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Mathematics in Science and Engineering, Volume 48: Comparison and Oscillation Theory of Linear Differential Equations deals primarily with the zeros of solutions of linear differential equations. This volume contains five chapters. Chapter 1 focuses on comparison theorems for second order equations, while Chapter 2 treats oscillation and nonoscillation theorems for second order equations. Separation, comparison, and oscillation theorems for fourth order equations are covered in Chapter 3. In Chapter 4, ordinary equations and systems of differential equations are reviewed. The last chapter discusses the result of the first analog of a Sturm-type comparison theorem for an elliptic partial differential equation. This publication is intended for college seniors or beginning graduate students who are well-acquainted with advanced calculus, complex analysis, linear algebra, and linear differential equations. 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. This text offers students in mathematics, engineering, and the applied sciences a solid foundation for advanced studies in mathematics.

Classical topics presented in a modern context include coverage of integral equations and basic scattering theory. Includes examples of inverse problems arising from improperly posed applications as well as exercises, many with answers. 1988 edition. Elementary Differential Equations and Boundary Value Problems, 12th Edition is written from the viewpoint of the applied mathematician, whose interest in differential equations may sometimes be quite theoretical, sometimes intensely practical, and often somewhere in between. In this revision, new author Douglas Meade focuses on developing students conceptual understanding with new concept questions and worksheets for each chapter. Meade builds upon Boyce and DiPrima’s work to combine a sound and accurate (but not abstract) exposition of the elementary theory of differential equations with considerable material on methods of solution, analysis, and approximation that have proved useful in a wide variety of applications. The main prerequisite for engaging with the program is a working knowledge of calculus, gained from a normal two or three semester course sequence or its equivalent. Some familiarity with matrices will also be helpful in the chapters on systems of differential equations. /homepage/sac/cam/na2000/index.html7-Volume Set now available at special set price ! This volume contains contributions in the area of differential equations and integral equations. Many numerical methods have arisen in response to the need to solve "real-life" problems in applied mathematics, in particular problems that do not have a closed-form solution. Contributions on both initial-value problems and boundary-value problems in ordinary differential equations appear in this volume. Numerical methods for initial-value problems in ordinary differential equations fall naturally into two classes: those which use one starting value at each step (one-step methods) and those which are based on several values of the solution (multistep methods). John Butcher has supplied an expert's perspective of the development of numerical methods for ordinary differential equations in the 20th century. Rob Corless and Lawrence Shampine talk about established technology, namely software for initial-value problems using Runge-Kutta and Rosenbrock methods, with interpolants to fill in the solution between mesh-points, but the 'slant' is new - based on the question, "How should such software integrate into the current generation of Problem Solving Environments?" Natalia Borovykh and Marc Spijker study the problem of establishing upper bounds for the norm of the nth power of square matrices. The dynamical system viewpoint has been of great benefit to ODE theory and numerical methods. Related is the study of chaotic behaviour. Willy Govaerts discusses the numerical methods for the computation and continuation of equilibria and bifurcation points of equilibria of dynamical systems. Arieh Iserles and Antonella Zanna survey the construction of Runge-Kutta methods which preserve algebraic invariant functions. Valeria Antohe and Ian Gladwell present numerical experiments on solving a Hamiltonian system of Hénon and Heiles with a symplectic and a nonsymplectic method with a variety of precisions and initial conditions. Stiff differential equations first became recognized as special during the 1950s. In 1963 two seminal publications laid to the foundations for later development: Dahlquist's paper on A-stable multistep methods and Butcher's first paper on implicit Runge-Kutta methods. Ernst Hairer and Gerhard Wanner deliver a survey which retraces the discovery of the order stars as well as the principal achievements obtained by that theory. Guido Vanden Berghe, Hans De Meyer, Marnix Van Daele and Tanja Van Hecke construct exponentially fitted Runge-Kutta methods with s stages. Differential-algebraic equations arise in control, in modelling of mechanical systems and in many other fields. Jeff Cash describes a fairly recent class of formulae for the numerical solution of initial-value problems for stiff and differential-algebraic systems. Shengtai Li and Linda Petzold describe methods and software for sensitivity analysis of solutions of DAE initial-value problems. Again in the area of differential-algebraic systems, Neil Biehn, John Betts, Stephen Campbell and William Huffman present current work on mesh adaptation for DAE two-point boundary-value problems. Contrasting approaches to the question of how good an approximation is as a solution of a given equation involve (i) attempting to estimate the actual error (i.e., the difference between the true and the approximate solutions) and (ii) attempting to estimate the defect This book is a study of how a particular vision of the unity of mathematics, often called geometric function theory, was created in the 19th century. The central focus is on the convergence of three mathematical topics: the hypergeometric and related linear differential equations, group theory, and on-Euclidean geometry. The text for this second edition has been greatly expanded and revised, and the existing appendices enriched. The exercises have been retained, making it possible to use the book as a companion to mathematics courses at the graduate level. This book has been designed to acquaint the students with advanced concepts of differential equations. Comprehensively written, it covers topics such as Boundary Value Problems and their Separation of Variables, Laplace Transforms with Applications, Fourier Transforms and their Applications, the Hankel Transform and its Applications and Calculus of Variations. While the textbook lucidly explains the theoretical concepts, it also presents the various methods and applications related to differential equations. Students of mathematics would find this book extremely useful as well as the aspirants of various competitive examinations. This work will serve as an excellent first course in modern analysis. The main focus is on showing how self-similar solutions are useful in studying the behavior of solutions of nonlinear partial differential equations, especially those of parabolic type. This textbook will be an excellent resource for self-study or classroom use. 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. 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. Simultaneous Differential Equations and Multi-Dimensional Vibrations is the fourth book within Ordinary Differential Equations with Applications to Trajectories and Vibrations, Six-volume Set. As a set, they are the fourth volume in the series Mathematics and Physics Applied to Science and Technology. This fourth book consists of two chapters (chapters 7 and 8 of the set). The first chapter concerns simultaneous systems of ordinary differential equations and focuses mostly on the cases that have a matrix of characteristic polynomials, namely linear systems with constant or homogeneous power coefficients. The method of the matrix of characteristic polynomials also applies to simultaneous systems of linear finite difference equations with constant coefficients. The second chapter considers linear multi-dimensional oscillators with any number of degrees of freedom including damping, forcing, and multiple resonance. The discrete oscillators may be extended from a finite number of degrees-of-freedom to infinite chains. The continuous oscillators correspond to waves in homogeneous or inhomogeneous media, including elastic, acoustic, electromagnetic, and water surface waves. The combination of propagation and dissipation leads to the equations of mathematical physics. Presents simultaneous systems of ordinary differential equations and their elimination for a single ordinary differential equation Includes cases with a matrix of characteristic polynomials, including simultaneous systems of linear differential and finite difference equations with constant coefficients Covers multi-dimensional oscillators with damping and forcing, including modal decomposition, natural frequencies and coordinates, and multiple resonance Discusses waves in inhomogeneous media, such as elastic, electromagnetic, acoustic, and water waves Includes solutions of partial differential equations of mathematical physics by separation of variables leading to ordinary differential equations 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 The statement which expresses the equality of two expressions is known as an equation.

A differential equation is a kind of mathematical equation that shows the connection between a function and its derivatives. Functions represent the physical quantities and derivatives show their rates of change. The differential equation seeks to define the relationship between the two. It can be classified into various types such as ordinary differential equations and partial differential equations. Ordinary differential equation contains one or more than one function of an independent variable. It is related to the derivatives of these functions. Partial differential equations contain unknown multi-variable functions as well as their partial derivatives. These are generally used to formulate problems which contain functions of several variables. The topics included in this book on ordinary and partial differential equations are of utmost significance and bound to provide incredible insights to readers. It presents researches and studies performed by experts across the globe. This book is appropriate for students seeking detailed information in this area as well as for experts. A thorough and systematic first course in elementary differential equations for undergraduates in mathematics and science, with many exercises and problems (with answers). Singular Differential Equations and Special Functions is the fifth book within Ordinary Differential Equations with Applications to Trajectories and Vibrations, Six-volume Set. As a set they are the fourth volume in the series Mathematics and Physics Applied to Science and Technology. This fifth book consists of one chapter (chapter 9 of the set). The chapter starts with general classes of differential equations and simultaneous systems for which the properties of the solutions can be established 'a priori', such as existence and unicity of solution, robustness and uniformity with regard to changes in boundary conditions and parameters, and stability and asymptotic behavior. The book proceeds to consider the most important class of linear differential equations with variable coefficients, that can be analytic functions or have regular or irregular singularities. The solution of singular differential equations by means of (i) power series; (ii) parametric integral transforms; and (iii) continued fractions lead to more than 20 special functions; among these is given greater attention to generalized circular, hyperbolic, Airy, Bessel and hypergeometric differential equations, and the special functions that specify their solutions. Includes existence, unicity, robustness, uniformity, and other theorems for non-linear differential equations Discusses properties of dynamical systems derived from the differential equations describing them, using methods such as Liapunov functions Includes linear differential equations with periodic coefficients, including Floquet theory, Hill infinite determinants and multiple parametric resonance Details theory of the generalized Bessel differential equation, and of the generalized, Gaussian, confluent and extended hypergeometric functions and relations with other 20 special functions Examines Linear Differential Equations with analytic coefficients or regular or irregular singularities, and solutions via power series, parametric integral transforms, and continued fractions Coherent, balanced introductory text focuses on initial- and boundary-value problems, general properties of linear equations, and the differences between linear and nonlinear systems. Includes large number of illustrative examples worked out in detail and extensive sets of problems. Answers or hints to most problems appear at end. This text, now in its second edition, presents the basic theory of ordinary differential equations and relates the topological theory used in differential equations to advanced applications in chemistry and biology. It provides new motivations for studying extension theorems and existence theorems, supplies real-world examples, gives an early introduction to the use of geometric methods and offers a novel treatment of the Sturm-Liouville theory. Rich in proofs, examples, and exercises, this widely adopted text emphasizes physics and engineering applications. The Student Solutions Manual can be downloaded free from Dover's site; the Instructor Solutions Manual is available upon request. 2004 edition, with minor revisions. Linear Differential Equations and Oscillators is the first book within Ordinary Differential Equations with Applications to Trajectories and Vibrations, Six-volume Set. As a set, they are the fourth volume in the series Mathematics and Physics Applied to Science and Technology. This first book consists of chapters 1 and 2 of the fourth volume. The first chapter covers linear differential equations of any order whose unforced solution can be obtained from the roots of a characteristic polynomial, namely those: (i) with constant coefficients; (ii) with homogeneous power coefficients with the exponent equal to the order of derivation. The method of characteristic polynomials is also applied to (iii) linear finite difference equations of any order with constant coefficients. The unforced and forced solutions of (i, ii, iii) are examples of some general properties of ordinary differential equations. The second chapter applies the theory of the first chapter to linear second-order oscillators with one degree-of-freedom, such as the mechanical mass-damper-spring-force system and the electrical self-resistor-capacitor-battery circuit. In both cases are treated free undamped, damped, and amplified oscillations; also forced oscillations including beats, resonance, discrete and continuous spectra, and impulsive inputs. Describes general properties of differential and finite difference equations, with focus on linear equations and constant and some power coefficients Presents particular and general solutions for all cases of differential and finite difference equations Provides complete solutions for many cases of forcing including resonant cases Discusses applications to linear second-order mechanical and electrical oscillators with damping Provides solutions with forcing including resonance using the characteristic polynomial, Green' s functions, trigonometrical series, Fourier integrals and Laplace transforms 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. Ordinary differential equations (ODEs) and linear algebra are foundational postcalculus mathematics courses in the sciences. The goal of this text is to help students master both subject areas in a one-semester course. Linear algebra is developed first, with an eye toward solving linear systems of ODEs. A computer algebra system is used for intermediate calculations (Gaussian elimination, complicated integrals, etc.); however, the text is not tailored toward a particular system. Ordinary Differential Equations and Linear Algebra: A Systems Approach systematically develops the linear algebra needed to solve systems of ODEs and includes over 15 distinct applications of the theory, many of which are not typically seen in a textbook at this level (e.g., lead poisoning, SIR models, digital filters). It emphasizes mathematical modeling and contains group projects at the end of each chapter that allow students to more fully explore the interaction between the modeling of a system, the solution of the model, and the resulting physical description. These notes provide a concise introduction to stochastic differential equations and their application to the study of financial markets and as a basis for modeling diverse physical phenomena. They are accessible to non-specialists and make a valuable addition to the collection of texts on the topic. --Srinivasa Varadhan, New York University This is a handy and very useful text for studying stochastic differential equations. There is enough mathematical detail so that the reader can benefit from this introduction with only a basic background in mathematical analysis and probability. --George Papanicolaou, Stanford University This book covers the most important elementary facts regarding stochastic differential equations; it also describes some of the applications to partial differential equations, optimal stopping, and options pricing. The book's style is intuitive rather than formal, and emphasis is made on clarity. This book will be very helpful to starting graduate students and strong undergraduates as well as to others who want to gain knowledge of stochastic differential equations. I recommend this book enthusiastically. --Alexander Lipton, Mathematical Finance Executive, Bank of America Merrill Lynch This short book provides a quick, but very readable introduction to stochastic differential equations, that is, to differential equations subject to additive ``white noise'' and related random disturbances. The exposition is concise and strongly focused upon the interplay between probabilistic intuition and mathematical rigor. Topics include a quick survey of measure theoretic probability theory, followed by an introduction to Brownian motion and the Ito stochastic calculus, and finally the theory of stochastic differential equations. The text also includes applications to partial differential equations, optimal stopping problems and options pricing. This book can be used as a text for senior undergraduates or beginning graduate students in mathematics, applied mathematics, physics, financial mathematics, etc., who want to learn the basics of stochastic differential equations. The reader is assumed to be fairly familiar with measure theoretic mathematical analysis, but is not assumed to have any particular knowledge of probability theory (which is rapidly developed in Chapter 2 of the book). This textbook is a comprehensive treatment of ordinary differential equations, concisely presenting basic and essential results in a rigorous manner. Including various examples from physics, mechanics, natural sciences, engineering and automatic theory, Differential Equations is a bridge between the abstract theory of differential equations and applied systems theory. Particular attention is given to the existence and uniqueness of the Cauchy problem, linear differential systems, stability theory and applications to first-order partial differential equations. Upper undergraduate students and researchers in applied mathematics and systems theory with a background in advanced calculus will find this book particularly useful. Supplementary topics are covered in an appendix enabling the book to be completely self-contained. This book presents a history of differential equations, both ordinary and partial, as well as the calculus of variations, from the origins of the subjects to around 1900. Topics treated include the wave equation in the hands of d'Alembert and Euler; Fourier's solutions to the heat equation and the contribution of Kovalevskaya; the work of Euler, Gauss, Kummer, Riemann, and Poincaré on the hypergeometric equation; Green's functions, the Dirichlet principle, and Schwarz's solution of the Dirichlet problem; minimal surfaces; the telegraphists' equation and Thomson's successful design of the trans-Atlantic cable; Riemann's paper on shock waves; the geometrical interpretation of mechanics; and aspects of the study of the calculus of variations from the problems of the catenary and the brachistochrone to attempts at a rigorous theory by Weierstrass, Kneser, and Hilbert. Three final chapters look at how the theory of partial differential equations stood around 1900, as they were treated by Picard and Hadamard. There are also extensive, new translations of original papers by Cauchy, Riemann, Schwarz, Darboux, and Picard. The first book to cover the history of differential equations and the calculus of variations in such breadth and detail, it will appeal to anyone with an interest in the field. Beyond secondary school mathematics and physics, a course in mathematical analysis is the only prerequisite to fully appreciate its contents. Based on a course for third-year university students, the book contains numerous historical and mathematical exercises, offers extensive advice to the student on how to write essays, and can easily be used in whole or in part as a course in the history of mathematics. Several appendices help make the book self-contained and suitable for self-study. Written in a clear and accurate language that students can understand, Trench's new book minimizes the number of explicitly stated theorems and definitions. Instead, he deals with concepts in a conversational style that engages students. He includes more than 250 illustrated, worked examples for easy reading and comprehension. One of the book's many strengths is its problems, which are of consistently high quality. Trench includes a thorough treatment of boundary-value problems and partial differential equations and has organized the book to allow instructors to select the level of technology desired. This has been simplified by using symbols, C and L, to designate the level of technology. C problems call for computations and/or graphics, while L problems are laboratory exercises that require extensive use of technology. Informal advice on the use of technology is included in several sections and instructors who prefer not to emphasize technology can ignore these exercises without interrupting the flow of material. Delay, difference, functional, fractional, and partial differential equations have many applications in science and engineering. In this Special Issue, 29 experts co-authored 10 papers dealing with these subjects. A summary of the main points of these papers follows: Several oscillation conditions for a first-order linear differential equation with non-monotone delay are established in Oscillation Criteria for First Order Differential Equations with Non-Monotone Delays, whereas a sharp oscillation criterion using the notion of slowly varying functions is established in A Sharp Oscillation Criterion for a Linear Differential Equation with Variable Delay. The approximation of a linear autonomous differential equation with a small delay is considered in Approximation of a Linear Autonomous Differential Equation with Small Delay; the model of infection diseases by Marchuk is studied in Around the Model of Infection Disease: The Cauchy Matrix and Its Properties. Exact solutions to fractional-order Fokker–Planck equations are presented in New Exact Solutions and Conservation Laws to the Fractional-Order Fokker–Planck Equations, and a spectral collocation approach to solving a class of time-fractional stochastic heat equations driven by Brownian motion is constructed in A Collocation Approach for Solving Time-Fractional Stochastic Heat Equation Driven by an Additive Noise. A finite difference approximation method for a space fractional convection-diffusion model with variable coefficients is proposed in Finite Difference Approximation Method for a Space Fractional Convection–Diffusion Equation with Variable Coefficients; existence results for a nonlinear fractional difference equation with delay and impulses are established in On Nonlinear Fractional Difference Equation with Delay and Impulses. A complete Noether symmetry analysis of a generalized coupled Lane–Emden–Klein–Gordon–Fock system with central symmetry is provided in Oscillation Criteria for First Order Differential Equations with Non-Monotone Delays, and new soliton solutions of a fractional Jaulent soliton Miodek system via symmetry analysis are presented in New Soliton Solutions of Fractional Jaulent-Miodek System with Symmetry Analysis. This text explores the essentials of partial differential equations as applied to engineering and the physical sciences. Discusses ordinary differential equations, integral curves and surfaces of vector fields, the Cauchy-Kovalevsky theory, more. Problems and answers. This book applies a step-by-step treatment of the current state-of-the-art of ordinary differential equations used in modeling of engineering systems/processes and beyond. It covers systematically ordered problems, beginning with first and second order ODEs, linear and higher-order ODEs of polynomial form, theory and criteria of similarity, modeling approaches, phase plane and phase space concepts, stability optimization and ending on chaos and synchronization. Presenting both an overview of the theory of the introductory differential equations in the context of applicability and a systematic treatment of modeling of numerous engineering and physical problems through linear and non-linear ODEs, the volume is self-contained, yet serves both scientific and engineering interests. The presentation relies on a general treatment, analytical and numerical methods, concrete examples and engineering intuition. The scientific background used is well balanced between elementary and advanced level, making it as a unique self-contained source for both theoretically and application oriented graduate and doctoral students, university teachers, researchers and engineers of mechanical, civil and mechatronic engineering. This text introduces students to the theory and practice of differential equations, which are fundamental to the mathematical formulation of problems in physics, chemistry, biology, economics, and other sciences. The book is ideally suited for undergraduate or beginning graduate students in mathematics, and will also be useful for students in the physical sciences and engineering who have already taken a three-course calculus sequence. This second edition incorporates much new material, including sections on the Laplace transform and the matrix Laplace transform, a section devoted to Bessel's equation, and sections on applications of variational methods to geodesics and to rigid body motion. There is also a more complete treatment of the Runge-Kutta scheme, as well as numerous additions and improvements to the original text. Students finishing this book will be well prepare 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 interdisciplinary work creates a bridge between the mathematical and the technical disciplines by providing a strong mathematical tool. The present book is a new, English edition of the volume published in 1999. It contains many improvements, as well as new topics, using enlarged and updated references. Only ordinary differential equations and their solutions in an analytical frame were considered, leaving aside their numerical approach. For over 300 years, differential equations have served as an essential tool for describing and analyzing problems in many scientific disciplines. This carefully-written textbook provides an introduction to many of the important topics associated with ordinary differential equations. Unlike most textbooks on the subject, this text includes nonstandard topics such as perturbation methods and differential equations and Mathematica. In addition to the nonstandard topics, this text also contains contemporary material in the area as well as its classical topics. This second edition is updated to be compatible with Mathematica, version 7.0. It also provides 81 additional exercises, a new section in Chapter 1 on the generalized logistic equation, an additional theorem in Chapter 2 concerning fundamental matrices, and many more other enhancements to the first edition. This book can be used either for a second course in ordinary differential equations or as an introductory course for well-prepared students. The prerequisites for this book are three semesters of calculus and a course in linear algebra, although the needed concepts from linear algebra are introduced along with examples in the book. An undergraduate course in analysis is needed for the more theoretical subjects covered in the final two chapters. The aim of this text is to aquaint the student with the fundamental classical results of partial differential equations and to guide them into some of the modern theory, enabling them to read more advanced works on the subject. The first edition (94301-3) was published in 1995 in TIMS and had 2264 regular US sales, 928 IC, and 679 bulk. This new edition updates the text to Mathematica 5.0 and offers a more extensive treatment of linear algebra. It has been thoroughly revised and corrected throughout. 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. 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 elem