Weakly Differentiable Functions Sobolev Spaces And Functions Of Bounded Variation 1st Edition

This book makes a significant inroad into the unexpectedly difficult question of existence of Fréchet derivatives of Lipschitz maps of Banach spaces into higher dimensional spaces. Because the question turns out to be closely related to porous sets in Banach spaces, it provides a bridge between descriptive set theory and the classical topic of existence of derivatives of vector-valued Lipschitz functions. The topic is relevant to classical analysis and descriptive set theory on Banach spaces. The book opens several new research directions in this area of geometric nonlinear functional analysis. The new methods developed here include a game approach to perturbational variational principles that is of independent interest. Detailed explanation of the underlying ideas and motivation behind the proofs of the new results on Fréchet differentiability of vector-valued functions should make these arguments accessible to a wider audience. The most important special case of the differentiability results, that Lipschitz mappings from a Hilbert space into the plane have points of Fréchet differentiability, is given its own chapter with a proof that is independent of much of the work done to prove more general results. The book raises several open questions concerning its two main topics.

The mathematical theory of ondelettes (wavelets) was developed by Yves Meyer and many collaborators about 10 years ago. It was designed for ap proximation of possibly irregular functions and surfaces and was successfully applied in data compression, turbulence analysis, image and signal process ing. Five years ago wavelet theory progressively appeared to be a power ful framework for nonparametric statistical problems. Efficient computa tional implementations are beginning to surface in this second lustrum of the nineties. This book brings together these three main streams of wavelet theory. It presents the theory, discusses approximations and gives a variety of statistical applications. It is the aim of this text to introduce the novice in this field into the various aspects of wavelets. Wavelets require a highly interactive computing interface. We present therefore all applications with software code from an interactive statistical computing environment. Readers interested in theory and construction of wavelets will find here in a condensed form results that are somewhat scattered around in the research literature. A practioner will be able to use wavelets via the available software code. We hope therefore to address both theory and practice with this book and thus help to construct bridges between the different groups of scientists. This te. xt grew out of a French-German cooperation (Seminaire Paris Berlin, Seminar Berlin-Paris). This seminar brings together theoretical and applied statisticians from Berlin and Paris. This work originates in the first of these seminars organized in Garchy, Burgundy in 1994.

This volume mark's the centenary of the birth of the outstanding mathematician of the 20th century, Sergey Sobolev. It includes new results on the latest topics of the theory of Sobolev spaces, partial differential equations, analysis and mathematical physics.

The field of variable exponent function spaces has witnessed an explosive growth in recent years. The standard reference article for basic properties is already 20 years old. Thus this self-contained monograph collecting all the basic properties of variable exponent Lebesgue and Sobolev spaces is timely and provides a much-needed accessible reference work utilizing consistent notation and terminology. Many results are also provided with new and improved proofs. The book also presents a number of applications to PDE and fluid dynamics.

Applied Analysis

Volume 1: Fundamentals

A First Course in Sobolev Spaces

Harmonic Function Theory

Maximal Function Methods for Sobolev Spaces

This volume is dedicated to our teacher and friend Hans Triebel. The core of the book is based on lectures given at the International Conference "Function Spaces, Differential Operators and Nonlinear Analysis" (FSDONA--01) held in Teistungen, Thuringia / Germany, from June 28 to July 4,2001, in honour of his 65th birthday. This was the fifth in a series of meetings organised under the same name by scientists from Finland (Helsinki, Oulu) , the Czech Republic (Prague, Plzen) and Germany (Jena) promoting the collaboration of specialists in East and West, working in these fields. This conference was a very special event because it celebrated Hans Triebel's extraordinary impact on mathematical analysis. The development of the mod ern theory of function spaces in the last 30 years and its application to various branches in both pure and applied mathematics is deeply influenced by his lasting contributions. In a series of books Hans Triebel has given systematic treatments of the theory of function spaces from different points of view, thus revealing its interdependence with interpolation theory, harmonic analysis, partial differential equations, nonlinear operators, entropy, spectral theory and, most recently, anal ysis on fractals. The presented collection of papers is a tribute to Hans Triebel's distinguished work. The book is subdivided into three parts: • Part I contains the two invited lectures by O.V. Besov (Moscow) and D.E. Edmunds (Sussex) having a survey character and honouring Hans Triebel's contributions.

This book focuses on nonlinear boundary value problems and the aspects of nonlinear analysis which are necessary to their study. The authors first give a comprehensive introduction to the many different classical methods from nonlinear analysis, variational principles, and Morse theory. They then provide a rigorous and detailed treatment of the relevant areas of nonlinear analysis with new applications to nonlinear boundary value problems for both ordinary and partial differential equations. Recent results on the existence and multiplicity of critical points for both smooth and nonsmooth functional, developments on the degree theory of monotone type operators, nonlinear maximum and comparison principles for p-Laplacian type operators, and new developments on nonlinear Neumann problems involving non-homogeneous differential operators appear for the first time in book form. The presentation is systematic, and an extensive bibliography and a remarks section at the end of each chapter highlight the text. This work will serve as an invaluable reference for researchers working in nonlinear analysis and partial differential equations as well as a useful tool for all those interested in the topics presented.

This textbook is a completely revised, updated, and expanded English edition of the important Analyse fonctionnelle (1983). In addition, it contains a wealth of problems and exercises (with solutions) to guide the reader. Uniquely, this book presents in a coherent, concise and unified way the main results from functional analysis together with the main results from the theory of partial differential equations (PDEs). Although there are many books on functional analysis and many on PDEs, this is the first to cover both of these closely connected topics. Since the French book was first published, it has been translated into Spanish, Italian, Japanese, Korean, Romanian, Greek and Chinese. The English edition makes a welcome addition to this list.

This is the proceedings volume of an international conference entitled Complex Analysis and Potential Theory, which was held to honor the important contributions of two influential analysts, Kohur N. GowriSankaran and Paul M. Gauthier, in June 2011 at the Centre de Recherches Mathematiques (CRM) in Montreal. More than fifty mathematicians from fifteen countries participated in the conference. The twenty-four surveys and research articles contained in this book are based on the lectures given by some of the most established specialists in the fields. They reflect the wide breadth of research interests of the two honorees: from potential theory on trees to approximation on Riemann surfaces, from universality to inner and outer functions and the disc algebra, from branching processes to harmonic extension and capacities, from harmonic mappings and the Harnack principle to integration formulae in $\mathbb {C}^n$ and the Hartogs phenomenon, from fine harmonicity and plurisubharmonic functions to the binomial identity and the Riemann hypothesis, and more. This volume will be a valuable resource for specialists, young researchers, and graduate students from both fields, complex analysis and potential theory. It will foster further cooperation and the exchange of ideas and techniques to find new research perspectives.

Functional Spaces for the Theory of Elliptic Partial Differential Equations

Mathematical methods for wave propagation in science and engineering

A Course on Function Spaces

Sobolev Spaces and Functions of Bounded Variation

Mathematical Foundations of Infinite-Dimensional Statistical Models

This book emphasizes the isomorphic theory of Banach spaces and techniques using the unifying viewpoint of basic sequences. Its aim is to provide the reader with the necessary technical tools and background to reach the frontiers of research without the introduction of too many extraneous concepts. Detailed and accessible proofs are included, as are a variety of exercises and problems.

This book discusses advances in maximal function methods related to Poincaré and Sobolev inequalities, pointwise estimates and approximation for Sobolev functions, Hardy's inequalities, and partial differential equations. Capacities are needed for fine properties of Sobolev functions and characterization of Sobolev spaces with zero boundary values. The authors consider several uniform quantitative conditions that are self-improving, such as Hardy's inequalities, capacity density conditions, and reverse Hölder inequalities. They also study Muckenhoupt weight properties of distance functions and combine these with weighted norm inequalities; notions of dimension are then used to characterize density conditions and to give sufficient and necessary conditions for Hardy's inequalities. At the end of the book, the theory of weak solutions to the p p-Laplace equation and the use of maximal function techniques is this context are discussed. The book is directed to researchers and graduate students interested in applications of geometric and harmonic analysis in Sobolev spaces and partial differential equations.

This authoritative book presents recent research results on nonlinear problems with lack of compactness. The topics covered include several nonlinear problems in the Euclidean setting as well as variational problems on manifolds. The combination of deep techniques in nonlinear analysis with applications to a variety of problems make this work an essential source of information for researchers and graduate students working in analysis and PDE's.

This is the first of two books on methods and techniques in the calculus of variations. Contemporary arguments are used throughout the text to streamline and present in a unified way classical results, and to provide novel contributions at the forefront of the theory. This book addresses fundamental questions related to lower semicontinuity and relaxation of functionals within the unconstrained setting, mainly in L^p spaces. It prepares the ground for the second volume where the variational treatment of functionals involving fields and their derivatives will be undertaken within the framework of Sobolev spaces. This book is self-contained. All the statements are fully justified and proved, with the exception of basic results in measure theory, which may be found in any good textbook on the subject. It also contains several exercises. Therefore,it may be used both as a graduate textbook as well as a reference text for researchers in the field. Irene Fonseca is the Mellon College of Science Professor of Mathematics and is currently the Director of the Center for Nonlinear Analysis in the Department of Mathematical Sciences at Carnegie Mellon University. Her research interests lie in the areas of continuum mechanics, calculus of variations, geometric measure theory and partial differential equations. Giovanni Leoni is also a professor in the Department of Mathematical Sciences at Carnegie Mellon University. He focuses his research on calculus of variations, partial differential equations and geometric measure theory with special emphasis on applications to problems in continuum mechanics and in materials science.

An Introduction to Operators on the Hardy-Hilbert Space

Modern Methods in the Calculus of Variations

An Introduction to Banach Space Theory

Lectures on Mappings of Finite Distortion

In this book we introduce the class of mappings of finite distortion as a generalization of the class of mappings of bounded distortion. Connections with models of nonlinear elasticity are also discussed. We study continuity properties, behavior of our mappings on null sets, topological properties like openness and discreteness, regularity of the potential inverse mappings and many other aspects.

Measure Theory and Fine Properties of Functions, Revised Edition provides a detailed examination of the central assertions of measure theory in n-dimensional Euclidean space. The book emphasizes the roles of Hausdorff measure and capacity in characterizing the fine properties of sets and functions. Topics covered include a quick review of abstract

This work covers the Sobolev spaces and their applications to many areas of differential equations. It deals with some basic results on Sobolev spaces, density theorems, and approximation theorems and embedding theorems.

This book is about differentiation of functions. It is divided into two parts, which can be used as different textbooks, one for an advanced undergraduate course in functions of one variable and one for a graduate course on Sobolev functions. The first part develops the theory of monotone, absolutely continuous, and bounded variation functions of one variable and their relationship with Lebesgue–Stieltjes measures and Sobolev functions. It also studies decreasing rearrangement and curves. The second edition includes a chapter on functions mapping time into Banach spaces. The second part of the book studies functions of several variables. It begins with an overview of classical results such as Rademacher's and Stepanoff's differentiability theorems, Whitney's extension theorem, Brouwer's fixed point theorem, and the divergence theorem for Lipschitz domains. It then moves to distributions, Fourier transforms and tempered distributions. The remaining chapters are a treatise on Sobolev functions. The second edition focuses more on higher order derivatives and it includes the interpolation theorems of Gagliardo and Nirenberg. It studies embedding theorems, extension domains, chain rule, superposition, Poincaré's inequalities and traces. A major change compared to the first edition is the chapter on Besov spaces, which are now treated using interpolation theory.

In Honor of Konstantin Oskolkov

Topics in Sobolev Spaces and Applications

Topics in Banach Space Theory

L^p Spaces

Measure Theory and Fine Properties of Functions, Revised Edition

Weakly Differentiable FunctionsSobolev Spaces and Functions of Bounded VariationSpringer Science & Business Media

This series of books deals with the mathematical modeling and computational simulation of complex wave propagation phenomena in science and engineering. This first volume of the series introduces the basic mathematical and physical fundamentals, and it is mainly intended as a reference guide and a general survey for scientists and engineers. It presents a broad and practical overview of the involved foundations, being useful as much in industrial research, development, and innovation activities, as in academic labors.

Special problems of functional analysis Variational methods in mathematical physics The theory of hyperbolic partial differential equations Comments Appendix: Methode nouvelle a resoudre le probleme de Cauchy pour les equations lineaires hyperboliques normales Comments on the appendix Bibliography Index

It is the main aim of this book to develop at an accessible, moderate level an L_2 theory for elliptic differential operators of second order on bounded smooth domains in Euclidean n-space, including a priori estimates for boundary-value problems in terms of (fractional) Sobolev spaces on domains and on their boundaries, together with a related spectral theory. The presentation is preceded by an introduction to the classical theory for the Laplace-Poisson equation, and some chapters provide required ingredients such as the theory of distributions, Sobolev spaces and the spectral theory in Hilbert spaces. The book grew out of two-semester courses the authors have given several times over a period of ten years at the Friedrich Schiller University of Jena. It is addressed to graduate students and mathematicians who have a working knowledge of calculus, measure theory and the basic elements of functional analysis (as usually covered by undergraduate courses) and who are seeking an accessible introduction to some aspects of the theory of function spaces and its applications to elliptic equations.

Functional Analysis, Sobolev Spaces and Partial Differential Equations

The Cauchy Problem in General Relativity

Recent Advances in Harmonic Analysis and Applications

A First Course in Sobolev Spaces: Second Edition

Complex Analysis and Potential Theory

This monograph introduces the theory of generalized homogeneous systems governed by differential equations in both Euclidean (finite-dimensional) and Banach/Hilbert (infinite-dimensional) spaces. It develops methods of stability and robustness analysis, control design, state estimation and discretization of homogeneous control systems. Generalized Homogeneity in Systems and Control is structured in two parts. Part I discusses various models of control systems and related tools for their analysis, including Lyapunov functions. Part II deals with the analysis and design of homogeneous control systems. Some of the key features of the text include: mathematical models of dynamical systems in finite-dimensional and infinite-dimensional spaces; the theory of linear dilations in Banach spaces; homogeneous control and estimation; simple methods for an "upgrade" of existing linear control laws; numerical schemes for a consistent digital implementation of homogeneous algorithms; and experiments confirming an improvement of PID controllers. The advanced mathematical material will be of interest to researchers, mathematicians working in control theory and mathematically oriented control engineers.

This book provides an introduction to those parts of analysis that are most useful in applications for graduate students. The material is selected for use in applied problems, and is presented clearly and simply but without sacrificing mathematical rigor. The text is accessible to students from a wide variety of backgrounds, including undergraduate students entering applied mathematics from non-mathematical fields and graduate students in the sciences and engineering who want to learn analysis. A basic background in calculus, linear algebra and ordinary differential equations, as well as some familiarity with functions and sets, should be sufficient.

The term "weakly differentiable functions" in the title refers to those inte n grable functions defined on an open subset of R whose partial derivatives in the sense of distributions are either LP functions or (signed) measures with finite total variation. The former class of functions comprises what is now known as Sobolev spaces, though its

origin, traceable to the early 1900s, predates the contributions by Sobolev. Both classes of functions, Sobolev spaces and the space of functions of bounded variation (BV func tions), have undergone considerable development during the past 20 years. From this development a rather complete theory has emerged and thus has provided the main impetus for the writing of this book. Since these classes of functions play a significant role in many fields, such as approximation theory, calculus of variations, partial differential equations, and non-linear potential theory, it is hoped that this monograph will be of assistance to a wide range of graduate students and researchers in these and perhaps other related areas. Some of the material in Chapters 1-4 has been presented in a graduate course at Indiana University during the 1987-88 academic year, and I am indebted to the students and colleagues in attendance for their helpful comments and suggestions.

The second edition of this classic textbook presents a rigorous and self-contained introduction to real analysis with the goal of providing a solid foundation for future coursework and research in applied mathematics. Written in a clear and concise style, it covers all of the necessary subjects as well as those often absent from standard introductory texts. Each chapter features a “Problems and Complements” section that includes additional material that briefly expands on certain topics within the chapter and numerous exercises for practicing the key concepts. The first eight chapters explore all of the basic topics for training in real analysis, beginning with a review of countable sets before moving on to detailed discussions of measure theory, Lebesgue integration, Banach spaces, functional analysis, and weakly differentiable functions. More topical applications are discussed in the remaining chapters, such as maximal functions, functions of bounded mean oscillation, rearrangements, potential theory, and the theory of Sobolev functions. This second edition has been completely revised and updated and contains a variety of new content and expanded coverage of key topics, such as new exercises on the calculus of distributions, a proof of the Riesz convolution, Steiner symmetrization, and embedding theorems for functions in Sobolev spaces. Ideal for either classroom use or self-study, Real Analysis is an excellent textbook both for students discovering real analysis for the first time and for mathematicians and researchers looking for a useful resource for reference or review. Praise for the First Edition: “[This book] will be extremely useful as a text. There is certainly enough material for a year-long graduate course, but judicious selection would make it possible to use this most appealing book in a one-semester course for well-prepared students.” —Mathematical Reviews

Sobolev Spaces

Topological and Variational Methods with Applications to Nonlinear Boundary Value Problems

Sobolev Spaces in Mathematics I

Function Spaces, Differential Operators and Nonlinear Analysis

Sobolev Type Inequalities

Sobolev spaces are a fundamental tool in the modern study of partial differential equations. In this book, Leoni takes a novel approach to the theory by looking at Sobolev spaces as the natural development of monotone, absolutely continuous, and BV functions of one variable. In this way, the majority of the text can be read without the prerequisite of a course in functional analysis. The first part of this text is devoted to studying functions of one variable. Several of the topics treated occur in courses on real analysis or measure theory. Here, the perspective emphasizes their applications to Sobolev functions, giving a very different flavor to the treatment. This elementary start to the book makes it suitable for advanced undergraduates or beginning graduate students. Moreover, the one-variable part of the book helps to develop a solid background that facilitates the reading and understanding of Sobolev functions of several variables. The second part of the book is more classical, although it also contains some recent results. Besides the standard results on Sobolev functions, this part of the book includes chapters on BV functions, symmetric rearrangement, and Besov spaces. The book contains over 200 exercises.

In nonparametric and high-dimensional statistical models, the classical Gauss–Fisher–Le Cam theory of the optimality of maximum likelihood estimators and Bayesian posterior inference does not apply, and new foundations and ideas have been developed in the past several decades. This book gives a coherent account of the statistical theory in infinite-dimensional parameter spaces. The mathematical foundations include self-contained 'mini-courses' on the theory of Gaussian and empirical processes, approximation and wavelet theory, and the basic theory of function spaces. The theory of statistical inference in such models - hypothesis testing, estimation and confidence sets - is presented within the minimax paradigm of decision theory. This includes the basic theory of convolution kernel and projection estimation, but also Bayesian nonparametrics and nonparametric maximum likelihood estimation. In a final chapter the theory of adaptive inference in nonparametric models is developed, including Lepski's method, wavelet thresholding, and adaptive inference for self-similar functions. Winner of the 2017 PROSE Award for Mathematics.

Sobolev spaces were firstly defined by the Russian mathematician, Sergei L. Sobolev (1908-1989) in the 1930s. Several properties of these spaces have been studied by mathematicians until today. Functions that account for existence and uniqueness, asymptotic behavior, blow up, stability and instability of the solution of many differential equations that occur in applied and in engineering sciences are carried out with the help of Sobolev spaces and embedding theorems in these spaces. An Introduction to Sobolev Spaces provides a brief introduction to Sobolev spaces at a simple level with illustrated examples. Readers will learn about the properties of these types of vector spaces and gain an understanding of advanced differential calculus and partial difference equations that are related to this topic. The contents of the book are suitable for undergraduate and graduate students, mathematicians, and engineers who have an interest in getting a quick, but carefully presented, mathematically sound, basic knowledge about Sobolev Spaces.

This book contains papers presented at the "Workshop on Singularities in PDE and the Calculus of Variations" at the CRM in July 2006. The main theme of the meeting was the formation of geometrical singularities in PDE problems with a variational formulation. These equations typically arise in some applications (to physics, engineering, or biology, for example) and their resolution often requires a combination of methods coming from areas such as functional and harmonic analysis, differential geometry and geometric measure theory. Among the PDE problems discussed were: the Cahn-Hilliard model of phase transitions and domain walls; vortices in Ginzburg-Landau type models for superconductivity and superfluidity; the Ohna-Kawasaki model for di-block copolymers; models of image enhancement; and Monge-Ampere functions. The articles give a sampling of problems and methods in this diverse area of mathematics, which touches a large part of modern mathematics and its applications.

Singularities in PDE and the Calculus of Variations

Distributions, Sobolev Spaces, Elliptic Equations

Approximation and Interpolation

Wavelets, Approximation, and Statistical Applications

The Hans Triebel Anniversary Volume

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.

This work is solely dedicated to the study of both the one variable as well as the multidimensional Lorentz spaces covering the theory of Lebesgue type spaces invariant by rearrangement. The authors provide proofs in full detail for most theorems. The self-contained text is valuable for advanced students and researchers.

"The general theory of relativity is a theory of manifolds equipped with Lorentz metrics and fields which describe the matter content. Einstein's equations equate the Einstein tensor (a curvature quantity associated with the Lorentz metric) with the stress energy tensor (an object constructed using the matter fields). In addition, there are equations describing the evolution of the matter. Using symmetry as a guiding principle, one is naturally led to the Schwarzschild and Friedmann-Lemaâitre-Robertson-Walker solutions, modelling an isolated system and the entire universe respectively. In a different approach, formulating Einstein's equations as an initial value problem allows a closer study of their solutions. This book first provides a definition of the concept of initial data and a proof of the correspondence between initial data and development. It turns out that some initial data allow non-isometric maximal developments, complicating the uniqueness issue. The second half of the book is concerned with this and related problems, such as strong cosmic censorship. The book presents complete proofs of several classical results that play a central role in mathematical relativity but are not easily accessible to those wishing to enter the subject. Prerequisites are a good knowledge of basic measure and integration theory as well as the fundamentals of Lorentz geometry. The necessary background from the theory of partial differential equations and Lorentz geometry is included."--Publisher's description.

This book is the first volume of a three-part textbook suitable for graduate coursework, professional engineering and academic research. It is also appropriate for graduate flipped classes. Each volume is divided into short chapters. Each chapter can be covered in one teaching unit and includes exercises as well as solutions available from a dedicated website. The salient ideas can be addressed during lecture, with the rest of the content assigned as reading material. To engage the reader, the text combines examples, basic ideas, rigorous proofs, and pointers to the literature to enhance scientific literacy. Volume I is divided into 23 chapters plus two appendices on Banach and Hilbert spaces and on differential calculus. This volume focuses on the fundamental ideas regarding the construction of finite elements and their approximation properties. It addresses the all-purpose Lagrange finite elements, but also vector-valued finite elements that are crucial to approximate the divergence and the curl operators. In addition, it also presents and analyzes quasi-interpolation operators and local commuting projections. The volume starts with four chapters on functional analysis, which are packed with examples and counterexamples to familiarize the reader with the basic facts on Lebesgue integration and weak derivatives. Volume I also reviews important implementation aspects when either developing or using a finite element toolbox, including the orientation of meshes and the enumeration of the degrees of freedom.

Gamma-convergence for Beginners

Classical and Multidimensional Lorentz Spaces

An Introduction to Sobolev Spaces

Sobolev Spaces on Metric Measure Spaces

Some Applications of Functional Analysis in Mathematical Physics

The theory of elliptic boundary problems is fundamental in analysis and the role of spaces of weakly differentiable functions (also called Sobolev spaces) is essential in this theory as a tool for analysing the regularity of the solutions. This book offers on the one hand a complete theory of Sobolev spaces, which are of fundamental importance for elliptic linear and non-linear differential equations, and explains on the other hand how the abstract methods of convex analysis can be combined with this theory to produce existence results for the solutions of non-linear elliptic boundary problems. The book also considers other kinds of functional spaces which are useful for treating variational problems such as the minimal surface problem. The main purpose of the book is to provide a tool for graduate and postgraduate students interested in partial differential equations, as well as a useful reference for researchers active in the field. Prerequisites include a knowledge of classical analysis, differential calculus, Banach and Hilbert spaces, integration and the related standard functional spaces, as well as the Fourier transformation on the Schwartz space. There are complete and detailed proofs of almost all the results announced and, in some cases, more than one proof is provided in order to highlight different features of the result. Each chapter concludes with a range of exercises of varying levels of difficulty, with hints to solutions provided for many of them.

This coherent treatment from first principles is an ideal introduction for graduate students and a useful reference for experts.

Preparing students for further study of both the classical works and current research, this is an accessible text for students who have had a course in real and complex analysis and understand the basic properties of L p spaces. It is sprinkled liberally with examples, historical notes, citations, and original sources, and over 450 exercises provide practice in the use of the results developed in the text through supplementary examples and counterexamples.

Sobolev Spaces presents an introduction to the theory of Sobolev Spaces and other related spaces of function, also to the imbedding characteristics of these spaces. This theory is widely used in pure and Applied Mathematics and in the Physical Sciences. This second edition of Adam's 'classic' reference text contains many additions and much modernizing and refining of material. The basic premise of the book remains unchanged: Sobolev Spaces is intended to provide a solid foundation in these spaces for graduate students and researchers alike. Self-contained and accessible for readers in other disciplines Written at elementary level making it accessible to graduate students

Weakly Differentiable Functions

Frechet Differentiability of Lipschitz Functions and Porous Sets in Banach Spaces

Nonlinear Problems with Lack of Compactness

Generalized Homogeneity in Systems and Control

Real Analysis

This textbook provides a thorough-yet-accessible introduction to function spaces, through the central concepts of integrability, weakly differentiability and fractionally differentiability. In an essentially self-contained treatment the reader is introduced to Lebesgue, Sobolev and BV-spaces, before being guided through various generalisations such as Bessel-potential spaces, fractional Sobolev spaces and Besov spaces. Written with the student in mind, the book gradually proceeds from elementary properties to more advanced topics such as lower dimensional trace embeddings, fine properties and approximate differentiability, incorporating recent approaches. Throughout, the authors provide careful motivation for the underlying concepts, which they illustrate with selected applications from partial differential equations, demonstrating the relevance and practical use of function spaces. Assuming only multivariable calculus and elementary functional analysis, as conveniently summarised in the opening chapters, A Course in Function Spaces is designed for lecture courses at the graduate level and will also be a valuable companion for young researchers in analysis.

Recent Advances in Harmonic Analysis and Applications features selected contributions from the AMS conference which took place at Georgia Southern University, Statesboro in 2011 in honor of Professor Konstantin Oskolkov's 65th birthday. The contributions are based on two special sessions, namely "Harmonic Analysis and Applications" and "Sparse Data Representations and Applications." Topics covered range from Banach space geometry to classical harmonic analysis and partial differential equations. Survey and expository articles by leading experts in their corresponding fields are included, and the volume also features selected high quality papers exploring new results and trends in Muckenhoupt-Sawyer theory, orthogonal polynomials, trigonometric series, approximation theory, Bellman functions and applications in differential equations. Graduate students and researchers in analysis will be particularly interested in the articles which emphasize remarkable connections between analysis and analytic number theory. The readers will learn about recent mathematical developments and directions for future work in the unexpected and surprising interaction between abstract problems in additive number theory and experimentally discovered optical phenomena in physics. This book will be useful for number theorists, harmonic analysts, algorithmists in multi-dimensional signal processing and experts in physics and partial differential equations.

This is a handbook of Gamma-convergence, which is a theoretical tool used to study problems in Applied Mathematics where varying parameters are present, with many applications that range from Mechanics to Computer Vision. The book is directed to Applied Mathematicians in all fields and to Engineers with a theoretical background.

This book is about harmonic functions in Euclidean space. This new edition contains a completely rewritten chapter on spherical harmonics, a new section on extensions of Bochers Theorem, new exercises and proofs, as well as revisions throughout to improve the text. A unique software package supplements the text for readers who wish to explore harmonic function theory on a computer.

Lebesgue and Sobolev Spaces with Variable Exponents

Finite Elements I