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A Hilbert Space Problem Book
Springer Science & Business Media

From the Preface: "This book was written for the active reader. The first part consists of problems, frequently preceded by definitions and motivation, and sometimes followed by corollaries and historical remarks... The second part, a very short one, consists of hints... The third part, the longest, consists of solutions: proofs, answers, or constructions, depending on the nature of the problem.... This is not an introduction to Hilbert space theory. Some knowledge

of that subject is a prerequisite: at the very least, a study of the elements of Hilbert space theory should proceed concurrently with the reading of this book."

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A Hilbert Space Problem Book

Springer Science & Business Media

Written for the active reader with some background in the topic, this book presents problems in Hilbert space theory, with definitions, corollaries and historical remarks, hints, proofs, answers and constructions.

A Hilbert Space Problem Book

An Introduction to Hilbert Space and Quantum Logic *Springer Science & Business Media*

Historically, nonclassical physics developed in three stages. First came a collection of ad hoc assumptions and then a cookbook of equations known as "quantum mechanics". The equations and their philosophical underpinnings were then collected into a model based on the mathematics of Hilbert space. From the Hilbert space model came the abstraction of "quantum logics". This book explores all three stages, but not in historical order. Instead, in an effort to illustrate how physics and abstract mathematics influence each other we hop back and forth between a purely mathematical development of Hilbert space, and a physically motivated definition of a logic, partially linking the two throughout, and then bringing them together at the deepest level in the last

two chapters. This book should be accessible to undergraduate and beginning graduate students in both mathematics and physics. The only strict prerequisites are calculus and linear algebra, but the level of mathematical sophistication assumes at least one or two intermediate courses, for example in mathematical analysis or advanced calculus. No background in physics is assumed.

A Hilbert Space Problem Book

Introduction to Spectral Theory in Hilbert Space

North-Holland Series in Applied Mathematics and Mechanics *Elsevier*
North-Holland Series in Applied

Mathematics and Mechanics, Volume 6: Introduction to Spectral Theory in Hilbert Space focuses on the mechanics, principles, and approaches involved in spectral theory in Hilbert space. The publication first elaborates on the concept and specific geometry of Hilbert space and bounded linear operators. Discussions focus on projection and adjoint operators, bilinear forms, bounded linear mappings, isomorphisms, orthogonal subspaces, base, subspaces, finite dimensional Euclidean space, and normed linear spaces. The text then takes a look at the general theory of linear operators and spectral analysis of compact linear operators, including spectral decomposition of a compact selfadjoint operator, weakly convergent sequences, spectrum of a compact linear

operator, and eigenvalues of a linear operator. The manuscript ponders on the spectral analysis of bounded linear operators and unbounded selfadjoint operators. Topics include spectral decomposition of an unbounded selfadjoint operator and bounded normal operator, functions of a unitary operator, step functions of a bounded selfadjoint operator, polynomials in a bounded operator, and order relation for bounded selfadjoint operators. The publication is a valuable source of data for mathematicians and researchers interested in spectral theory in Hilbert space.

Introduction to Hilbert Space and the Theory of Spectral Multiplicity

Second Edition *Courier Dover Publications*

Concise introductory treatment consists of three chapters: The Geometry of Hilbert Space, The Algebra of Operators, and The Analysis of Spectral Measures. A background in measure theory is the sole prerequisite. 1957 edition.

An Introduction to Hilbert Space *Cambridge University Press*

This textbook is an introduction to the theory of Hilbert space and its applications. The notion of Hilbert space is central in functional analysis and is used in numerous branches of pure and applied mathematics. Dr Young has stressed applications of the theory, particularly to the solution of partial differential equations in mathematical

physics and to the approximation of functions in complex analysis. Some basic familiarity with real analysis, linear algebra and metric spaces is assumed, but otherwise the book is self-contained. It is based on courses given at the University of Glasgow and contains numerous examples and exercises (many with solutions). Thus it will make an excellent first course in Hilbert space theory at either undergraduate or graduate level and will also be of interest to electrical engineers and physicists, particularly those involved in control theory and filter design.

A Hilbert Space Problem Book

A Complex Analysis Problem Book
Birkhäuser

This second edition presents a collection of exercises on the theory of analytic functions, including completed and detailed solutions. It introduces students to various applications and aspects of the theory of analytic functions not always touched on in a first course, while also addressing topics of interest to electrical engineering students (e.g., the realization of rational functions and its connections to the theory of linear systems and state space representations of such systems). It provides examples of important Hilbert spaces of analytic functions (in particular the Hardy space and the Fock space), and also includes a section reviewing essential aspects of topology, functional analysis and Lebesgue integration. Benefits of the 2nd edition Rational functions are now

covered in a separate chapter. Further, the section on conformal mappings has been expanded.

A Hilbert Space Problem Book

Operators on Hilbert Space *Springer*

The primarily objective of the book is to serve as a primer on the theory of bounded linear operators on separable Hilbert space. The book presents the spectral theorem as a statement on the existence of a unique continuous and measurable functional calculus. It discusses a proof without digressing into a course on the Gelfand theory of commutative Banach algebras. The book also introduces the reader to the basic facts concerning the various von Neumann-Schatten ideals, the compact

operators, the trace-class operators and all bounded operators.

Hilbert Space Operators

A Problem Solving Approach *Springer Science & Business Media*

This self-contained work on Hilbert space operators takes a problem-solving approach to the subject, combining theoretical results with a wide variety of exercises that range from the straightforward to the state-of-the-art. Complete solutions to all problems are provided. The text covers the basics of bounded linear operators on a Hilbert space and gradually progresses to more advanced topics in spectral theory and quasireducible operators. Written in a motivating and rigorous style, the work

has few prerequisites beyond elementary functional analysis, and will appeal to graduate students and researchers in mathematics, physics, engineering, and related disciplines.

Theory of Linear Operators in Hilbert Space *Courier Corporation*

This classic textbook by two mathematicians from the USSR's prestigious Kharkov Mathematics Institute introduces linear operators in Hilbert space, and presents in detail the geometry of Hilbert space and the spectral theory of unitary and self-adjoint operators. It is directed to students at graduate and advanced undergraduate levels, but because of the exceptional clarity of its theoretical presentation and the inclusion of results

obtained by Soviet mathematicians, it should prove invaluable for every mathematician and physicist. 1961, 1963 edition.

Convex Analysis and Monotone Operator Theory in Hilbert Spaces
Springer

This reference text, now in its second edition, offers a modern unifying presentation of three basic areas of nonlinear analysis: convex analysis, monotone operator theory, and the fixed point theory of nonexpansive operators. Taking a unique comprehensive approach, the theory is developed from the ground up, with the rich connections and interactions between the areas as the central focus, and it is illustrated by a large number of examples. The Hilbert

space setting of the material offers a wide range of applications while avoiding the technical difficulties of general Banach spaces. The authors have also drawn upon recent advances and modern tools to simplify the proofs of key results making the book more accessible to a broader range of scholars and users. Combining a strong emphasis on applications with exceptionally lucid writing and an abundance of exercises, this text is of great value to a large audience including pure and applied mathematicians as well as researchers in engineering, data science, machine learning, physics, decision sciences, economics, and inverse problems. The second edition of *Convex Analysis and Monotone Operator Theory in Hilbert Spaces* greatly expands on the first

edition, containing over 140 pages of new material, over 270 new results, and more than 100 new exercises. It features a new chapter on proximity operators including two sections on proximity operators of matrix functions, in addition to several new sections distributed throughout the original chapters. Many existing results have been improved, and the list of references has been updated. Heinz H. Bauschke is a Full Professor of Mathematics at the Kelowna campus of the University of British Columbia, Canada. Patrick L. Combettes, IEEE Fellow, was on the faculty of the City University of New York and of Université Pierre et Marie Curie - Paris 6 before joining North Carolina State University as a Distinguished Professor of Mathematics in 2016.

An Operator Theory Problem Book *World Scientific*

This book is for third and fourth year university mathematics students (and Master students) as well as lecturers and tutors in mathematics and anyone who needs the basic facts on Operator Theory (e.g. Quantum Mechanists). The main setting for bounded linear operators here is a Hilbert space. There is, however, a generous part on General Functional Analysis (not too advanced though). There is also a chapter on Unbounded Closed Operators. The book is divided into two parts. The first part contains essential background on all of the covered topics with the sections: True or False Questions, Exercises, Tests and More Exercises. In the second part, readers may find answers and detailed

solutions to the True or False Questions, Exercises and Tests. Another virtue of the book is the variety of the topics and the exercises and the way they are tackled. In many cases, the approaches are different from what is known in the literature. Also, some very recent results from research papers are included.

An Advanced Complex Analysis Problem Book

Topological Vector Spaces, Functional Analysis, and Hilbert Spaces of Analytic Functions *Birkhäuser*

This is an exercises book at the beginning graduate level, whose aim is to illustrate some of the connections between functional analysis and the

theory of functions of one variable. A key role is played by the notions of positive definite kernel and of reproducing kernel Hilbert space. A number of facts from functional analysis and topological vector spaces are surveyed. Then, various Hilbert spaces of analytic functions are studied.

Linear Algebra Problem Book *American Mathematical Soc.*

Linear Algebra Problem Book can be either the main course or the dessert for someone who needs linear algebra and today that means every user of mathematics. It can be used as the basis of either an official course or a program of private study. If used as a course, the book can stand by itself, or if so desired, it can be stirred in with a standard linear

algebra course as the seasoning that provides the interest, the challenge, and the motivation that is needed by experienced scholars as much as by beginning students. The best way to learn is to do, and the purpose of this book is to get the reader to DO linear algebra. The approach is Socratic: first ask a question, then give a hint (if necessary), then, finally, for security and completeness, provide the detailed answer.

An Introduction to Operators on the Hardy-Hilbert Space *Springer Science & Business Media*

This book offers an elementary and engaging introduction to operator theory on the Hardy-Hilbert space. It provides a firm foundation for the study of all

spaces of analytic functions and of the operators on them. Blending techniques from "soft" and "hard" analysis, the book contains clear and beautiful proofs. There are numerous exercises at the end of each chapter, along with a brief guide for further study which includes references to applications to topics in engineering.

Applied Analysis by the Hilbert Space Method

An Introduction with Applications to the Wave, Heat, and Schrödinger Equations *Courier Corporation*

Numerous worked examples and exercises highlight this unified treatment. Simple explanations of difficult subjects make it accessible to

undergraduates as well as an ideal self-study guide. 1990 edition.

Hilbert Space Methods in Probability and Statistical Inference *John Wiley & Sons*

Explains how Hilbert space techniques cross the boundaries into the foundations of probability and statistics. Focuses on the theory of martingales stochastic integration, interpolation and density estimation. Includes a copious amount of problems and examples.

Pick Interpolation and Hilbert Function Spaces *American Mathematical Soc.*

This book first rigorously develops the theory of reproducing kernel Hilbert spaces. The authors then discuss the

Pick problem of finding the function of smallest H^∞ norm that has specified values at a finite number of points in the disk. Their viewpoint is to consider H^∞ as the multiplier algebra of the Hardy space and to use Hilbert space techniques to solve the problem. This approach generalizes to a wide collection of spaces. The authors then consider the interpolation problem in the space of bounded analytic functions on the bidisk and give a complete description of the solution. They then consider very general interpolation problems. The book includes developments of all the theory that is needed, including operator model theory, the Arveson extension theorem, and the hereditary functional calculus.

Introduction to Hilbert Spaces with Applications *Elsevier*

Building on the success of the two previous editions, Introduction to Hilbert Spaces with Applications, Third Edition, offers an overview of the basic ideas and results of Hilbert space theory and functional analysis. It acquaints students with the Lebesgue integral, and includes an enhanced presentation of results and proofs. Students and researchers will benefit from the wealth of revised examples in new, diverse applications as they apply to optimization, variational and control problems, and problems in approximation theory, nonlinear instability, and bifurcation. The text also includes a popular chapter on wavelets that has been completely updated. Students and researchers agree that this

is the definitive text on Hilbert Space theory. Updated chapter on wavelets Improved presentation on results and proof Revised examples and updated applications Completely updated list of references

A Hilbert Space Problem Book

Iterative Methods for Fixed Point Problems in Hilbert Spaces *Springer*

Iterative methods for finding fixed points of non-expansive operators in Hilbert spaces have been described in many publications. In this monograph we try to present the methods in a consolidated way. We introduce several classes of operators, examine their properties, define iterative methods generated by operators from these classes and

present general convergence theorems. On this basis we discuss the conditions under which particular methods converge. A large part of the results presented in this monograph can be found in various forms in the literature (although several results presented here are new). We have tried, however, to show that the convergence of a large class of iteration methods follows from general properties of some classes of operators and from some general convergence theorems.

Unbounded Self-adjoint Operators on Hilbert Space *Springer Science & Business Media*

The book is a graduate text on unbounded self-adjoint operators on Hilbert space and their spectral theory

with the emphasis on applications in mathematical physics (especially, Schrödinger operators) and analysis (Dirichlet and Neumann Laplacians, Sturm-Liouville operators, Hamburger moment problem) . Among others, a number of advanced special topics are treated on a text book level accompanied by numerous illustrating examples and exercises. The main themes of the book are the following: - Spectral integrals and spectral decompositions of self-adjoint and normal operators - Perturbations of self-adjointness and of spectra of self-adjoint operators - Forms and operators - Self-adjoint extension theory :boundary triplets, Krein-Birman-Vishik theory of positive self-adjoint extension

Reproducing Kernel Hilbert Spaces in Probability and Statistics *Springer Science & Business Media*

The book covers theoretical questions including the latest extension of the formalism, and computational issues and focuses on some of the more fruitful and promising applications, including statistical signal processing, nonparametric curve estimation, random measures, limit theorems, learning theory and some applications at the fringe between Statistics and Approximation Theory. It is geared to graduate students in Statistics, Mathematics or Engineering, or to scientists with an equivalent level.

Linear Transformations in Hilbert Space and Their Applications to

Analysis *American Mathematical Soc.*

Harmonic Analysis of Operators on Hilbert Space *Springer Science & Business Media*

The existence of unitary dilations makes it possible to study arbitrary contractions on a Hilbert space using the tools of harmonic analysis. The first edition of this book was an account of the progress done in this direction in 1950-70. Since then, this work has influenced many other areas of mathematics, most notably interpolation theory and control theory. This second edition, in addition to revising and amending the original text, focuses on further developments of the theory, including the study of two operator classes: operators whose powers do not converge strongly to zero,

and operators whose functional calculus (as introduced in Chapter III) is not injective. For both of these classes, a wealth of material on structure, classification and invariant subspaces is included in Chapters IX and X. Several chapters conclude with a sketch of other developments related with (and developing) the material of the first edition.

Elements of Hilbert Spaces and Operator Theory *Springer*

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.

Hilbert Space Methods in Signal Processing *Cambridge University Press*

An accessible introduction to Hilbert spaces, combining the theory with applications of Hilbert methods in signal processing.

Gaussian Hilbert Spaces *Cambridge University Press*

This book treats the fundamental mathematical properties that hold for a family of Gaussian random variables.

Hilbert Spaces, Wavelets, Generalised Functions and Modern Quantum Mechanics *Springer Science & Business Media*

This book gives a comprehensive introduction to modern quantum mechanics, emphasising the underlying Hilbert space theory and generalised function theory. All the major modern techniques and approaches used in quantum mechanics are introduced, such as Berry phase, coherent and squeezed states, quantum computing, solitons and quantum mechanics. Audience: The book is suitable for graduate students in physics and mathematics.

Elements of Operator Theory

Springer Science & Business Media

{\it Elements of Operator Theory} is aimed at graduate students as well as a new generation of mathematicians and scientists who need to apply operator

theory to their field. Written in a user-friendly, motivating style, fundamental topics are presented in a systematic fashion, i.e., set theory, algebraic structures, topological structures, Banach spaces, Hilbert spaces, culminating with the Spectral Theorem, one of the landmarks in the theory of operators on Hilbert spaces. The exposition is concept-driven and as much as possible avoids the formula-computational approach. Key features of this largely self-contained work include: * required background material to each chapter * fully rigorous proofs, over 300 of them, are specially tailored to the presentation and some are new * more than 100 examples and, in several cases, interesting counterexamples that demonstrate the frontiers of an

important theorem * over 300 problems, many with hints * both problems and examples underscore further auxiliary results and extensions of the main theory; in this non-traditional framework, the reader is challenged and has a chance to prove the principal theorems anew This work is an excellent text for the classroom as well as a self-study resource for researchers. Prerequisites include an introduction to analysis and to functions of a complex variable, which most first-year graduate students in mathematics, engineering, or another formal science have already acquired. Measure theory and integration theory are required only for the last section of the final chapter.

Problem Book in Hilbert Space

Commutation Properties of Hilbert Space Operators and Related Topics

Springer Science & Business Media

What could be regarded as the beginning of a theory of commutators $AB - BA$ of operators A and B on a Hilbert space, considered as a discipline in itself, goes back at least to the two papers of Weyl [3] {1928} and von Neumann [2] {1931} on quantum mechanics and the commutation relations occurring there. Here A and B were unbounded self-adjoint operators satisfying the relation $AB - BA = iI$, in some appropriate sense, and the problem was that of establishing the essential uniqueness of the pair A and B . The study of commutators of bounded operators on a Hilbert space has a more recent origin, which can probably be

pinpointed as the paper of Wintner [6] {1947}. An investigation of a few related topics in the subject is the main concern of this brief monograph. The ensuing work considers commuting or "almost" commuting quantities A and B , usually bounded or unbounded operators on a Hilbert space, but occasionally regarded as elements of some normed space. An attempt is made to stress the role of the commutator $AB - BA$, and to investigate its properties, as well as those of its components A and B when the latter are subject to various restrictions. Some applications of the results obtained are made to quantum mechanics, perturbation theory, Laurent and Toeplitz

operators, singular integral transformations, and Jacobi matrices.

Hilbert Space Methods in Partial Differential Equations *Courier Corporation*

This graduate-level text opens with an elementary presentation of Hilbert space theory sufficient for understanding the rest of the book. Additional topics include boundary value problems, evolution equations, optimization, and approximation. 1979 edition.

Second Order Partial Differential Equations in Hilbert Spaces *Cambridge University Press*
Publisher Description