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Introductory treatment explores existence theorems for first-order scalar and vector equations, basic properties of linear vector equations, and two-dimensional nonlinear autonomous systems. "A rigorous and lively introduction." — The American Mathematical Monthly. 1958 edition. A thorough and systematic first course in elementary differential equations for undergraduates in mathematics and science, with many exercises and problems (with answers). The first contemporary textbook on ordinary differential equations (ODEs) to include instructions on MATLAB, Mathematica, and Maple A Course in Ordinary Differential Equations focuses on applications and methods of analytical and numerical solutions, emphasizing approaches used in the typical engineering, physics, or mathematics student's field o Learn to develop numerical methods for ordinary differential equations General Linear Methods for Ordinary Differential Equations fills a gap in the existing literature by presenting a comprehensive and up-to-date collection of recent advances and developments in the field. This book provides modern coverage of the theory, construction, and implementation of both classical and modern general linear methods for solving ordinary differential equations as they apply to a variety of related areas, including mathematics, applied science, and engineering. The author provides the theoretical foundation for understanding basic concepts and presents a short introduction to ordinary differential equations that encompasses the related concepts of existence and uniqueness theory, stability theory, and stiff differential equations and systems. In addition, a thorough presentation of general linear methods explores relevant subtopics such as pre-consistency, consistency, stage-consistency, zero stability, convergence, order- and stage-order conditions, local discretization error, and linear stability theory. Subsequent chapters feature coverage of: Differential equations and systems Introduction to general linear methods (GLMs) Diagonally implicit multistage integration methods (DIMSIMs) Implementation of DIMSIMs Two-step Runge-Kutta (TSRK) methods Implementation of TSRK methods GLMs with inherent Runge-Kutta stability (IRKS) Implementation of GLMs with IRKS General Linear Methods for Ordinary Differential Equations is an excellent book for courses on numerical ordinary differential equations at the upper-undergraduate and graduate levels. It is also a useful reference for academic and research professionals in the fields of computational and applied mathematics, computational physics, civil and chemical engineering, chemistry, and the life sciences. Among the topics covered in this classic treatment are linear differential equations; solution in an infinite form; solution by definite integrals; algebraic theory; Sturmian theory and its later developments; further developments in the theory of boundary problems; existence theorems, equations of first order; nonlinear equations of higher order; more. "Highly recommended" — Electronics Industries. Based on a one-year course taught by the author to graduates at the University of Missouri, this book provides a student-friendly account of some of the standard topics encountered in an introductory course of ordinary differential equations. In a second semester, these ideas can be expanded by introducing more advanced concepts and applications. A central theme in the book is the use of Implicit Function Theorem, while the latter sections of the book introduce the basic ideas of perturbation theory as applications of this Theorem. The book also contains material differing from standard treatments, for example, the Fiber Contraction Principle is used to prove the smoothness of functions that are obtained as fixed points of contractions. The ideas introduced in this section can be extended to infinite dimensions. These materials - developed and thoroughly class tested over many years by the authors -are for use in courses at the sophomore/junior level. A prerequisite is the calculus of one variable, although calculus of several variables, and linear algebra are recommended. The text covers the standard topics in first and second order equations, power series solutions, first order systems, Laplace transforms, numerical methods and stability of non-linear systems. Liberal use is made of programs in Mathematica, both for symbolic computations and graphical displays. The programs are described in separate sections, as well as in the accompanying Mathematica notebooks. However, the book has been designed so that it can be read with or without Mathematica and no previous knowledge of Mathematica is required. The CD-ROM contains the Mathematica solution of worked examples, a selection of various Mathematica notebooks, Mathematica movies and sample labs for students. Mathematica programs and additional problem/example files will be available online through the TELOS Web site and the authors dedicated web site. Skillfully organized introductory text examines origin of differential equations, then defines basic terms and outlines the general solution of a differential equation. Subsequent sections deal with integrating factors; dilution and accretion problems; linearization of first order systems; Laplace Transforms; Newton's Interpolation Formulas, more. This book offers readers a primer on the theory and applications of Ordinary Differential Equations. The style used is simple, yet thorough and rigorous. Each chapter ends with a broad set of exercises that range from the routine to the more challenging and thought-provoking.

Solutions to selected exercises can be found at the end of the book. The book contains many interesting examples on topics such as electric circuits, the pendulum equation, the logistic equation, the Lotka-Volterra system, the Laplace Transform, etc., which introduce students to a number of interesting aspects of the theory and applications. The work is mainly intended for students of Mathematics, Physics, Engineering, Computer Science and other areas of the natural and social sciences that use ordinary differential equations, and who have a firm grasp of Calculus and a minimal understanding of the basic concepts used in Linear Algebra. It also studies a few more advanced topics, such as Stability Theory and Boundary Value Problems, which may be suitable for more advanced undergraduate or first-year graduate students. The second edition has been revised to correct minor errata, and features a number of carefully selected new exercises, together with more detailed explanations of some of the topics. A complete Solutions Manual, containing solutions to all the exercises published in the book, is available. Instructors who wish to adopt the book may request the manual by writing directly to one of the authors. This book provides a self-contained introduction to ordinary differential equations and dynamical systems suitable for beginning graduate students. The first part begins with some simple examples of explicitly solvable equations and a first glance at qualitative methods. Then the fundamental results concerning the initial value problem are proved: existence, uniqueness, extensibility, dependence on initial conditions. Furthermore, linear equations are considered, including the Floquet theorem, and some perturbation results. As somewhat independent topics, the Frobenius method for linear equations in the complex domain is established and Sturm-Liouville boundary value problems, including oscillation theory, are investigated. The second part introduces the concept of a dynamical system. The Poincare-Bendixson theorem is proved, and several examples of planar systems from classical mechanics, ecology, and electrical engineering are investigated. Moreover, attractors, Hamiltonian systems, the KAM theorem, and periodic solutions are discussed. Finally, stability is studied, including the stable manifold and the Hartman-Grobman theorem for both continuous and discrete systems. The third part introduces chaos, beginning with the basics for iterated interval maps and ending with the Smale-Birkhoff theorem and the Melnikov method for homoclinic orbits. The text contains almost three hundred exercises. Additionally, the use of mathematical software systems is incorporated throughout, showing how they can help in the study of differential equations. This introductory text explores 1st- and 2nd-order differential equations, series solutions, the Laplace transform, difference equations, much more. Numerous figures, problems with solutions, notes. 1994 edition. Includes 268 figures and 23 tables. The contemporary approach of J Kurzweil and R Henstock to the Perron integral is applied to the theory of ordinary differential equations in this book. It focuses mainly on the problems of continuous dependence on parameters for ordinary differential equations. For this purpose, a generalized form of the integral based on integral sums is defined. The theory of generalized differential equations based on this integral is then used, for example, to cover differential equations with impulses or measure differential equations. Solutions of generalized differential equations are found to be functions of bounded variations.The book may be used for a special undergraduate course in mathematics or as a postgraduate text. As there are currently no other special research monographs or textbooks on this topic in English, this book is an invaluable reference text for those interested in this field. In the traditional curriculum, students rarely study nonlinear differential equations and nonlinear systems due to the difficulty or impossibility of computing explicit solutions manually. Although the theory associated with nonlinear systems is advanced, generating a numerical solution with a computer and interpreting that solution are fairly elementary. Bringing the computer into the classroom, Ordinary Differential Equations: Applications, Models, and Computing emphasizes the use of computer software in teaching differential equations. Providing an even balance between theory, computer solution, and application, the text discusses the theorems and applications of the first-order initial value problem, including learning theory models, population growth models, epidemic models, and chemical reactions. It then examines the theory for n-th order linear differential equations and the Laplace transform and its properties, before addressing several linear differential equations with constant coefficients that arise in physical and electrical systems. The author also presents systems of first-order differential equations as well as linear systems with constant coefficients that arise in physical systems, such as coupled spring-mass systems, pendulum systems, the path of an electron, and mixture problems. The final chapter introduces techniques for determining the behavior of solutions to systems of first-order differential equations without first finding the solutions. Designed to be independent of any particular software package, the book includes a CD-ROM with the software used to generate the solutions and graphs for the examples. The appendices contain complete instructions for running the software. A solutions manual is available for qualifying instructors. This treatment presents most of the methods for solving ordinary differential equations and systematic arrangements of more than 2,000 equations and their solutions. The material is organized so that standard equations can be easily found. Plus, the substantial number and variety of equations promises an exact equation or a sufficiently similar one. 1960 edition. The subject of this book is the solution of stiff differential equations and of differential-algebraic systems. This second edition contains new material including new numerical tests, recent progress in numerical differential-algebraic equations, and improved FORTRAN codes. From the reviews: "A superb book...Throughout, illuminating graphics, sketches and quotes from papers of researchers in the field add an element of easy informality and motivate the text." --MATHEMATICS TODAY This book presents a complete theory of ordinary differential equations, with many illustrative examples and interesting exercises. A rigorous treatment is offered in this book with clear proofs for the theoretical results and with detailed solutions for the examples and problems. This book is intended for undergraduate students who major in mathematics and have acquired a prerequisite knowledge of calculus and partly the knowledge of a complex variable, and are now reading advanced calculus and linear algebra. Additionally, the comprehensive coverage of the theory with a wide array of examples and detailed solutions, would appeal to mathematics graduate students and researchers as well as graduate students in majors of other disciplines. As a handy reference, advanced knowledge is provided in this book with details developed beyond the basics; optional sections, where main results are extended, offer an understanding of further applications of ordinary differential equations. This book deals with methods for solving nonstiff ordinary differential equations. The first chapter describes the historical development of the classical theory, and the second chapter includes a modern treatment of Runge-Kutta and extrapolation methods. Chapter three begins with the classical theory of multistep methods, and concludes with the theory of general linear methods. The reader will benefit from many illustrations, a historical and didactic approach, and computer programs which help him/her learn to solve all kinds of ordinary differential equations. This new edition has been rewritten and new material has been included. "Whatever regrets may be, we have done our best." (Sir Ernest Shackleton, turning back on 9 January 1909 at 88°23' South.) Brahms struggled for 20 years to write his first symphony. Compared to this, the 10 years we have been working on these two volumes may even appear short. This second volume treats stiff differential equations and differential alge braic equations. It contains three chapters: Chapter IV on one-step (Runge Kutta) methods for stiff problems, Chapter Von multistep methods for stiff problems, and Chapter VI on singular perturbation and differential-algebraic equations. Each chapter is divided into sections. Usually the first sections of a chapter are of an introductory nature, explain numerical phenomena and exhibit numerical results. Investigations of a more theoretieal nature are presented in the later sections of each chapter. As in Volume I, the formulas, theorems, tables and figures are numbered consecutively in each section and indicate, in addition, the section num ber. In cross references to other chapters the (latin) chapter number is put first. References to the bibliography are again by "author" plus "year" in parentheses. The bibliography again contains only those papers which are discussed in the text and is in no way meant to be complete. 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 Lie's group theory of differential equations unifies the many ad hoc methods known for solving differential equations and provides powerful new ways to find solutions. The theory has applications to both ordinary and partial differential equations and is not restricted to linear equations. Applications of Lie's Theory of Ordinary and Partial Differential Equations provides a concise, simple introduction to the application of Lie's theory to the solution of differential equations. The author emphasizes clarity and immediacy of understanding rather than encyclopedic completeness, rigor, and generality. This enables readers to quickly grasp the essentials and start applying the methods to find solutions. The book includes worked examples and problems from a wide range of scientific and engineering fields. This rigorous treatment prepares readers for the study of differential equations and shows them how to research current literature. It emphasizes nonlinear problems and specific analytical methods. 1969 edition. Written by an engineer and sharply focused on practical matters, this text explores the application of Lie groups to solving ordinary differential equations (ODEs). Although the mathematical proofs and derivations in are de-emphasized in favor of problem solving, the author retains the conceptual basis of continuous groups and relates the theory to problems in engineering and the sciences. The author has developed a number of new techniques that are published here for the first time, including the important and useful enlargement procedure. The author also introduces a new way of organizing tables reminiscent of that used for integral tables. These new methods and the unique organizational scheme allow a significant increase in the number of ODEs amenable to group-theory solution. Solution of Ordinary Differential Equations by Continuous Groups offers a self-contained treatment that presumes only a rudimentary exposure to ordinary differential equations. Replete with fully worked examples, it is the ideal self-study vehicle for upper division and graduate students and professionals in applied mathematics, engineering, and the sciences. Covers ODEs and PDEs—in One Textbook Until now, a comprehensive textbook covering both ordinary differential equations (ODEs) and partial differential equations (PDEs) didn’t exist. Fulfilling this need, Ordinary and Partial Differential Equations provides a complete and accessible course on ODEs and PDEs using many examples and exercises as well as intuitive, easy-to-use software. Teaches the Key Topics in Differential Equations The text includes all the topics that form the core of a modern undergraduate or beginning graduate course in differential equations. It also discusses other optional but important topics such as integral equations, Fourier series, and special functions. Numerous carefully chosen examples offer practical guidance on the concepts and techniques. Guides Students through the Problem-Solving Process Requiring no user programming, the accompanying computer software allows students to fully investigate problems, thus enabling a deeper study into the role of boundary and initial conditions, the dependence of the solution on the parameters, the accuracy of the solution, the speed of a series convergence, and related questions. The ODE module compares students' analytical solutions to the results of computations while the PDE module demonstrates the sequence of all necessary analytical solution steps. Exact solutions of differential equations continue to play an important role in the understanding of many phenomena and processes throughout the natural sciences in that they can verify the correctness of or estimate errors in solutions reached by numerical, asymptotic, and approximate analytical methods. The new edition of this bestselling handbook now contains the exact solutions to more than 6200 ordinary differential equations. The authors have made significant enhancements to this edition, including: An introductory chapter that describes exact, asymptotic, and approximate analytical methods for solving ordinary differential equations The addition of solutions to more than 1200 nonlinear equations An improved format that allows for an expanded table of contents that makes locating equations of interest more quickly and easily Expansion of the supplement on special functions This handbook's focus on equations encountered in applications and on equations that appear simple but prove particularly difficult to integrate make it an indispensable addition to the arsenals of mathematicians, scientists, and engineers alike. The Second Edition of Ordinary Differential Equations: An Introduction to the Fundamentals 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 coverage and depth. Students will appreciate the author's approach and engaging style. Reasoning behind concepts and computations motivates readers. New topics are introduced in an easily accessible manner before being further developed later. The author emphasizes a basic understanding of the principles as well as modeling, computation procedures and the use of technology. The students will further appreciate the guides for carrying out the lengthier computational procedures with illustrative examples integrated into the discussion. Features of the Second Edition: Emphasizes motivation, a basic understanding of the mathematics, modeling and use of technology A layered approach that allows for a flexible presentation based on instructor's preferences and students' abilities An instructor's guide 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 equations) Many additional exercises, including two "chapters" of review exercises for first- 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 brief modern introduction to the subject of ordinary differential equations emphasizes stability theory. Concisely and lucidly expressed, it is intended as a supplementary text for advanced undergraduates or beginning graduate students who have completed a first course in ordinary differential equations. The author begins by developing the notions of a fundamental system of solutions, the Wronskian, and the corresponding fundamental matrix. Subsequent chapters explore the linear equation with constant coefficients, stability theory for autonomous and nonautonomous systems, and the problems of the existence and uniqueness of solutions and related topics. Problems at the end of each chapter and two Appendixes on special topics enrich the text. Ordinary differential equations serve as mathematical models for many exciting real world problems. Rapid growth in the theory and applications of differential equations has resulted in a continued interest in their study by students in many disciplines. This textbook organizes material around theorems and proofs, comprising of 42 class-tested lectures that effectively convey the subject in easily manageable sections. The presentation is driven by detailed examples that illustrate how the subject works. Numerous exercise sets, with an "answers and hints" section, are included. The book further provides a background and history of the subject. 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. This outstanding text concentrates on the mathematical ideas underlying various asymptotic methods for ordinary differential equations that lead to full, infinite expansions. "A book of great value." — Mathematical Reviews. 1976 revised edition. Numerical Solutions of Boundary Value Problems for Ordinary Differential Equations covers the proceedings of the 1974 Symposium by the same title, held at the University of Maryland, Baltimore Country Campus. This symposium aims to bring together a number of numerical analysis involved in research in both theoretical and practical aspects of this field. This text is organized into three parts encompassing 15 chapters. Part I reviews the initial and boundary value problems. Part II explores a large number of important results of both theoretical and practical nature of the field, including discussions of the smooth and local interpolant with small K-th derivative, the occurrence and solution of boundary value reaction systems, the posteriori error estimates, and boundary problem solvers for first order systems based on deferred corrections. Part III highlights the practical applications of the boundary value problems, specifically a high-order finite-difference method for the solution of two-point boundary-value problems on a uniform mesh. This book will prove useful to mathematicians, engineers, and physicists. Teaches techniques for constructing solutions of differential equations in a novel way, often giving readers opportunity for ingenuity.

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