Functional Analysis
An Elementary Introduction

Markus Haase

Elementary Functional Analysis

Charles W Swartz
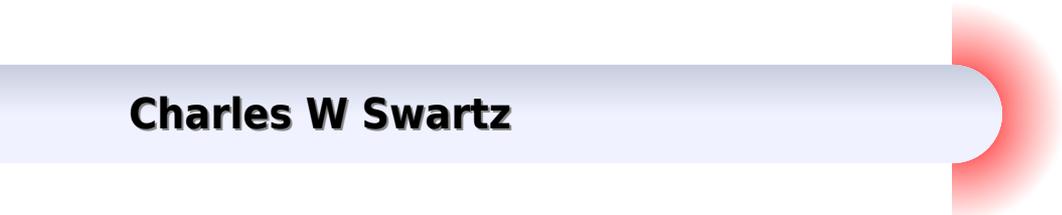
Elementary Functional Analysis:

   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 fu tional analysis that I have taught a number of times since 1996 at the University of Virginia My students have included rst and second year graduate students prep ing for thesis work in analysis algebra or topology graduate students in various departments in the School of Engineering and Applied Science and several und graduate mathematics or physics majors After a rst draft of the manuscript was completed it was also used for an independent reading course for several und graduates preparing for graduate school   *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 Zermello 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 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   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** Georgi Eugen Shilov (Mathématicien.),1974   **Elementary Functional Analysis** Georgii Evgen'evich Shilov,1974   *Elementary Functional Analysis* Georgi E. Shilov,Gueorgi Evguenievitch Chilov,1996-01-01 In this introductory work on mathematical analysis the noted mathematician Georgi E Shilov begins with an extensive and important chapter on the basic structures of mathematical analysis   Elementary Functional Analysis ,1974   *Functional Analysis* Sergei Ovchinnikov,2018-06-09 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 *Mathematical Analysis* G.E. Shilov,R.A. Silverman,1974 *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 P lya Szeg and Faber Krahn 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 **Mathematical Analysis: Elementary functional analysis** Georgiĭ Evgenʹevich Shilov,1973 **Beginning Functional Analysis** Karen Saxe,2013-04-17 This book is designed as a text for a first course on functional analysis for ad vanced undergraduates or for beginning graduate students It can be used in the undergraduate curriculum for an honors seminar or for a capstone course It can also be used for self study or independent study The course prerequisites are few but a certain degree of mathematical sophistication is required A reader must have had the equivalent of a first real analysis course as might be taught using 25 or 109 and a first linear algebra course Knowledge of the Lebesgue integral is not a prerequisite Throughout the book we use elementary facts about the complex numbers these are gathered in Appendix A In one spe cific place Section 5 3 we require a few properties of analytic functions These are usually taught in the first half of an undergraduate complex analysis course Because we want this book to be accessible to students who have not taken a course on complex function theory a complete description of the needed results is given However we do not prove these results *Elementary Functional Analysis, Engl* Georgij E. Šilov,1974 **Basic Methods of Linear Functional Analysis** John D. Pryce,2014-05-05 Introduction to the themes of mathematical analysis geared toward advanced undergraduate and graduate students Topics include operators function spaces Hilbert spaces and elementary Fourier analysis Numerous exercises and worked examples 1973 edition **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 **Functional Analysis I** Yu.I. Lyubich,2013-03-09 Up to a certain time the attention of mathematicians was concentrated on the study of individual objects for example specific elementary functions or curves defined by special equations With the creation of the method of Fourier series which allowed mathematicians to work with arbitrary functions the individual approach was replaced by the class approach in which a particular function is considered only as an element of some function space More or less simultane ously the development of geometry and algebra led to the general concept of a linear space while in analysis the basic forms of convergence for series of functions were identified uniform mean square pointwise and so on It turns out moreover that a specific type of convergence is associated with each linear function space for example uniform convergence in the case of the space of continuous functions on a closed interval It was only comparatively recently that in this connection the general idea of a linear topological space L TS l was formed here the algebraic structure is compatible with the topological structure in the sense that the basic operations addition and multiplication by a scalar are continuous *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 Cebysev 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 **Lectures and Exercises on Functional Analysis** Александр Яковлевич Хелемский, The book is based on courses taught by the author at Moscow State University Compared to many other books on the subject it is unique in that the exposition is based on extensive use of the language and elementary constructions of category theory Among topics featured in the book are the theory of Banach and Hilbert tensor products the theory of distributions and weak topologies and Borel operator calculus The book contains many examples illustrating the general theory presented as well as multiple exercises that help the reader to learn the subject It can be used as a textbook

on selected topics of functional analysis and operator theory Prerequisites include linear algebra elements of real analysis and elements of the theory of metric spaces   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

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