Basic Classes Of Linear Operators 1st Edition

The Surveys series of the AMS features some of the Society's most distinguished titles. This monograph has been specially priced for a bookshop audience and features the work of two prominent US mathematicians.

This book focuses on the theory of linear operators on non-Archimedean Banach spaces. The topics treated in this book range from a basic introduction to non-Archimedean valued fields, free non-Archimedean Banach spaces, bounded and unbounded linear operators in the non-Archimedean setting, to the spectral theory for some classes of linear operators. The theory of Fredholm operators is emphasized and used as an important tool in the study of the spectral theory of non-Archimedean operators. Explicit descriptions of the spectra of some operators are worked out. Moreover, detailed background materials on non-Archimedean valued fields and free non-Archimedean Banach spaces are included for completeness and for reference. The readership of the book is aimed toward graduate and postgraduate students, mathematicians, and non-mathematicians such as physicists and engineers who are interested in non-Archimedean functional analysis. Further, it can be used as an introduction to the study of non-Archimedean operator theory in general and to the study of spectral theory in other special cases.

Most books on linear operators are not easy to follow for students and researchers without an extensive background in mathematics. Self-contained and using only matrix theory, Invitation to Linear Operators: From Matricies to Bounded Linear Operators on a Hilbert Space explains in easy-to-follow steps a variety of interesting recent results on linear operators on a Hilbert space. The author first states the important properties of a Hilbert space, then sets out the fundamental properties of bounded linear operators on a Hilbert space. The final section presents some of the more recent developments in bounded linear operators.

The Backward Shift on the Hardy Space

Basic Classes of Linear Operators

Israel Gohberg and Friends

Special Classes of Linear Operators and Other Topics 11th International Conference on Operator Theory, Bucharest (romania), June 2-12, 1986

Perturbation theory for linear operators

This wide ranging but self-contained account of the spectral theory of non-self-adjoint linear operators is ideal for postgraduate students and researchers, and contains many illustrative examples and exercises. Fredholm theory, Hilbert-Schmidt and trace class operators are discussed, as are one-parameter semigroups and perturbations of their generators. Two chapters are devoted to using these tools to analyze Markov semigroups. The text also provides a thorough account of the new theory of pseudospectra, and presents the recent analysis by the author and Barry Simon of the form of the pseudospectra at the boundary of the numerical range. This was a key ingredient in the determination of properties of the zeros of certain orthogonal polynomials on the unit circle. Finally, two methods, both very recent, for obtaining bounds on the eigenvalues of non-self-adjoint Schrodinger operators are described. The text concludes with a description of the surprising spectral properties of the non-self-adjoint harmonic oscillator.

This book is an introduction to the subject and is devoted to standard material on linear functional analysis, and presents some ergodic theorems for classes of operators containing the quasi-compact operators. It discusses various classes of operators connected with the numerical range.

The book presents an introduction to the geometry of Hilbert spaces and operator theory, targeting graduate and senior undergraduate students of mathematics. Major topics discussed in the book are inner product spaces, linear operators, spectral theory and special classes of operators, and Banach spaces. On vector spaces, the structure of inner product is imposed. After discussing geometry of Hilbert spaces, its applications to diverse branches of mathematics have been studied. Along the way are introduced orthogonal polynomials and their use in Fourier series and approximations. Spectrum of an operator is the key to the understanding of the operator. Properties of the spectrum of different classes of operators, such as normal operators, self-adjoint operators, unitaries, isometries and compact operators have been discussed. A large number of examples of operators, along with their spectrum and its splitting into point spectrum, continuous spectrum, residual spectrum, approximate point spectrum and compression spectrum, have been worked out. Spectral theorems for self-adjoint operators, and normal operators, follow the spectral theorem for compact normal operators. The book also discusses invariant subspaces with special attention to the Volterra operator and unbounded operators. In order to make the text as accessible as possible, motivation for the topics is introduced and

a greater amount of explanation than is usually found in standard texts on the subject is provided. The abstract theory in the book is supplemented with concrete examples. It is expected that these features will help the reader get a good grasp of the topics discussed. Hints and solutions to all the problems are collected at the end of the book. Additional features are introduced in the book when it becomes imperative. This spirit is kept alive throughout the book.

In Honor of Rien Kaashoek

Classes of Linear Operators Vol. I

Classes of Linear Operators on Pseudo-Hilbert and Applications

Denseness and Bases with Applications

Elements of Hilbert Spaces and Operator Theory

A comprehensive graduate textbook that introduces functional analysis with an emphasis on the theory of linear operators and its application to differential equations, integral equations, infinite systems of linear equations, approximation theory, and numerical analysis. As a textbook designed for senior undergraduate and graduate students, it begins with the geometry of Hilbert spaces and proceeds to the theory of linear operators on these spaces including Banach spaces. Presented as a natural continuation of linear algebra, the book provides a firm foundation in operator theory which is an essential part of mathematical training for students of mathematics, engineering, and other technical sciences.

This book discusses the important aspects of spectral theory, in particular, the completeness of generalised eigenvectors, Riesz bases, semigroup theory, families of analytic operators, and Gribov operator acting in the Bargmann space. Recent mathematical developments of perturbed non-self-adjoint operators are discussed with the completeness of the space of generalized eigenvectors, bases on Hilbert and Banach spaces and asymptotic behavior of the eigenvalues of these operators. Most results in the book are motivated by physical problems, such as the perturbation method for sound radiation by a vibrating plate in a light fluid, Gribov operator in Bargmann space and other applications in mathematical physics and mechanics. This book is intended for students, researchers in the field of spectral theory of linear non self-adjoint operators, pure analysts and mathematicians.

This volume is dedicated to Rien Kaashoek on the occasion of his 80th birthday and celebrates his many contributions to the field of operator theory during more than fifty years. In the first part of the volume, biographical information and personal accounts on the life of Rien Kaashoek are presented. Eighteen research papers by friends and colleagues of Rien Kaashoek are included in the second part. Contributions by J. Agler, Z.A. Lykova, N.J. Young, J.A. Ball, G.J. Groenewald, S. ter Horst, H. Bart, T. Ehrhardt, B. Silbermann, J.M. Bogoya, S.M. Grudsky, I.S. Malysheva, A. Böttcher, E. Wegert, Z. Zhou, Y. Eidelman, I. Haimovici, A.E. Frazho, A.C.M. Ran, B. Fritzsche, B. Kirstein, C.Madler, J. J. Jaftha, D.B. Janse van Rensburg, P. Junghanns, R. Kaiser, J. Nemcova, M. Petreczky, J.H. van Schuppen, L. Plevnik, P. Semrl, A. Sakhnovich, F.-O. Speck, S. Sremac, H.J. Woerdeman, H. Wolkowicz and N. Vasilevski.

Selected Topics in Complex Analysis

The S. Ya. Khavinson Memorial Volume

Classes of linear operators on pseudo-Hilbert spaces and applications. 1

Classes of Linear Operators

Approximation Theory Using Positive Linear Operators

Some of the results on automatic continuity of intertwining operators and homomorphisms that were obtained between 1960 and 1973 are here collected together to provide a detailed discussion of the subject. The book will be appreciated by graduate students of functional analysis who already have a good foundation in this and in the theory of Banach algebras.

In this monograph, we combine operator techniques with state space methods to solve factorization, spectral estimation, and interpolation problems arising in control and signal processing. We present both the theory and algorithms with some Matlab code to solve these problems. A classical approach to spectral factorization problems in control theory is based on Riccati equations arising in linear quadratic control theory and Kalman ?ltering. One advantage of this approach is that it readily leads to algorithms in the non-degenerate case. On the other hand, this approach does not easily generalize to the nonrational case, and it is not always transparent where the Riccati equations are coming from. Operator theory has developed some elegant methods to prove the existence of a solution to some of these factorization and spectral estimation problems in a very general setting. However, these techniques are in general not used to develop computational algorithms. In this monograph, we will use operator theory with state space methods to derive computational methods to solve factorization, sp- tral estimation, and interpolation problems. It is emphasized that our approach is geometric and the algorithms are obtained as a special application of the theory. We will present two methods for spectral factorization. One method derives al- rithms based on ?nite sections of a certain Toeplitz matrix. The other approach uses operator theory to develop the Riccati factorization method. Finally, we use isometric extension techniques to solve some interpolation problems.

After the book "Basic Operator Theory" by Gohberg-Goldberg was pub lished, we, that is the present authors, intended to continue with another book which would show the readers the large variety of classes of operators and the important role they play in applications. The book was planned to be of modest size, but due to the profusion of results in this area of analysis, the number of topics grew larger than ex pected. Consequently, we decided to divide the material into two volumes - the first volume being presented now. During the past years, courses and seminars were given at our respective in stitutions based on parts of the texts. These were well received by the audience and enabled us to make appropriate choices for the topics and presentation for the two vol umes. We would like to thank G.J. Groenewald, A.B. Kuijper and A.C.M. Ran of the Vrije Universiteit at Amsterdam, who provided us with lists of remarks and corrections. We are now aware that the Basic Operator

Theory book should be revised so that it may suitably fit in with our present volumes. This revision is planned to be the last step of an induction and not the first.
Partially Observable Linear Systems Under Dependent Noises
Spectral Theory of Linear Operators and Spectral Systems in Banach Algebras
From Matrices to Bounded Linear Operators on a Hilbert Space
Linear Operators in Hilbert Spaces
Classes of linear operators on pseudo-Hilbert spaces and applications. 2
This is the first volume of a collection of original and review articles on recent advances and new directions in a multifaceted and interconnected area of mathematics and its applications. It encompasses many topics in theoretical developments in operator theory and its diverse applications in applied mathematics, physics, engineering, and other disciplines. The purpose is to bring in one volume many important original results of cutting edge research as well as authoritative review of recent achievements, challenges, and future directions in the area of operator theory and its applications.
This volume opens with a paper by V.P. Havin that presents a comprehensive survey of the work of mathematician S.Ya. Khavinson. It includes a complete bibliography, previously unpublished, of 163 items, and twelve peer-reviewed research and expository papers by leading mathematicians, including the joint paper by Khavinson and T.S. Kuzina. The emphasis is on the usage of tools from functional analysis, potential theory, algebra, and topology.
This self-contained book provides the reader with a comprehensive presentation of recent investigations on operator theory over non-Archimedean Banach and Hilbert spaces. This includes, non-Archimedean valued fields, bounded and unbounded linear operators, bilinear forms, functions of linear operators and one-parameter families of bounded linear operators on free branch spaces.
Perturbation Theory for Linear Operators
Introduction to Linear Operator Theory
On the Occasion of his 80th Birthday
Classes of Linear Operators Vol. 1 and 2
Multivalued Linear Operators

rii application of linear operators on a Hilbert space. We begin with a chapter on the geometry of Hilbert space and then proceed to the spectral theory of compact self adjoint operators; operational calculus is next presented as a nat ural outgrowth of the spectral theory. The second part of the text concentrates on Banach spaces and linear operators acting on these spaces. It includes, for example, the three 'basic principles of linear analysis and the Riesz Fredholm theory of compact operators. Both parts contain plenty of applications. All chapters deal exclusively with linear problems, except for the last chapter which is an introduction to the theory of nonlinear operators. In addition to the standard topics in functional anal ysis, we have presented relatively recent results which appear, for example, in Chapter VII. In general, in writ ing this book, the authors were strongly influenced by re cent developments in operator theory which affected the choice of topics, proofs and exercises. One of the main features of this book is the large number of new exercises chosen to expand the reader's com prehension of the material, and to train him or her in the use of it. In the beginning portion of the book we offer a large selection of computational exercises; later, the proportion of exercises dealing with theoretical questions increases. We have, however, omitted exercises after Chap ters V, VII and XII due to the specialized nature of the subject matter.
This English edition is almost identical to the German original Lineare Operatoren in Hilbertriiumen, published by B. G. Teubner, Stuttgart in 1976. A few proofs have been simplified, some additional exercises have been included, and a small number of new results has been added (e.g., Theorem 11.11 and Theorem 11.23). In addition a great number of minor errors has been corrected. Frankfurt, January 1980 J. Weidmann vii Preface to the German edition The purpose of this book is to give an introduction to the theory of linear operators on Hilbert spaces and then to proceed to the interesting applica tions of differential operators to mathematical physics. Besides the usual introductory courses common to both mathematicians and physicists, only a fundamental knowledge of complex analysis and of ordinary differential equations is assumed. The most important results of Lebesgue integration theory, to the extent that they are used in this book, are compiled with complete proofs in Appendix A. I hope therefore that students from the fourth semester on will be able to read this book without major difficulty. However, it might also be of some interest and use to the teaching and research mathematician or physicist, since among other things it makes easily accessible several new results of the spectral theory of differential operators.
Constructs a theoretical framework for the study of linear relations and provides underlying concepts, rules, formulae, theorems and techniques. The book compares the inversion, adjoints, completion and closure of various classes of linear operators. It highlights compact and precompact relations.
Non-Archimedean Linear Operators and Applications
Topics in Operator Theory
Factorization of Matrix and Operator Functions: The State Space Method
Linear Operators and their Spectra

Basic Operator Theory provides an introduction to functional analysis with an emphasis on the theory of linear operators and its application to differential and integral equations, approximation theory, and numerical analysis. A textbook designed for senior undergraduate and graduate students, Basic Operator Theory begins with the geometry of Hilbert space and proceeds to the spectral theory for compact self-adjoint operators with a wide range of applications. Part of the volume is devoted to Banach spaces and operators acting on these spaces. Presented as a natural continuation of linear algebra, Basic Operator Theory provides a firm foundation in operator theory, an essential part of mathematical

training for students of mathematics, engineering, and other technical sciences.
The second edition of this textbook presents the basic mathematical knowledge and skills that are needed for courses on modern theoretical physics, such as those on quantum mechanics, classical and quantum field theory, and related areas. The authors stress that learning mathematical physics is not a passive process and include numerous detailed proofs, examples, and over 200 exercises, as well as hints linking mathematical concepts and results to the relevant physical concepts and theories. All of the material from the first edition has been updated, and five new chapters have been added on such topics as distributions, Hilbert space operators, and variational methods. The text is divided into three parts: - Part I: A brief introduction to (Schwartz) distribution theory. Elements from the theories of ultra distributions and (Fourier) hyperfunctions are given in addition to some deeper results for Schwartz distributions, thus providing a rather comprehensive introduction to the theory of generalized functions. Basic properties and methods for distributions are developed with applications to constant coefficient ODEs and PDEs. The relation between distributions and holomorphic functions is considered, as well as basic properties of Sobolev spaces. - Part II: Fundamental facts about Hilbert spaces. The basic theory of linear (bounded and unbounded) operators in Hilbert spaces and special classes of linear operators - compact, Hilbert-Schmidt, trace class, and Schrödinger operators, as needed in quantum physics and quantum information theory – are explored. This section also contains a detailed spectral analysis of all major classes of linear operators, including completeness of generalized eigenfunctions, as well as of (completely) positive mappings, in particular quantum operations. - Part III: Direct methods of the calculus of variations and their applications to boundary- and eigenvalue-problems for linear and nonlinear partial differential operators. The authors conclude with a discussion of the Hohenberg-Kohn variational principle. The appendices contain proofs of more general and deeper results, including completions, basic facts about metrizable Hausdorff locally convex topological vector spaces, Baire's fundamental results and their main consequences, and bilinear functionals. Mathematical Methods in Physics is aimed at a broad community of graduate students in mathematics, mathematical physics, quantum information theory, physics and engineering, as well as researchers in these disciplines. Expanded content and relevant updates will make this new edition a valuable resource for those working in these disciplines.
This book is based on lectures given at "Mekhmat", the Department of Mechanics and Mathematics at Moscow State University, one of the top mathematical departments worldwide, with a rich tradition of teaching functional analysis. Featuring an advanced course on real and functional analysis, the book presents not only core material traditionally included in university courses of different levels, but also a survey of the most important results of a more subtle nature, which cannot be considered basic but which are useful for applications. Further, it includes several hundred exercises of varying difficulty with tips and references. The book is intended for graduate and PhD students studying real and functional analysis as well as mathematicians and physicists whose research is related to functional analysis.
Real and Functional Analysis
11th International Conference on Operator Theory Bucharest (Romania) June 2–12, 1986
Special Classes of Linear Operators and Other Topics
Distributions, Hilbert Space Operators, Variational Methods, and Applications in Quantum Physics
Operator Theory, Analysis and the State Space Approach

These two volumes constitute texts for graduate courses in linear operator theory. The reader is assumed to have a knowledge of both complex analysis and the first elements of operator theory. The texts are intended to concisely present a variety of classes of linear operators, each with its own character, theory, techniques and tools. For each of the classes, various differential and integral operators motivate or illustrate the main results. Although each class is treated seperately and the first impression may be that of many different theories, interconnections appear frequently and unexpectedly. The result is a beautiful, unified and powerful theory. The classes we have chosen are representatives of the principal important classes of operators, and we believe that these illustrate the richness of operator theory, both in its theoretical developments and in its applicants. Because we wanted the books to be of reasonable size, we were selective in the classes we chose and restricted our attention to the main features of the corresponding theories. However, these theories have been updated and enhanced by new developments, many of which appear here for the first time in an operator-theory text. In the selection of the material the taste and interest of the authors played an important role.
This book delineates the various types of factorization problems for matrix and operator functions. The problems originate from, or are motivated by, the theory of non-selfadjoint operators, the theory of matrix polynomials, mathematical systems and control theory, the theory of Riccati equations, inversion of convolution operators, and the theory of job scheduling in operations research. The book presents a geometric principle of factorization which has its origins in the state space theory of linear input-output systems and in the theory of characteristic operator functions.
The Operator Theory conferences, organized by the Department of Mathematics of INCREST and the University of Timi~oara, are conceived as a means to promote cooperation and exchange of information between specialists in all areas of operator theory. This volume consists of a careful selec£ion of papers contributed by the participants of the 1986 Conference. They reflect most of the topics dealt with by the modern operator theory, including recent advances in dual operator algebras and the fnvariant subspace problem, operators in indefinite metric spaces, hyponormal, quasi triangular and decomposable operators, various problems in C*- and W*-algebras and so on. The research contracts of the Department of Mathematics of INCREST with the National Council for Science and Technology of Romania provided the means for developing the research activity in mathematics; they represent the generous framework of these meetings, too. It is our pleasure to acknowledge the financial support of UNESCO which also contributed to the success of this meeting. We are indebted to Professor Israel Gohberg for including these Proceedings in the OT Series and for valuable advice in the editing process. Birkhiiuser Verlag was very cooperative in publishing this volume. Camelia Minculescu, Iren Nemethi and Rodica Stoenescu dealt with the dif ficult task of typing the whOle manuscript using a Rank Xerox 860 word processor; we thank them for the excellent job they did.
Mathematical Methods in Physics

Volume 1: Operators, Matrices and Analytic functions
An Introduction to Classical and P-adic Theory of Linear Operators and Applications
An Operator Perspective on Signals and Systems
Non-Archimedean Operator Theory

This book discusses the methods of fighting against noise. It can be regarded as a mathematical view of specific engineering problems with known and new methods of control and estimation in noisy media. From the reviews: "An excellent reference on the complete sets of equations for the optimal controls and for the optimal filters under wide band noises and shifted white noises and their possible application to navigation of spacecraft." --MATHEMATICAL REVIEWS

This book is dedicated to the spectral theory of linear operators on Banach spaces and of elements in Banach algebras. It presents a survey of results concerning various types of spectra, both of single and n-tuples of elements. Typical examples are the one-sided spectra, the approximate point, essential, local and Taylor spectrum, and their variants. Many results appear here for the first time in a monograph.

Mathematicians do not work in isolation. They stand in a long and time honored tradition. They write papers and (sometimes) books, they read the publications of fellow workers in the ?eld, and they meet other mathematicians at conferences all over the world. In this way, in contact with colleagues far away and nearby, from the past (via their writings) and from the present, scienti?c results are obtained whicharerecognizedasvalid.Andthat–remarkablyenough–regardlessofethnic background, political inclination or religion. In this process, some distinguished individuals play a special and striking role. They assume a position of leadership. They guide the people working with them through uncharted territory, thereby making a lasting imprint on the ?eld. So- thing which can only be accomplished through a combination of rare talents: - usually broad knowledge, unfailing intuition and a certain kind of charisma that binds people together.

AllofthisispresentinIsraelGohberg,themantowhomthisbookisdedicated,on theoccasionof his 80thbirthday.This comes to the foregroundunmistakably from the contributions from those who worked with him or whose life was a?ected by him. Gohberg'sexceptionalqualitiesarealsoapparentfromthe articleswritten by himself, sometimes jointly with others, that are reproduced in this book. Among these are stories of his life, some dealing with mathematical aspects, others of a more general nature. Also included are reminiscences paying tribute to a close colleaguewho isnotamongusanymore,speechesorreviewshighlightingthework and personality of a friend or esteemed colleague, and responses to the laudatio's connected with the several honorary degrees that were bestowed upon him.

Invitation to Linear Operators
Basic Operator Theory
Automatic Continuity of Linear Operators

This book provides the reader with a self-contained treatment of the classical operator theory with significant applications to abstract differential equations, and an elegant introduction to basic concepts and methods of the rapidly growing theory of the so-called p-adic operator theory.

Offers an examination of the multivariate approximation case Special focus on the Bernstein operators, including applications, and on two new classes of Bernstein-type operators Many general estimates, leaving room for future applications (e.g. the B-spline case) Extensions to approximation operators acting on spaces of vector functions Historical perspective in the form of previous significant results

Basic Classes of Linear OperatorsBirkhäuser