The present monograph is devoted to the theory of general parabolic boundary value problems. The vastness of this theory forced us to take difficult decisions in selecting the results to be presented and in determining the degree of detail needed to describe their proofs. In the first chapter we define the basic notions at the origin of the theory of parabolic boundary value problems and give various examples of illustrative and descriptive character. The main part of the monograph (Chapters II to V) is devoted to a the detailed and systematic exposition of the L-theory of parabolic 2 boundary value problems with smooth coefficients in Hilbert spaces of smooth functions and distributions of arbitrary finite order and with some natural applications of the theory. Wishing to make the monograph more informative, we included in Chapter VI a survey of results in the theory of the Cauchy problem and boundary value problems in the traditional spaces of smooth functions. We give no proofs; rather, we attempt to compare different results and techniques. Special attention is paid to a detailed analysis of examples illustrating and complementing the results for mulated. The chapter is written in such a way that the reader interested only in the results of the classical theory of the Cauchy problem and boundary value problems may concentrate on it alone, skipping the previous chapters.

Brannan provides engineers with both an introduction to, and a survey of, modern methods, applications, and theory of a powerful mathematical apparatus that will help them in the field. Section exercises of varying levels of difficulty provide
hands-on experience in modelling, analysis, and computer experimentation.

* Presents a comprehensive treatment with a global view of the subject * Rich in examples, problems with hints, and solutions, the book makes a welcome addition to the library of every mathematician

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This volume endeavours to summarise all available data on the theorems on isomorphisms and their ever increasing number of possible applications. It deals with the theory of solvability in generalised functions of general boundary-value problems for elliptic equations. In the early sixties, Lions and Magenes, and Berezansky, Krein and Roitberg established the theorems on complete collection of isomorphisms. Further progress of the theory was connected with proving the theorem on complete collection of isomorphisms for new classes of problems, and hence with the development of new methods to prove these theorems. The theorems on isomorphisms were first established for elliptic equations with normal boundary conditions. However, after the Noetherian property of elliptic problems was proved without assuming the normality of the boundary expressions, this became the natural way to consider the problems of establishing the theorems on isomorphisms for general elliptic problems. The present author's method of solving this problem enabled proof of the theorem on complete collection of isomorphisms for the operators generated by elliptic boundary-value problems for general systems of equations. Audience: This monograph will be of interest to mathematicians whose work involves partial differential equations, functional analysis, operator theory and the mathematics of mechanics.

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In the modern theory of boundary value problems the following approach to investigation is agreed upon (we call it the functional approach): some functional spaces are chosen; the statements of boundary value problems are formulated on the basis of these spaces; and the solvability of problems are formulated on the problems, properties of solutions, and their dependence on the original data of the problems are analyzed. These stages are put on the basis of the correct statement of different problems of mathematical physics (or of the definition of ill-posed problems). For example, if the solvability of a problem in the functional spaces chosen cannot be established then, probably, the reason is in their unsatisfactory choice. Then the analysis should be repeated employing other functional spaces. Elliptical problems can serve as an example of classical problems which are analyzed by this approach. Their investigations brought a number of new notions and results in the theory of Sobolev spaces W;(D) which, in turn, enabled us to create a sufficiently complete theory of solvability of elliptical equations. Nowadays the mathematical theory of radiative transfer problems and kinetic equations is an extensive area of modern mathematical physics. It has various applications in astrophysics, the theory of nuclear reactors, geophysics, the theory of chemical processes, semiconductor theory, fluid mechanics, etc. [25,29,31,39,40, 47, 52, 78, 83, 94, 98, 120, 124, 125, 135, 146].
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The authors give a treatment of the theory of ordinary differential equations (ODEs) that is excellent for a first course at the graduate level as well as for individual study. The reader will find it to be a captivating introduction with a number of non-routine exercises dispersed throughout the book. The authors begin with a study of initial value problems for systems of differential equations including the Picard and Peano existence theorems. The continuability of solutions, their continuous dependence on initial conditions, and their continuous dependence with respect to parameters are presented in detail. This is followed by a discussion of the differentiability of solutions with respect to initial conditions and with respect to parameters. Comparison results and differential inequalities are included as well. Linear systems of differential equations are treated in detail as is appropriate for a study of ODEs at this level. Just the right amount of basic properties of matrices are introduced to facilitate the observation of matrix systems and especially those with constant coefficients. Floquet theory for linear periodic systems is presented and used to analyze nonhomogeneous linear systems.

Stability theory of first order and vector linear systems are considered. The relationships between stability of solutions, uniform stability, asymptotic stability, uniformly asymptotic stability, and strong stability are examined and illustrated with examples as is the stability of vector linear systems. The book concludes with a chapter on perturbed systems of ODEs.

Contents: Systems of Differential EquationsContinuation of Solutions and Maximal Intervals of ExistenceSmooth Dependence on Initial Conditions and Smooth Dependence on a ParameterSome Comparison Theorems and Differential InequalitiesLinear Systems of Differential EquationsPeriodic Linear Systems and Floquet TheoryStability TheoryPerturbed Systems and More on Existence of Periodic SolutionsReadership: Graduate students and researchers interested in ordinary differential equations. Keywords: Differential Equations; Linear Systems; Comparison Theorems; Differential Inequalities; Periodic Systems; Floquet Theory; Stability Theory; Perturbed Equations; Periodic Solutions

Review: Key Features: Clarity of presentationTreatment of linear and nonlinear problemsIntroduction to stability theoryNonroutine exercises to expand insight into more difficult conceptsExamples provided with thorough explanations

Providing an introduction to functional analysis, this text treats in detail its application to boundary-value problems and finite elements, and is distinguished by the fact that abstract concepts are motivated and illustrated wherever possible. It is intended for use by senior undergraduates and graduates in mathematics, the physical sciences and engineering, who may not have been exposed to the conventional prerequisites for a course in functional analysis, such as real analysis. Mature researchers wishing to learn the basic ideas of functional analysis will equally find this useful. Offers a good grounding in those aspects of functional analysis which are most relevant to a proper understanding and appreciation of the mathematical aspects of boundary-value problems and the finite element method.

This volume provides a comprehensive overview on different types of higher order boundary value problems defined on the half-line or on the real line (Sturm–Liouville and Lidstone types, impulsive, functional and problems defined by Hammerstein integral equations). It also includes classical and new methods and techniques to deal with the lack of compactness of the related operators. The reader will find a selection of original and recent results in this field, conditions to obtain
solutions with particular qualitative properties, such as homoclinic and heteroclinic solutions and its relation with the solutions of Lidstone problems on all the real line. Each chapter contains applications to real phenomena, to classical equations or problems, with a common denominator: they are defined on unbounded intervals and the existing results in the literature are scarce or proven only numerically in discrete cases. The last part features some higher order functional problems, which generalize the classical two-point or multi-point boundary conditions, to more comprehensive data where an overall behavior of the unknown functions and their derivatives is involved. Contents: Boundary Value Problems on the Half-Line: Third-Order Boundary Value ProblemsGeneral nth-Order ProblemsImpulsive Problems on the Half-Line with Infinite Impulse MomentsHomoclinic Solutions and Lidstone Problems: Homoclinic Solutions for Second-Order ProblemsHomoclinic Solutions to Fourth-Order ProblemsLidstone Boundary Value ProblemsHeteroclinic Solutions and Hammerstein Equations: Heteroclinic Solutions for Semi-Linear Problems (i)Heteroclinic Solutions for Semi-Linear Problems (ii)Heteroclinic Solutions for Semi-Linear Problems (iii)Hammerstein Integral Equations with Sign-Changing KernelsFunctional Boundary Value Problems: Second-Order Functional ProblemsThird-Order Functional Problemsϕ-Laplacian Equations with Functional Boundary Conditions

Readership: Graduate students and researchers interested in nonlinear analysis. Keywords: Boundary Value Problems in Unbounded Domains;Impulsive Problems with Infinite Impulses;Homoclinic Solutions;Lidstone Problems on the Real Line;Heteroclinic Solutions for Hammerstein Equations;Functional Problems

Review: Key Features: Presents higher order boundary value and impulsive problems on unbounded domainsElucidates homoclinic and heteroclinic solutions without growth, sign or periodicity assumptions on the nonlinearity, and their relation with Lidstone problems and Hammerstein equations on the real lineExplains clearly the semi-linear and higher order functional problems where the boundary conditions can include nonlocal data and global variation on the unknown functions, such as multi-point, integral, maximum and/or minimum arguments.

Building on the basic techniques of separation of variables and Fourier series, the book presents the solution of boundary-value problems for basic partial differential equations: the heat equation, wave equation, and Laplace equation, considered in various standard coordinate systems—rectangular, cylindrical, and spherical. Each of the equations is derived in the three-dimensional context; the solutions are organized according to the geometry of the coordinate system, which makes the mathematics especially transparent. Bessel and Legendre functions are studied and used whenever appropriate throughout the text. The notions of steady-state solution of closely related stationary solutions are developed for the heat equation; applications to the study of heat flow in the earth are presented. The problem of the vibrating string is studied in detail both in the Fourier transform setting and from the viewpoint of the explicit representation (d'Alembert formula). Additional chapters include the numerical analysis of solutions and the method of Green's functions for solutions of partial differential equations. The exposition also includes asymptotic methods (Laplace transform and stationary phase). With more than 200 working examples and 700 exercises (more than 450 with answers), the book is suitable for an undergraduate course in partial differential equations.

Unlike other books in the market, this second edition presents differential equations consistent with the way scientists and engineers use modern methods in their work. Technology is used freely, with more emphasis on modeling, graphical representation, qualitative concepts, and geometric intuition than on theoretical issues. It also refers to larger-scale computations that computer algebra systems and DE solvers make possible. And more exercises and examples involving working with data and devising the model provide scientists and engineers with the tools needed to model complex real-world situations.
Boundary Value Problems is a translation from the Russian of lectures given at Kazan and Rostov Universities, dealing with the theory of boundary value problems for analytic functions. The emphasis of the book is on the solution of singular integral equations with Cauchy and Hilbert kernels. Although the book treats the theory of boundary value problems, emphasis is on linear problems with one unknown function. The definition of the Cauchy type integral, examples, limiting values, behavior, and its principal value are explained. The Riemann boundary value problem is emphasized in considering the theory of boundary value problems of analytic functions. The book then analyzes the application of the Riemann boundary value problem as applied to singular integral equations with Cauchy kernel. A second fundamental boundary value problem of analytic functions is the Hilbert problem with a Hilbert kernel; the application of the Hilbert problem is also evaluated. The use of Sokhotski's formulas for certain integral analysis is explained and equations with logarithmic kernels and kernels with a weak power singularity are solved. The chapters in the book all end with some historical briefs, to give a background of the problem(s) discussed. The book will be very valuable to mathematicians, students, and professors in advanced mathematics and geometrical functions.

In this book I present, in a systematic form, some local theorems on existence, uniqueness, and analytic dependence on the load, which I have recently obtained for some types of boundary value problems of finite elasticity. Actually, these results concern an n-dimensional (n ~ 1) formal generalization of three-dimensional elasticity. Such a generalization, besides being quite spontaneous, allows us to consider a great many interesting mathematical situations, and sometimes allows us to clarify certain aspects of the three-dimensional case. Part of the matter presented is unpublished; other arguments have been only partially published and in lesser generality. Note that I concentrate on simultaneous local existence and uniqueness; thus, I do not deal with the more general theory of existence. Moreover, I restrict my discussion to compressible elastic bodies and I do not treat unilateral problems. The clever use of the inverse function theorem in finite elasticity made by STOPPELLI [1954, 1957a, 1957b], in order to obtain local existence and uniqueness for the traction problem in hyperelasticity under dead loads, inspired many of the ideas which led to this monograph. Chapter I aims to give a very brief introduction to some general concepts in the mathematical theory of elasticity, in order to show how the boundary value problems studied in the sequel arise. Chapter II is very technical; it supplies the framework for all subsequent developments.

This book introduces the method of lower and upper solutions for ordinary differential equations. This method is known to be both easy and powerful to solve second order boundary value problems. Besides an extensive introduction to the method, the first half of the book describes some recent and more involved results on this subject. These concern the combined use of the method with degree theory, with variational methods and positive operators. The second half of the book concerns applications. This part exemplifies the method and provides the reader with a fairly large introduction to the problematic of boundary value problems. Although the book concerns mainly ordinary differential equations, some attention is given to other settings such as partial differential equations or functional differential equations. A detailed history of the problem is described in the introduction. · Presents the fundamental features of the method · Construction of lower and upper solutions in problems · Working applications and illustrated theorems by examples · Description of the history of the method and Bibliographical notes
Fourier Analysis and Boundary Value Problems provides a thorough examination of both the theory and applications of partial differential equations and the Fourier and Laplace methods for their solutions. Boundary value problems, including the heat and wave equations, are integrated throughout the book. Written from a historical perspective with extensive biographical coverage of pioneers in the field, the book emphasizes the important role played by partial differential equations in engineering and physics. In addition, the author demonstrates how efforts to deal with these problems have lead to wonderfully significant developments in mathematics. A clear and complete text with more than 500 exercises, Fourier Analysis and Boundary Value Problems is a good introduction and a valuable resource for those in the field. Topics are covered from a historical perspective with biographical information on key contributors to the field. The text contains more than 500 exercises. Includes practical applications of the equations to problems in both engineering and physics.

In the present edition I have included "Supplements and Problems" located at the end of each chapter. This was done with the aim of illustrating the possibilities of the methods contained in the book, as well as with the desire to make good on what I have attempted to do over the course of many years for my students-to awaken their creativity, providing topics for independent work. The source of my own initial research was the famous two-volume book Methods of Mathematical Physics by D. Hilbert and R. Courant, and a series of original articles and surveys on partial differential equations and their applications to problems in theoretical mechanics and physics. The works of K. o. Friedrichs, which were in keeping with my own perception of the subject, had an especially strong influence on me. I was guided by the desire to prove, as simply as possible, that, like systems of n linear algebraic equations in n unknowns, the solvability of basic boundary value (and initial-boundary value) problems for partial differential equations is a consequence of the uniqueness theorems in a "sufficiently large" function space. This desire was successfully realized thanks to the introduction of various classes of general solutions and to an elaboration of the methods of proof for the corresponding uniqueness theorems. This was accomplished on the basis of comparatively simple integral inequalities for arbitrary functions and of a priori estimates of the solutions of the problems without enlisting any special representations of those solutions.

This open access book presents a comprehensive survey of modern operator techniques for boundary value problems and spectral theory, employing abstract boundary mappings and Weyl functions. It includes self-contained treatments of the extension theory of symmetric operators and relations, spectral characterizations of selfadjoint operators in terms of the analytic properties of Weyl functions, form methods for semibounded operators, and functional analytic models for reproducing kernel Hilbert spaces. Further, it illustrates these abstract methods for various applications, including Sturm-Liouville operators, canonical systems of differential equations, and multidimensional Schrödinger operators, where the abstract Weyl function appears as either the classical Titchmarsh-Weyl coefficient or the Dirichlet-to-Neumann map. The book is a valuable reference text for researchers in the areas of differential equations, functional analysis, mathematical physics, and system theory. Moreover, thanks to its detailed exposition of the theory, it is also accessible and useful for advanced students and researchers in other branches of natural sciences and engineering.

Let me begin by explaining the meaning of the title of this book. In essence, the book studies boundary value problems for linear partial differential equations in a finite domain in n-dimensional Euclidean space. The problem that is investigated is the question of the dependence of the nature of the solvability of a given equation on the way in which the boundary conditions are chosen, i.e. on the supplementary requirements which the solution is to satisfy on specified parts of the boundary. The branch of mathematical analysis dealing with the study of boundary value problems for partial differential
equations is often called mathematical physics. Classical courses in this subject usually consider quite restricted classes of equations, for which the problems have an immediate physical context, or generalizations of such problems. With the expanding domain of application of mathematical methods at the present time, there often arise problems connected with the study of partial differential equations that do not belong to any of the classical types. The elucidation of the correct formulation of these problems and the study of the specific properties of the solutions of similar equations are closely related to the study of questions of a general nature.

This book provides an elementary, accessible introduction for engineers and scientists to the concepts of ordinary and partial boundary value problems, acquainting readers with fundamental properties and with efficient methods of constructing solutions or satisfactory approximations. Discussions include: ordinary differential equations classical theory of partial differential equations Laplace and Poisson equations heat equation variational methods of solution of corresponding boundary value problems methods of solution for evolution partial differential equations The author presents special remarks for the mathematical reader, demonstrating the possibility of generalizations of obtained results and showing connections between them. For the non-mathematician, the author provides profound functional-analytical results without proofs and refers the reader to the literature when necessary. Solving Ordinary and Partial Boundary Value Problems in Science and Engineering contains essential functional analytical concepts, explaining its subject without excessive abstraction.

References questions which can be answered by looking at the illustrations, such as "This poor sheep is in despair, her naughty lamb is hiding where?"
be an enticing invitation to join this important area of mathematical research. Starting with the basics of boundary value problems for ordinary differential equations, linear equations and the construction of Green's functions are presented clearly. A discussion of the important question of the existence of solutions to both linear and nonlinear problems plays a central role in this volume and this includes solution matching and the comparison of eigenvalues. The important and very active research area on existence and multiplicity of positive solutions is treated in detail. The last chapter is devoted to nodal solutions for BVPs with separated boundary conditions as well as for non-local problems. While this Volume II complements, it can be used as a stand-alone work.

Initial-Boundary Value Problems and the Navier-Stokes Equations gives an introduction to the vast subject of initial and initial-boundary value problems for PDEs. Applications to parabolic and hyperbolic systems are emphasized in this text. The Navier-Stokes equations for compressible and incompressible flows are taken as an example to illustrate the results. The subjects addressed in the book, such as the well-posedness of initial-boundary value problems, are of frequent interest when PDEs are used in modeling or when they are solved numerically. The book explains the principles of these subjects. The reader will learn what well-posedness or ill-posedness means and how it can be demonstrated for concrete problems. Audience: when the book was written, the main intent was to write a text on initial-boundary value problems that was accessible to a rather wide audience. Functional analytical prerequisites were kept to a minimum or were developed in the book. Boundary conditions are analyzed without first proving trace theorems, and similar simplifications have been used throughout. This book continues to be useful to researchers and graduate students in applied mathematics and engineering.


A book on an advanced level that exposes the reader to the fascinating field of differential equations and provides a ready access to an up-to-date state of this art is of immense value. This book presents a variety of techniques that are employed in the theory of nonlinear boundary value problems. For example, the following are discussed: methods that involve differential inequalities; shooting and angular function techniques; functional analytic approaches; topological methods.

Never HIGHLIGHT a Book Again! Virtually all of the testable terms, concepts, persons, places, and events from the textbook are included. Cram101 Just the FACTS101 studyguides give all of the outlines, highlights, notes, and quizzes for your textbook with optional online comprehensive practice tests. Only Cram101 is Textbook Specific. Accompanys: 9780470418505.