In summary, the author has provided an elegant introduction to important topics in the theory of ordinary differential equations and has expanded his classic book to include new material on exponential growth, predator-prey, the pendulum, impulse response, symmetry groups and geometric properties of ODEs and their solutions, rather than on routine presentation of algorithms. From the reviews: "Professor Arnold Few books on Ordinary Differential Equations (ODEs) have the elegant geometric insight of this one, which puts emphasis on the qualitative three additional chapters (Eigenvalue Problems and Sturm-Liouville Equations; Stability of Autonomous Systems; and Existence and Uniqueness or junior-level course. Fundamentals of Differential Equations with Boundary Value Problems, Fifth Edition, contains enough material for a commercial available computer software. Fundamentals of Differential Equations, Seventh Edition is suitable for a one-semester sophomore- or junior-level course. Fundamentals of Differential Equations with Boundary Value Problems, Fifth Edition, contains enough material for a two-semester course that covers and builds on boundary value problems. The Boundary Value Problems version consists of the main text plus three additional chapters (Eigenvalue Problems and Sturm-Liouville Equations; Stability of Autonomous Systems; and Existence and Uniqueness Theory).

Few books on Ordinary Differential Equations (ODEs) have the elegant geometric insight of this one, which puts emphasis on the qualitative and geometric properties of ODEs and their solutions, rather than on routine presentation of algorithms. From the reviews: "Professor Arnold has expanded his classic book to include new material on exponential growth, predator-prey, the pendulum, impulse response, symmetry groups and group actions, perturbation and bifurcation." — SIAM REVIEW

In summary, the author has provided an elegant introduction to important topics in the theory of ordinary differential equations and

The book's combination of mathematical comprehensiveness and natural scientific motivation represents a step forward in the presentation of the classical theory of ODEs.

Periodic Differential Equations: An Introduction to Mathieu's, Lamé, and Allied Functions covers the fundamental problems and techniques of solution of periodic differential equations. This book is composed of 10 chapters that present important equations and the special functions they generate, ranging from Mathieu's equation to the intractable ellipsoidal wave equation. This book starts with a survey of the main problems related to the formation of periodic differential equations. The subsequent chapters deal with the general theory of Mathieu's equation, Lamé's functions of integral order, and the principles of asymptotic expansions. These topics are followed by discussions of the stable and unstable solutions of Mathieu's general equation; general properties and characteristic exponent of Hill's equation; and the general nature and solutions of the spherical wave equation. The concluding chapters explore the polyharmonics, orthogonal properties, and integral relations of Lamé's equation. These chapters also describe the wave functions and solutions of the ellipsoidal wave equation. This book will prove useful to pure and applied mathematicians and functional analysts.

A Practical Course in Differential Equations and Mathematical Modelling is a unique blend of the traditional mathematical problems and solution of ordinary differential equations with Lie group analysis enriched by the author's own theoretical developments. This book is aimed at courses in mathematical analysis. The book is a valuable tool for both pure and applied mathematicians and scientists, including physicists, chemical engineers, and chemists. The book begins with an elementary discussion of the fundamental principles of differential equations that are useful in the solution of physical problems and are likely to be used in research. Qualitative Estimates For Partial Differential Equations: An Introduction is an ideal book for students, professors, lecturers, and researchers who need a comprehensive introduction to qualitative methods for solving ODEs in engineering and the natural sciences.

This text is about the analytical aspects of ordinary differential equations and the relations between dynamical systems and certain fields outside pure mathematics. It is an update of one of Aca

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The book's combination of mathematical comprehensiveness and natural scientific motivation represents a step forward in the presentation of the classical theory of ODEs.
This volume is intended as an essentially self contained exposition of portions of the theory of second order quasilinear elliptic partial differential equations. Chapter 7 is a concise introduction to the important Fredholm theory of linear integral equations. The final chapter is a well selected collection of fascinating miscellaneous facts about differential and integral equations. The preface and introduction provide a good course in advanced calculus, some preparation in linear algebra, and a reasonable acquaintance with elementary complex analysis. There are exercises throughout the text, with the more advanced of them providing good challenges to the student.

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 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 recent nonlinear, shock wave dynamics, symmetry and soliton theory, Maximum Principle, finite models, dispersion and solutions, Boundary Value Problems, quation, 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 two most basic approaches: Finite differences and finite elements. Maximum Principles for the Hill’s Equation focuses on the application of these methods to nonlinear equations with singularities (e.g. Brillouin-bem focusing equation, Ermakov-Pinney,) and for problems with parametric dependence. The authors discuss the properties of the related Green’s functions coupled with different boundary value conditions. In addition, they establish the equations’ relationship with the spectral theory developed for the homogeneous case, and discuss stability and constant sign solutions. Finally, reviews of present classical and recent results made by the authors and by other key authors are included. Evaluates classical techniques in the Hill’s equation that are crucial for understanding modern physical models and non-linear applications. Describes explicit and effective conditions on maximum and anti-maximum principles. Collates information from disparate sources in one self-contained volume, with extensive referencing throughout.

Maximum Principles are central to the theory and applications of second-order partial differential equations and systems. This self-contained text establishes the fundamental principles and provides a variety of applications.

An accessible, practical introduction to the principles of differential equations. The field of differential equations is a keystone of scientific knowledge today, with broad applications in mathematics, engineering, physics, and other scientific fields. Encompassing both basic concepts and advanced results, Principles of Differential Equations is the definitive, hands-on introduction for professionals and students in need of a strong knowledge base applicable to the many diverse subfields of differential equations and dynamical systems. Nelson Markley includes essential background from analysis and linear algebra, in a unified approach to ordinary differential equations that underscores how key theoretical ingredients interconnect. With basic existence and uniqueness results, Principles of Differential Equations systematically illuminates the theory, progressing through linear systems to stable manifolds and bifurcation theory. Other topics covered include: Basic dynamical systems concepts, Constant coefficients Stability, The Poincaré return map, Smooth vector fields, A comprehensive resource with complete proofs and more than 200 exercises, Principles of Differential Equations is the ideal study reference for professionals, and an effective introduction and tutorial for students.

This concise book covers the classical tools of PDE theory used in today’s science and engineering: characteristics, the wave propagation, the Fourier method, distributions, Sobolev spaces, fundamental solutions, and Green’s functions. The approach is problem-oriented, giving the reader an opportunity to master solution techniques. The theoretical part is rigorous and with important details presented with care. Hints are provided to help the reader restore the arguments to their full rigor. Many examples from physics are intended to keep the book intuitive and to illustrate the applied nature of the subject. The book is useful for a higher-level undergraduate course and for self-study.

This book introduces new methods in the theory of partial differential equations derived from a Lagrangian. These methods constitute, in part, an extension to partial differential equations of the methods of symplectic geometry and Hamilton-Jacobi theory for Lagrangian systems of ordinary differential equations. A distinguishing characteristic of this approach is that one considers, at once, entire families of solutions of the Euler-Lagrange equations, rather than restricting attention to single solutions at a time. The second part of the book develops a general theory of integral identities, the theory of “compatible currents,” which extends the work of W. Noether. Finally, this third part introduces a new general definition of hyperbolicity, based on a quadratic form associated with the Lagrangian, which overcomes the obstacles arising from the characteristic variety that were encountered in previous approaches. On the basis of the new definition, the domain-of-dependence theorem and stability properties of solutions are derived. Applications to continuum mechanics are discussed throughout the book. The last chapter is devoted to the electrodynamics of nonlinear continuous media.

The maximum principle induces an order structure for partial differential equations, and has become an important tool in nonlinear analysis. This book is the first of two volumes to systematically introduce the applications of order structure in certain nonlinear partial differential equations. The maximum principle is revisited through the use of the Kras-Rutman theorem and the principal eigenvalues. Various techniques such as the moving plane and sliding plane methods, are applied to a variety of important problems of current interest. The upper and lower solution method, especially its weak version, is presented in its most up-to-date form with enough generality to cater for wide applications. Recent progress on the boundary blow-up problems and their applications are discussed, as well as some new symmetry and Liouville type results over half and entire spaces. Some of the results included here are published for the first time.

The inverse problem of the calculus of variations was first studied by Helmholtz in 1887 and it is entirely solved for the differential operators, but only recent results are known in the more general case of differential equations. This book looks at second-order differential equations and the Euler-Lagrange equations, if we are quadratic, the problem reduces to the characterization which are Levi-Civita for some Riemann metric. To solve the inverse problem, the authors use the formal inverse of the calculus of variations developed in the previous section. The main theorems of the book furnish a complete illustration of these techniques because all possible situations appear: involutivity, 2-acyclicity, prolongation, integrability theory of overdetermined partial differential systems in the Spencer-Quillen-Goldschmidt version. The main theorems of the book give a complete illustration of these techniques because all possible situations appear: involutivity, 2-acyclicity, prolongation, integrability theory of overdetermined partial differential systems in the Spencer-Quillen-Goldschmidt version.

The Second Edition of Ordinary Differential Equations: An Introduction to the Fundamental Ideas builds on the successful First Edition. It is unique in its approach to motivation, precision, explanation and method. Its layered approach offers the instructor opportunity for greater flexibility in course design, suggesting how the text can be applied to different courses. New chapters on more advanced numerical methods and systems (including the Runge-Kutta method and the numerical solution of second- and higher-order differential equations) An extensive on-line solution manual About the author: Kenneth B. Howell earned bachelor's degrees in both mathematics and physics from Rose-Hulman Institute of Technology, and master's and doctoral degrees in mathematics from Indiana University. For more than thirty years, he was a professor in the Department of Mathematical Sciences of the University of Alabama in Huntsville. Dr. Howell published numerous research articles in applied and theoretical mathematics in prestigious journals, served as a consulting research scientist for various companies and federal agencies in the space and defense industries, and received awards from the College and University for outstanding teaching. He is also the author of Principles of Fourier Analysis, Second Edition (Chapman & Hall/CRC, 2016).

This volume is intended as an essentially self contained exposition of portions of the theory of second order quasilinear elliptic partial differential equations. Chapter 7 is a concise introduction to the important Fredholm theory of linear integral equations. The final chapter is a well selected collection of fascinating miscellaneous facts about differential and integral equations. The preceeding sections on ordinary differential equa...
differential equations, with emphasis on the Dirichlet problem in bounded domains. It grew out of lecture notes for graduate courses by the authors at Stanford University, the final material extending well beyond the scope of these courses. By including preparatory chapters on topics such as potential theory and functional analysis, we have attempted to make the work accessible to a broad spectrum of readers. Above all, we hope the readers of this book will gain an appreciation of the multitude of ingenious handcrafted techniques that have been developed in the study of elliptic equations and become part of the repertoire of analysts. Many individuals have assisted us during the evolution of this work over the past several years. In particular, we are grateful for the valuable discussions with L. M. Simon and his contributions in Sections 15.4 to 15.8, for the helpful comments and corrections of J. M. Closs, A. S. Grue, J. Nash, P. Trudinger and B. Turkington; for the contributions of G. Williams in Section 10.5 and of A. S. Grue in Section 10.6; and for the impecably typed manuscript which resulted from the dedicated efforts of Isfjord Field at Stanford and Anna Zalucki at Cambridge. The research of the authors connected with this volume was supported in part by the National Science Foundation.

Suitable for both senior undergraduate and graduate students, this is a self-contained book dealing with the classical theory of the partial differential equations through a modern approach; requiring minimal previous knowledge. It represents the solutions to three important equations of mathematical physics - Laplace and Poisson equations, Heat or diffusion equation, and wave equations in one and more space dimensions. Keen readers will benefit from more advanced topics and many references cited at the end of each chapter. In addition, the book covers advanced topics such as Conservation Laws and Hamilton-Jacobi Equation. Numerous real-life applications are interspersed throughout the book to retain the reader's interest.

This advanced graduate-level text examines variational methods in partial differential equations and illustrates their applications to a number of free-boundary problems and parabolic operators make this treatment readable for engineers, students, and non-specialists alike. The text's first two chapters can be used for a single-semester graduate course in variational inequalities or partial differential equations. The succeeding chapters -- covering jets and cavities, variational problems with potential, etc. -- are more specialized and self-contained. Readers who have mastered chapters 1 and 2 will be able to conduct research on the problems explored in subsequent chapters. Bibliographic remarks conclude each chapter, along with several problems and exercises.

Maxium principles are central to the theory and applications of second-order partial differential equations and systems. This text establishes the fundamental principles and provides a variety of applications.

"Optimal control theory is concerned with finding control functions that minimize cost functions for systems described by differential equations. The methods have found widespread applications in aeronautics, mechanical engineering, the life sciences, and many other disciplines. This book focuses on optimal control problems where the state equation is an elliptic or parabolic partial differential equation. It is intended to be an introductory text on the existence of optimal solutions, necessary optimality conditions and adjoint equations, second-order sufficient conditions, and main principles of selected numerical techniques. It also contains a survey on the Karush-Kuhn-Tucker theory of non-linear programming in Banach spaces. The exposition begins with control problems with linear equations, quadratic cost functionals, and the book self-contained, basic facts on weak solutions of elliptic and parabolic equations are introduced. Principles of functional analysis are introduced and explained as they are needed. Many simple examples illustrate the theory and its difficulties. This starts with the book makes it fairly self-contained and suitable for advanced undergraduates or beginning graduate students. Advanced control problems for nonlinear partial differential equations are also discussed. A prerequisite, results on boundedness and continuity of solutions to semilinear elliptic and parabolic equations are addressed. These topics are not yet readily available in books on PDEs, making the exposition also interesting for researchers. Alongside the main theme of the analysis of problems of optimal control, Tr"oltzsch also includes the basic ideas in order to give the reader an impression of how the theory can be realized numerically. For the reader reading this book, the reader will be familiar with the main principles of the numerical analysis of PDE-constrained optimization."--Publisher's description.

International Series of Monographs in Pure and Applied Mathematics, Volume 67: Non-Linear Differential Equations, Revised Edition focuses on the analysis of the phase portrait of two-dimensional autonomous systems; qualitative methods used in finding periodic solutions in periodic systems; and study of asymptotic behavior of solutions of differential systems. Periodic, autonomous systems, and interval curves are explained. The text explains the singularities of B"ottcher-Bouquet theory. The selection takes a look at plane autonomous systems. Topics include limiting sets, plane cycles, isolated singular points, index, and the torus as phase space. The text also examines autonomous plane systems with perturbations and autonomous and non-autonomous systems with one degree of freedom. The book also tackles linear systems. Reducible systems, periodic solutions, and linear periodic systems are considered. The book is a vital source of information for researchers interested in applied mathematics.

Incorporating an innovative modeling approach, this book for a one-semester differential equations course emphasizes conceptual understanding to help users relate information taught in the classroom to real-world experiences. Certain models reappear throughout the book as running themes to synthesize different concepts from multiple angles, and a dynamical systems focus emphasizes predicting the long-term behavior of these recurring models. Users will discover how to identify and harness the mathematics they will use in their careers, and apply it effectively outside the classroom. Important Notice: Media content referenced with the product description or the product text may not be available in the eBook version.

Inclusive, self-contained account of tensor analysis and the calculus of exterior differential forms, interaction between the concept of invariance and the calculus of variations. Emphasis is on analytical techniques. Includes problems.

An easy to understand guide covering key principles of ordinary differential equations and their applications.


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 applications 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 depth to reinforce vital skills and inspire additional self-study. Topics are presented in a logical progression, with major concepts such as wave propagation, heat and diffusion, electrodynamics, 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.

An introduction to symmetry methods, informally written and aimed at applied mathematicians, physicists, and engineers. Graduate-level text offers full treatments of existence theorems, representation of solutions by series, theory of majorants, dominants and minorants, questions of growth, much more. Includes 675 exercises. Bibliography.

A complete introduction to partial differential equations, this is a textbook aimed at students of mathematics, physics and engineering.

This concise book covers the classical tools of Partial Differential Equations Theory in today's science and engineering. The rigorous theoretical presentation includes many hints, and the book contains many illustrative applications from physics. The first chapter collects together (but does not prove) those aspects of Lie group theory which are of importance to differential equations. A classification of the applications covered in the body of the book include a complete review of symmetry of differential equations, existence of ordinary differential equations, integration of ordinary differential equations, including special techniques for Euler-Lagrange equations or Hamiltonian systems, differential invariants and construction of equations with pre-scribed
symmetry groups, group-invariant solutions of partial differential equations, dimensional analysis, and the connections between conservation laws and symmetry groups. Generalizations of the basic symmetry group concept, and applications to conservation laws, integrability conditions, completely integrable systems and soliton equations, and bi-Hamiltonian systems are covered in detail. The exposition is reasonably self-contained, and supplemented by numerous examples of direct physical importance, chosen from classical mechanics, fluid mechanics, elasticity and other applied areas.