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An Introduction to Partial Differential Equations

An Introduction

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Partial Differential Equations with Fourier Series and Boundary Value Problems
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ALBERT SILAS

*With Fourier Series and Boundary Value
Problems* Academic Press

An Introduction to Partial Differential Equations with MATLAB®, Second Edition illustrates the usefulness of PDEs through numerous applications and helps students appreciate the beauty of the underlying mathematics. Updated throughout, this second edition of a bestseller shows students how PDEs can model diverse problems, including the flow of heat, the propagation of sound waves, the spread of algae along the ocean's surface, the fluctuation in the price of a stock option, and the quantum mechanical behavior of a hydrogen atom. Suitable for a two-semester introduction to PDEs and Fourier series for mathematics, physics, and engineering students, the text teaches the equations based on method of solution. It provides both physical and mathematical motivation as much as possible. The author treats problems in one spatial dimension before dealing with those in higher dimensions. He covers PDEs on bounded domains and then on unbounded domains, introducing students to Fourier series early on in the

text. Each chapter's prelude explains what and why material is to be covered and considers the material in a historical setting. The text also contains many exercises, including standard ones and graphical problems using MATLAB. While the book can be used without MATLAB, instructors and students are encouraged to take advantage of MATLAB's excellent graphics capabilities. The MATLAB code used to generate the tables and figures is available in an appendix and on the author's website.

**Applied Partial Differential
Equations with Fourier Series and
Boundary Value Problems** Courier
Corporation

Combining both the classical theory and numerical techniques for partial differential equations, this thoroughly modern approach shows the significance of computations in PDEs and illustrates the strong interaction between mathematical theory and the development of numerical methods. Great care has been taken throughout the book to seek a sound balance between these techniques. The authors present the material at an easy pace and exercises ranging from the straightforward to the challenging have been included. In addition there are some "projects" suggested, either to refresh the students memory of results needed in this course, or to extend the theories developed in the text. Suitable for undergraduate and graduate

students in mathematics and engineering.

Partial Differential Equations with Numerical Methods Springer Science & Business Media

This book introduces finite difference methods for both ordinary differential equations (ODEs) and partial differential equations (PDEs) and discusses the similarities and differences between algorithm design and stability analysis for different types of equations. A unified view of stability theory for ODEs and PDEs is presented, and the interplay between ODE and PDE analysis is stressed. The text emphasizes standard classical methods, but several newer approaches also are introduced and are described in the context of simple motivating examples.

Applied Partial Differential Equations: Allied Publishers

This text provides an application oriented introduction to the numerical methods for partial differential equations. It covers finite difference, finite element, and finite volume methods, interweaving theory and applications throughout. The book examines modern topics such as adaptive methods, multilevel methods, and methods for convection-dominated problems and includes detailed illustrations and extensive exercises.

Partial Differential Equations and Boundary-value Problems with Applications CRC Press

This book is written to meet the needs of undergraduates in applied mathematics, physics and engineering studying partial differential equations. It is a more modern, comprehensive treatment intended for students who need more than the purely numerical solutions provided by programs like the MATLAB PDE Toolbox, and those obtained by the

method of separation of variables, which is usually the only theoretical approach found in the majority of elementary textbooks. This will fill a need in the market for a more modern text for future working engineers, and one that students can read and understand much more easily than those currently on the market. * Includes new and important materials necessary to meet current demands made by diverse applications * Very detailed solutions to odd numbered problems to help students * Instructor's Manual Available

Applied Partial Differential Equations Springer Science & Business Media

This text emphasizes the physical interpretation of mathematical solutions and introduces applied mathematics while presenting differential equations. Coverage includes Fourier series, orthogonal functions, boundary value problems, Green's functions, and transform methods. This text is ideal for students in science, engineering, and applied mathematics.

Springer Science & Business Media

The book has been completely rewritten for this new edition. While most of the material found in the earlier editions has been retained, though in changed form, there are considerable additions, in which extensive use is made of Fourier transform techniques, Hilbert space, and finite difference methods. A condensed version of the present work was presented in a series of lectures as part of the Tata Institute of Fundamental Research -Indian Institute of Science Mathematics Programme in Bangalore in 1977. I am indebted to Professor K. G. Ramanathan for the opportunity to participate in this exciting educational venture, and to Professor K. Balagangadharan for his ever ready help

and advice and many stimulating discussions. Very special thanks are due to N. Sivaramakrishnan and R. Mythili, who ably and cheerfully prepared notes of my lectures which I was able to use as the nucleus of the present edition. A word about the choice of material. The constraints imposed by a partial differential equation on its solutions (like those imposed by the environment on a living organism) have an infinite variety of consequences, local and global, identities and inequalities. Theories of such equations usually attempt to analyse the structure of individual solutions and of the whole manifold of solutions by testing the compatibility of the differential equation with various types of additional constraints.

Finite Difference Methods for Ordinary and Partial Differential Equations

Walter de Gruyter

This new edition features the latest tools for modeling, characterizing, and solving partial differential equations. The Third Edition of this classic text offers a comprehensive guide to modeling, characterizing, and solving partial differential equations (PDEs). The author provides all the theory and tools necessary to solve problems via exact, approximate, and numerical methods. The Third Edition retains all the hallmarks of its previous editions, including an emphasis on practical applications, clear writing style and logical organization, and extensive use of real-world examples. Among the new and revised material, the book features:

- * A new section at the end of each original chapter, exhibiting the use of specially constructed Maple procedures that solve PDEs via many of the methods presented in the chapters. The results can be evaluated numerically or displayed graphically.
- * Two new

chapters that present finite difference and finite element methods for the solution of PDEs. Newly constructed Maple procedures are provided and used to carry out each of these methods. All the numerical results can be displayed graphically.

- * A related FTP site that includes all the Maple code used in the text.
- * New exercises in each chapter, and answers to many of the exercises are provided via the FTP site.

A supplementary Instructor's Solutions Manual is available. The book begins with a demonstration of how the three basic types of equations—parabolic, hyperbolic, and elliptic—can be derived from random walk models. It then covers an exceptionally broad range of topics, including questions of stability, analysis of singularities, transform methods, Green's functions, and perturbation and asymptotic treatments. Approximation methods for simplifying complicated problems and solutions are described, and linear and nonlinear problems not easily solved by standard methods are examined in depth. Examples from the fields of engineering and physical sciences are used liberally throughout the text to help illustrate how theory and techniques are applied to actual problems. With its extensive use of examples and exercises, this text is recommended for advanced undergraduates and graduate students in engineering, science, and applied mathematics, as well as professionals in any of these fields. It is possible to use the text, as in the past, without use of the new Maple material.

Applied Partial Differential Equations

Springer Science & Business Media

This is an accessible book on the advanced symmetry methods for differential equations, including such subjects as conservation laws, Lie-

Bäcklund symmetries, contact transformations, adjoint symmetries, Nöther's Theorem, mappings with some modification, potential symmetries, nonlocal symmetries, nonlocal mappings, and non-classical method. Of use to graduate students and researchers in mathematics and physics.

[Applied Partial Differential Equations](#)

Applied Partial Differential Equations with Fourier Series and Boundary Value Problems, Books a la Carte

This title is part of the Pearson Modern Classics series. Pearson Modern Classics are acclaimed titles at a value price.

Please visit

www.pearsonhighered.com/math-classics-series for a complete list of titles.

Applied Partial Differential Equations with Fourier Series and Boundary Value Problems emphasizes the physical interpretation of mathematical solutions and introduces applied mathematics while presenting differential equations. Coverage includes Fourier series, orthogonal functions, boundary value problems, Green's functions, and transform methods. This text is ideal for readers interested in science, engineering, and applied mathematics.

[An Introduction to Partial Differential Equations with MATLAB, Second Edition](#)

Springer Science & Business Media

This textbook is designed for a one year course covering the fundamentals of partial differential equations, geared towards advanced undergraduates and beginning graduate students in mathematics, science, engineering, and elsewhere. The exposition carefully balances solution techniques, mathematical rigor, and significant applications, all illustrated by numerous examples. Extensive exercise sets appear at the end of almost every subsection, and include straightforward

computational problems to develop and reinforce new techniques and results, details on theoretical developments and proofs, challenging projects both computational and conceptual, and supplementary material that motivates the student to delve further into the subject. No previous experience with the subject of partial differential equations or Fourier theory is assumed, the main prerequisites being undergraduate calculus, both one- and multi-variable, ordinary differential equations, and basic linear algebra. While the classical topics of separation of variables, Fourier analysis, boundary value problems, Green's functions, and special functions continue to form the core of an introductory course, the inclusion of nonlinear equations, shock wave dynamics, symmetry and similarity, the Maximum Principle, financial models, dispersion and solutions, Huygens' Principle, quantum mechanical systems, and more make this text well attuned to recent developments and trends in this active field of contemporary research. Numerical approximation schemes are an important component of any introductory course, and the text covers the two most basic approaches: finite differences and finite elements.

[Pearson New International Edition](#)

Springer

This textbook is for the standard, one-semester, junior-senior course that often goes by the title "Elementary Partial Differential Equations" or "Boundary Value Problems;" The audience usually consists of students in mathematics, engineering, and the physical sciences. The topics include derivations of some of the standard equations of mathematical physics (including the heat equation, the wave equation, and the Laplace's equation) and methods for solving those

equations on bounded and unbounded domains. Methods include eigenfunction expansions or separation of variables, and methods based on Fourier and Laplace transforms. Prerequisites include calculus and a post-calculus differential equations course. There are several excellent texts for this course, so one can legitimately ask why one would wish to write another. A survey of the content of the existing titles shows that their scope is broad and the analysis detailed; and they often exceed five hundred pages in length. These books generally have enough material for two, three, or even four semesters. Yet, many undergraduate courses are one-semester courses. The author has often felt that students become a little uncomfortable when an instructor jumps around in a long volume searching for the right topics, or only partially covers some topics; but they are secure in completely mastering a short, well-defined introduction. This text was written to provide a brief, one-semester introduction to partial differential equations.

[An Introduction to Theory and Applications](#) Oxford University Press on Demand

Partial Differential Equations presents a balanced and comprehensive introduction to the concepts and techniques required to solve problems containing unknown functions of multiple variables. While focusing on the three most classical partial differential equations (PDEs)—the wave, heat, and Laplace equations—this detailed text also presents a broad practical perspective that merges mathematical concepts with real-world application in diverse areas including molecular structure, photon and electron interactions, radiation of

electromagnetic waves, vibrations of a solid, and many more. Rigorous pedagogical tools aid in student comprehension; advanced topics are introduced frequently, with minimal technical jargon, and a wealth of exercises reinforce vital skills and invite additional self-study. Topics are presented in a logical progression, with major concepts such as wave propagation, heat and diffusion, electrostatics, and quantum mechanics placed in contexts familiar to students of various fields in science and engineering. By understanding the properties and applications of PDEs, students will be equipped to better analyze and interpret central processes of the natural world.

A Posteriori Estimates for Partial Differential Equations Springer

Science & Business Media

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.

Partial Differential Equations in Action
John Wiley & Sons

This text is designed for engineers, scientists, and mathematicians with a background in elementary ordinary differential equations and calculus.

Numerical Analysis of Partial Differential Equations Springer Science & Business Media

KEY BENEFIT Emphasizing physical interpretations of mathematical solutions, this book introduces applied mathematics and presents partial differential equations. KEY TOPICS Leading readers from simple exercises through increasingly powerful mathematical techniques, this book discusses heat flow and vibrating strings and membranes, for a better understanding of the relationship between mathematics and physical problems. It also emphasizes problem solving and provides a thorough approach to solutions. The third edition of *Elementary Applied Partial Differential Equations; With Fourier Series and Boundary Value Problems* has been revised to include a new chapter covering dispersive waves. It also includes new sections covering fluid flow past a circular cylinder; reflection and refraction of light and sound waves; the finite element method; partial

differential equations with spherical geometry; eigenvalue problems with a continuous and discrete spectrum; and first-order nonlinear partial differential equations. An essential reference for any technical or mathematics professional.

A Visual Approach Addison-Wesley Longman

The only comprehensive guide to modeling, characterizing, and solving partial differential equations This classic text by Erich Zauderer provides a comprehensive account of partial differential equations and their applications. Dr. Zauderer develops mathematical models that give rise to partial differential equations and describes classical and modern solution techniques. With an emphasis on practical applications, he makes liberal use of real-world examples, explores both linear and nonlinear problems, and provides approximate as well as exact solutions. He also describes approximation methods for simplifying complicated solutions and for solving linear and nonlinear problems not readily solved by standard methods. The book begins with a demonstration of how the three basic types of equations (parabolic, hyperbolic, and elliptic) can be derived from random walk models. It continues in a less statistical vein to cover an exceptionally broad range of topics, including stabilities, singularities, transform methods, the use of Green's functions, and perturbation and asymptotic treatments. Features that set *Partial Differential Equations of Applied Mathematics, Second Edition* above all other texts in the field include: Coverage of random walk problems, discontinuous and singular solutions, and perturbation and asymptotic methods More than 800 practice exercises, many of which are fully worked out Numerous up-to-date

examples from engineering and the physical sciences Partial Differential Equations of Applied Mathematics, Second Edition is a superior advanced-undergraduate to graduate-level text for students in engineering, the sciences, and applied mathematics. The title is also a valuable working resource for professionals in these fields. Dr. Zauderer received his doctorate in mathematics from the New York University-Courant Institute. Prior to joining the staff of Polytechnic University, he was a Senior Weitzmann Fellow of the Weitzmann Institute of Science in Rehovot, Israel.

Numerical Methods for Elliptic and Parabolic Partial Differential Equations Springer Science & Business Media This edition features the exact same content as the traditional text in a convenient, three-hole-punched, loose-leaf version. Books a la Carte also offer a great value--this format costs significantly less than a new textbook. This text emphasizes the physical interpretation of mathematical solutions and introduces applied mathematics while presenting differential equations. Coverage includes Fourier series, orthogonal functions, boundary value problems, Green's functions, and transform methods. This text is ideal for students in science, engineering, and applied mathematics.

Semigroups of Linear Operators and Applications to Partial Differential Equations Courier Dover Publications This book deals with the reliable verification of the accuracy of approximate solutions which is one of the central problems in modern applied analysis. After giving an overview of the methods developed for models based on partial differential equations, the author derives computable a posteriori error

estimates by using methods of the theory of partial differential equations and functional analysis. These estimates are applicable to approximate solutions computed by various methods.

Applications of Symmetry Methods to Partial Differential Equations Courier Dover Publications

The author would like to acknowledge his obligation to all his colleagues and friends at the Institute of Mathematical Sciences of New York University for their stimulation and criticism which have contributed to the writing of this tract. The author also wishes to thank

Aughtum S. Howard for permission to include results from her unpublished dissertation, Larkin Joyner for drawing the figures, Interscience Publishers for their cooperation and support, and particularly Lipman Bers, who suggested the publication in its present form. New Rochelle FRITZ JOHN September, 1955 [v] CONTENTS Introduction. 1 CHAPTER I Decomposition of an Arbitrary Function into Plane Waves Explanation of notation 7 The spherical mean of a function of a single coordinate. 7 9 Representation of a function by its plane integrals . CHAPTER II The Initial Value Problem for Hyperbolic Homogeneous Equations with Constant Coefficients Hyperbolic equations. 15 Geometry of the normal surface for a strictly hyperbolic equation. 16 Solution of the Cauchy problem for a strictly hyperbolic equation . 20 Expression of the kernel by an integral over the normal surface. 23 The domain of dependence 29 The wave equation 32 The initial value problem for hyperbolic equations with a normal surface having multiple points 36 CHAPTER III The Fundamental

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