the lectures supply a thorough mathematical grounding.

A Short Course on Spectral Theory William Arveson, 2001-11-09. This book presents the basic tools of modern analysis within the context of the fundamental problem of operator theory: to calculate spectra of specific operators on infinite-dimensional spaces, especially operators on Hilbert spaces. The tools are diverse and they provide the basis for more refined methods that allow one to approach problems that go well beyond the computation of spectra: the mathematical foundations of quantum physics, noncommutative K -theory, and the classification of simple C^* -algebras, being three areas of current research activity which require mastery of the material presented here.

Quantum Functional Analysis Aleksandr I. A. Khelemskiĭ, 2010. Interpreting quantized coefficients as finite rank operators in a fixed Hilbert space allows the author to replace matrix computations with algebraic techniques of module theory and tensor

products thus achieving a more invariant approach to the subject *Applications of Functional Analysis and Operator Theory* V. Hutson, J. Pym, M. Cloud, 2005-02-08 Functional analysis is a powerful tool when applied to mathematical problems arising from physical situations The present book provides by careful selection of material a collection of concepts and techniques essential for the modern practitioner Emphasis is placed on the solution of equations including nonlinear and partial differential equations The assumed background is limited to elementary real variable theory and finite dimensional vector spaces Provides an ideal transition between introductory math courses and advanced graduate study in applied mathematics the physical sciences or engineering Gives the reader a keen understanding of applied functional analysis building progressively from simple background material to the deepest and most significant results Introduces each new topic with a clear concise explanation Includes numerous examples linking fundamental principles with applications Solidifies the reader's understanding with numerous end of chapter problems

Decoding **Elementary Functional Analysis**: Revealing the Captivating Potential of Verbal Expression

In an era characterized by interconnectedness and an insatiable thirst for knowledge, the captivating potential of verbal expression has emerged as a formidable force. Its power to evoke sentiments, stimulate introspection, and incite profound transformations is genuinely awe-inspiring. Within the pages of "**Elementary Functional Analysis**," a mesmerizing literary creation penned by a celebrated wordsmith, readers embark on an enlightening odyssey, unraveling the intricate significance of language and its enduring affect our lives. In this appraisal, we shall explore the book's central themes, evaluate its distinctive writing style, and gauge its pervasive influence on the hearts and minds of its readership.

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Elementary Functional Analysis Introduction

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