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THE THEORY OF DIFFERENTIAL EQUATIONS

CLASSICAL AND QUALITATIVE

Springer Science & Business Media **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.**

STABILITY THEORY OF DIFFERENTIAL EQUATIONS

Courier Corporation **Suitable for advanced undergraduates and graduate students, this text introduces the stability theory and asymptotic behavior of solutions of linear and nonlinear differential equations. 1953 edition.**

BASIC THEORY OF ORDINARY DIFFERENTIAL EQUATIONS

Springer Science & Business Media **Providing readers with the very basic knowledge necessary to begin research on differential equations with professional ability, the selection of topics here covers the methods and results that are applicable in a variety of different fields. The book is divided into four parts. The first covers fundamental existence, uniqueness, smoothness with respect to data, and nonuniqueness. The second part describes the basic results concerning linear differential equations, while the third deals with nonlinear equations. In the last part the authors write about the basic results concerning power series solutions. Each chapter begins with a brief discussion of its contents and history, and hints and comments for many problems are given throughout. With 114 illustrations and 206 exercises, the book is suitable for a one-year graduate course, as well as a reference book for research mathematicians.**

INTRODUCTION TO COMPLEX THEORY OF DIFFERENTIAL EQUATIONS

Birkhäuser **This book discusses the complex theory of differential equations or more precisely, the theory of differential equations on complex-analytic manifolds. Although the theory of differential equations on real manifolds is well known – it is described in thousands of papers and its usefulness requires no comments or explanations – to date specialists on differential equations have not focused on the complex theory of partial differential equations. However, as well as being remarkably beautiful, this theory can be used to solve a number of problems in real theory, for instance, the Poincaré balayage problem and the mother body problem in geophysics. The monograph does not require readers to be familiar with advanced notions in complex analysis, differential equations, or topology. With its numerous examples and exercises, it appeals to advanced undergraduate and graduate students, and also to researchers wanting to familiarize themselves with the subject.**

THEORY AND EXAMPLES OF ORDINARY DIFFERENTIAL EQUATIONS

World Scientific **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.

THEORY OF DIFFERENTIAL EQUATIONS IN ENGINEERING AND MECHANICS

CRC Press **This gives comprehensive coverage of the essential differential equations students they are likely to encounter in solving engineering and mechanics problems across the field -- alongside a more advance volume on applications. This first volume covers a very broad range of theories related to solving differential equations, mathematical preliminaries, ODE (n-th order and system of 1st order ODE in matrix form), PDE (1st order, 2nd, and higher order including wave, diffusion, potential, biharmonic equations and more). Plus more advanced topics such as Green's function method, integral and integro-differential equations, asymptotic expansion and perturbation, calculus of variations, variational and related methods, finite difference and numerical methods. All readers who are concerned with and interested in engineering mechanics problems, climate change, and nanotechnology will find topics covered in these books providing valuable information and mathematics background for their multi-disciplinary research and education.**

INTRODUCTION TO THE THEORY OF LINEAR PARTIAL DIFFERENTIAL EQUATIONS

Elsevier **Introduction to the Theory of Linear Partial Differential Equations**

GEOMETRICAL METHODS IN THE THEORY OF ORDINARY DIFFERENTIAL EQUATIONS

Springer Science & Business Media **Since the first edition of this book, geometrical methods in the theory of ordinary differential equations have become very popular and some progress has been made partly with the help of computers. Much of this progress is represented in this revised, expanded edition, including such topics as the Feigenbaum universality of period doubling, the Zoladec solution, the Iljashenko proof, the Ecalle and Voronin theory, the Varchenko and Hovanski theorems, and the Neistadt theory. In the selection of material for this book, the author explains basic ideas and methods applicable to the study of differential equations. Special efforts were made to keep the basic ideas free from excessive technicalities. Thus the most fundamental questions are considered in great detail, while of the more special and difficult parts of the theory have the character of a survey. Consequently, the reader needs only a general mathematical knowledge to easily follow this text. It is directed to mathematicians, as well as all users of the theory of differential equations.**

GALOIS THEORY OF LINEAR DIFFERENTIAL EQUATIONS

Springer Science & Business Media **From the reviews: "This is a great book, which will hopefully become a classic in the subject of differential Galois theory. [...] the specialist, as well as the novice, have long been missing an introductory book covering also specific and advanced research topics. This gap is filled by the volume under review, and more than satisfactorily." Mathematical Reviews**

THE QUALITATIVE THEORY OF ORDINARY DIFFERENTIAL EQUATIONS

AN INTRODUCTION

Courier Corporation **"This is a very good book ... with many well-chosen examples and illustrations." — American Mathematical Monthly This highly regarded text presents a self-contained introduction to some important aspects of modern qualitative theory for ordinary differential equations. It is accessible to any student of physical sciences, mathematics or engineering who has a good knowledge of calculus and of the elements of linear algebra. In addition, algebraic results are stated as needed; the less familiar ones are proved either in the text or in appendixes. The topics covered in the first three chapters are the standard theorems concerning linear systems, existence and uniqueness of solutions, and dependence on parameters. The next three chapters, the heart of the book, deal with stability theory and some applications, such as oscillation phenomena, self-excited oscillations and the regulator problem of Lurie. One of the special features of this work is its abundance of exercises-routine computations, completions of mathematical arguments, extensions of theorems and applications to physical problems. Moreover, they are found in the body of the text where they naturally occur, offering students substantial aid in understanding the ideas and concepts discussed. The level is intended for students ranging from juniors to first-year graduate students in mathematics, physics or engineering; however, the book is also ideal for a one-semester undergraduate course in ordinary differential equations, or for engineers in need of a course in state space methods.**

ORDINARY DIFFERENTIAL EQUATIONS

INTRODUCTION TO THE THEORY OF ORDINARY DIFFERENTIAL EQUATIONS IN THE REAL DOMAIN

Elsevier Science Limited **The author, Professor Kurzweil, is one of the world's top experts in the area of ordinary differential equations - a fact fully reflected in this book. Unlike many classical texts which concentrate primarily on methods of integration of differential equations, this book pursues a modern approach: the topic is discussed in full generality which, at the same time, permits us to gain a deep insight into the theory and to develop a fruitful intuition. The basic framework of the theory is expanded**

by considering further important topics like stability, dependence of a solution on a parameter, Caratheodory's theory and differential relations. The book is very well written, and the prerequisites needed are minimal - some basics of analysis and linear algebra. As such, it is accessible to a wide circle of readers, in particular to non-mathematicians.

THEORY OF DIFFERENTIAL EQUATIONS

Theory of Differential Equations ...

INTRODUCTION TO THE THEORY AND APPLICATION OF DIFFERENTIAL EQUATIONS WITH DEVIATING ARGUMENTS

Academic Press **Introduction to the Theory and Application of Differential Equations with Deviating Arguments 2nd edition is a revised and substantially expanded edition of the well-known book of L. E. El'sgol'ts published under this same title by Nauka in 1964. Extensions of the theory of differential equations with deviating argument as well as the stimuli of developments within various fields of science and technology contribute to the need for a new edition. This theory in recent years has attracted the attention of vast numbers of researchers, interested both in the theory and its applications. The development of the foundations of the theory of differential equations with a deviating argument is still far from complete. This situation, of course, leaves its mark on our suggestions to the reader of the book and prevents as orderly and systematic a presentation as is usual for mathematical literature. However, it is hoped that in spite of these deficiencies the book will prove useful as a first acquaintanceship with the theory of differential equations with a deviating argument.**

QUANTIZATION METHODS IN THE THEORY OF DIFFERENTIAL EQUATIONS

CRC Press **This volume presents a systematic and mathematically rigorous exposition of methods for studying linear partial differential equations. It focuses on quantization of the corresponding objects (states, observables and canonical transformations) in the phase space. The quantization of all three types of classical objects is carried out in a unified w**

STUDENT'S SOLUTIONS MANUAL TO ACCOMPANY DIFFERENTIAL EQUATIONS

THEORY, TECHNIQUE, AND PRACTICE

McGraw-Hill Science, Engineering & Mathematics **This traditional text is intended for mainstream one- or two-semester differential equations courses taken by undergraduates majoring in engineering, mathematics, and the sciences. Written by two of the world's leading authorities on differential equations, Simmons/Krantz provides a cogent and accessible introduction to ordinary differential equations written in classical style. Its rich variety**

of modern applications in engineering, physics, and the applied sciences illuminate the concepts and techniques that students will use through practice to solve real-life problems in their careers. This text is part of the Walter Rudin Student Series in Advanced Mathematics.

GALOIS' DREAM: GROUP THEORY AND DIFFERENTIAL EQUATIONS

GROUP THEORY AND DIFFERENTIAL EQUATIONS

Springer Science & Business Media **First year, undergraduate, mathematics students in Japan have for many years had the opportunity of a unique experience---an introduction, at an elementary level, to some very advanced ideas in mathematics from one of the leading mathematicians of the world. English reading students now have the opportunity to enjoy this lively presentation, from elementary ideas to cartoons to funny examples, and to follow the mind of an imaginative and creative mathematician into a world of enduring mathematical creations.**

ORDINARY DIFFERENTIAL EQUATIONS

QUALITATIVE THEORY

American Mathematical Soc. **This textbook provides a comprehensive introduction to the qualitative theory of ordinary differential equations. It includes a discussion of the existence and uniqueness of solutions, phase portraits, linear equations, stability theory, hyperbolicity and equations in the plane. The emphasis is primarily on results and methods that allow one to analyze qualitative properties of the solutions without solving the equations explicitly. The text includes numerous examples that illustrate in detail the new concepts and results as well as exercises at the end of each chapter. The book is also intended to serve as a bridge to important topics that are often left out of a course on ordinary differential equations. In particular, it provides brief introductions to bifurcation theory, center manifolds, normal forms and Hamiltonian systems.**

DIFFERENTIAL EQUATIONS: THEORY AND APPLICATIONS

WITH MAPLE®

Springer Science & Business Media **This book provides a comprehensive introduction to the theory of ordinary differential equations with a focus on mechanics and dynamical systems as important applications of the theory. The text is written to be used in the traditional way or in a more applied way. The accompanying CD contains Maple worksheets for the exercises, and special Maple code for performing various tasks. In addition to its use in a traditional one or two semester graduate course in mathematics, the book is organized to be used for interdisciplinary courses in applied mathematics, physics, and engineering.**

ORDINARY DIFFERENTIAL EQUATIONS

AN ELEMENTARY TEXTBOOK FOR STUDENTS OF MATHEMATICS, ENGINEERING, AND THE SCIENCES

Courier Corporation **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.**

QUALITATIVE THEORY OF DIFFERENTIAL EQUATIONS

Princeton University Press **Book 22 in the Princeton Mathematical Series. Originally published in 1960. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905.**

THEORY OF FUNCTIONAL DIFFERENTIAL EQUATIONS

Springer Science & Business Media **Since the publication of my lecture notes, Functional Differential Equations in the Applied Mathematical Sciences series, many new developments have occurred. As a consequence, it was decided not to make a few corrections and additions for a second edition of those notes, but to present a more compre hensive theory. The present work attempts to consolidate those elements of the theory which have stabilized and also to include recent directions of research. The following chapters were not discussed in my original notes. Chapter 1 is an elementary presentation of linear differential difference equations with constant coefficients of retarded and neutral type. Chapter 4 develops the recent theory of dissipative systems. Chapter 9 is a new chapter on perturbed systems. Chapter 11 is a new presentation incorporating recent results on the existence of periodic solutions of autonomous equations. Chapter 12 is devoted entirely to neutral equations. Chapter 13 gives an introduction to the global and generic theory. There is also an appendix on the location of the zeros of characteristic polynomials. The remainder of the material has been completely revised and updated with the most significant changes occurring in Chapter 3 on the properties of solutions, Chapter 5 on stability, and Chapter lOon behavior near a periodic orbit.**

ENGINEERING DIFFERENTIAL EQUATIONS

THEORY AND APPLICATIONS

Springer Science & Business Media **This book is a comprehensive treatment of engineering undergraduate differential equations as well as linear vibrations and feedback control. While this material has traditionally been separated into different courses in undergraduate engineering curricula. This text provides a streamlined and efficient treatment of material normally covered in three courses. Ultimately, engineering students study mathematics in order to be able to solve problems within the engineering realm. Engineering Differential Equations: Theory and Applications guides students to approach the mathematical theory with much greater interest and enthusiasm by teaching the theory together with applications. Additionally, it includes an abundance of detailed examples. Appendices include numerous C and FORTRAN example programs. This book is intended for engineering undergraduate students, particularly aerospace and mechanical engineers and students in other disciplines concerned with mechanical systems analysis and control. Prerequisites include basic and advanced calculus with an introduction to linear algebra.**

ORDINARY DIFFERENTIAL EQUATIONS AND STABILITY THEORY:

Courier Dover Publications **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.**

APPLICATIONS OF LIE'S THEORY OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

CRC Press **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.

EXISTENCE THEORY FOR NONLINEAR ORDINARY DIFFERENTIAL EQUATIONS

Springer Science & Business Media **We begin our applications of fixed point methods with existence of solutions to certain first order initial initial value problems. This problem is relatively easy to treat, illustrates important methods, and in the end will carry us a good deal further than may first meet the eye. Thus, we seek solutions to Y'. = I(t,y) (1. 1) { yeO) = r n where I: I X R n ---+ R and I = [0, b]. We shall seek solutions that are de fined either locally or globally on I, according to the assumptions imposed on I. Notice that (1. 1) is a system of first order equations because I takes its values in Rn. In section 3. 2 we will first establish some basic existence theorems which guarantee that a solution to (1. 1) exists for t > 0 and near zero. Familiar examples show that the interval of existence can be arbi trarily short, depending on the initial value r and the nonlinear behaviour of I. As a result we will also examine in section 3. 2 the dependence of the interval of existence on I and r. We mention in passing that, in the results which follow, the interval I can be replaced by any bounded interval and the initial value can be specified at any point in I. The reasoning needed to cover this slightly more general situation requires minor modifications on the arguments given here.**

ORDINARY DIFFERENTIAL EQUATIONS IN THEORY AND PRACTICE

SIAM **In order to emphasize the relationships and cohesion between analytical and numerical techniques, Ordinary Differential Equations in Theory and Practice presents a comprehensive and integrated treatment of both aspects in combination with the modeling of relevant problem classes. This text is uniquely geared to provide enough insight into qualitative aspects of ordinary differential equations (ODEs) to offer a thorough account of quantitative methods for approximating solutions numerically, and to acquaint the reader with mathematical modeling, where such ODEs often play a significant role. Although originally published in 1995, the text remains timely and useful to a wide audience. It provides a thorough introduction to ODEs, since it treats not only standard aspects such as existence, uniqueness, stability, one-step methods, multistep methods, and singular perturbations, but also chaotic systems, differential-algebraic systems, and boundary value problems.**

THEORY OF INTEGRO-DIFFERENTIAL EQUATIONS

CRC Press **This unique monograph investigates the theory and applications of Volterra integro-differential equations. Whilst covering the basic theory behind these equations it also studies their qualitative properties and**

discusses a large number of applications. This comprehensive work presents a unified framework to investigate the fundamental existence of theory, treats stability theory in terms of Lyapunov functions and functionals, develops the theory of integro-differential equations with impulse effects, and deals with linear evolution equations in abstract spaces. Various applications of integro-differential equations, such as population dynamics, nuclear reactors, viscoelasticity, wave propagation and engineering systems, are discussed, making this book indispensable for mathematicians and engineers alike.

DIFFERENTIAL EQUATIONS: TECHNIQUES, THEORY, AND APPLICATIONS

American Mathematical Soc. **Differential Equations: Techniques, Theory, and Applications is designed for a modern first course in differential equations either one or two semesters in length. The organization of the book interweaves the three components in the subtitle, with each building on and supporting the others. Techniques include not just computational methods for producing solutions to differential equations, but also qualitative methods for extracting conceptual information about differential equations and the systems modeled by them. Theory is developed as a means of organizing, understanding, and codifying general principles. Applications show the usefulness of the subject as a whole and heighten interest in both solution techniques and theory. Formal proofs are included in cases where they enhance core understanding; otherwise, they are replaced by informal justifications containing key ideas of a proof in a more conversational format. Applications are drawn from a wide variety of fields: those in physical science and engineering are prominent, of course, but models from biology, medicine, ecology, economics, and sports are also featured. The 1,400+ exercises are especially compelling. They range from routine calculations to large-scale projects. The more difficult problems, both theoretical and applied, are typically presented in manageable steps. The hundreds of meticulously detailed modeling problems were deliberately designed along pedagogical principles found especially effective in the MAA study Characteristics of Successful Calculus Programs, namely, that asking students to work problems that require them to grapple with concepts (or even proofs) and do modeling activities is key to successful student experiences and retention in STEM programs. The exposition itself is exceptionally readable, rigorous yet conversational. Students will find it inviting and approachable. The text supports many different styles of pedagogy from traditional lecture to a flipped classroom model. The availability of a computer algebra system is not assumed, but there are many opportunities to incorporate the use of one.**

FLOQUET THEORY FOR PARTIAL DIFFERENTIAL EQUATIONS

Birkhäuser **Linear differential equations with periodic coefficients constitute**

a well developed part of the theory of ordinary differential equations [17, 94, 156, 177, 178, 272, 389]. They arise in many physical and technical applications [177, 178, 272]. A new wave of interest in this subject has been stimulated during the last two decades by the development of the inverse scattering method for integration of nonlinear differential equations. This has led to significant progress in this traditional area [27, 71, 72, 111 119, 250, 276, 277, 284, 286, 287, 312, 313, 337, 349, 354, 392, 393, 403, 404]. At the same time, many theoretical and applied problems lead to periodic partial differential equations. We can mention, for instance, quantum mechanics [14, 18, 40, 54, 60, 91, 92, 107, 123, 157-160, 192, 193, 204, 315, 367, 412, 414, 415, 417], hydrodynamics [179, 180], elasticity theory [395], the theory of guided waves [87-89, 208, 300], homogenization theory [29, 41, 348], direct and inverse scattering [175, 206, 216, 314, 388, 406-408], parametric resonance theory [122, 178], and spectral theory and spectral geometry [103 105, 381, 382, 389]. There is a sjgnificant distinction between the cases of ordinary and partial differential periodic equations. The main tool of the theory of periodic ordinary differential equations is the so-called Floquet theory [17, 94, 120, 156, 177, 267, 272, 389]. Its central result is the following theorem (sometimes called Floquet-Lyapunov theorem) [120, 267].

RECENT ADVANCES IN DIFFERENTIAL EQUATIONS AND CONTROL THEORY

Springer Nature **This book collects the latest results and new trends in the application of mathematics to some problems in control theory, numerical simulation and differential equations. The work comprises the main results presented at a thematic minisymposium, part of the 9th International Congress on Industrial and Applied Mathematics (ICIAM 2019), held in Valencia, Spain, from 15 to 18 July 2019. The topics covered in the 6 peer-review contributions involve applications of numerical methods to real problems in oceanography and naval engineering, as well as relevant results on switching control techniques, which can have multiple applications in industrial complexes, electromechanical machines, biological systems, etc. Problems in control theory, as in most engineering problems, are modeled by differential equations, for which standard solving procedures may be insufficient. The book also includes recent geometric and analytical methods for the search of exact solutions for differential equations, which serve as essential tools for analyzing problems in many scientific disciplines.**

LINEAR DIFFERENTIAL EQUATIONS AND GROUP THEORY FROM RIEMANN TO POINCARE

Springer Science & Business Media **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.

APPLIED THEORY OF FUNCTIONAL DIFFERENTIAL EQUATIONS

This volume provides an introduction to the properties of functional differential equations and their applications in diverse fields such as immunology, nuclear power generation, heat transfer, signal processing, medicine and economics. In particular, it deals with problems and methods relating to systems having a memory (hereditary systems). The book contains eight chapters. Chapter 1 explains where functional differential equations come from and what sort of problems arise in applications. Chapter 2 gives a broad introduction to the basic principle involved and deals with systems having discrete and distributed delay. Chapters 3-5 are devoted to stability problems for retarded, neutral and stochastic functional differential equations. Problems of optimal control and estimation are considered in Chapters 6-8. For applied mathematicians, engineers, and physicists whose work involves mathematical modeling of hereditary systems. This volume can also be recommended as a supplementary text for graduate students who wish to become better acquainted with the properties and applications of functional differential equations.

A SHORT COURSE IN ORDINARY DIFFERENTIAL EQUATIONS

Springer **This text is a rigorous treatment of the basic qualitative theory of ordinary differential equations, at the beginning graduate level. Designed as a flexible one-semester course but offering enough material for two semesters, A Short Course covers core topics such as initial value problems, linear differential equations, Lyapunov stability, dynamical systems and the Poincaré—Bendixson theorem, and bifurcation theory, and second-order topics including oscillation theory, boundary value problems, and Sturm—Liouville problems. The presentation is clear and easy-to-understand, with figures and copious examples illustrating the meaning of and motivation behind definitions, hypotheses, and general theorems. A thoughtfully conceived selection of exercises together with answers and hints reinforce the reader's understanding of the material. Prerequisites are limited to advanced calculus and the elementary theory of differential equations and linear algebra, making the text suitable for senior undergraduates as well.**

INTRODUCTION TO THE THEORY OF DIFFERENTIAL INCLUSIONS

American Mathematical Society **A differential inclusion is a relation of the form**

$dot x in F(x)$, where F is a set-valued map associating any point $x in R^n$ with a set $F(x) subset R^n$. As such, the notion of a differential inclusion generalizes the notion of an ordinary differential equation of the form $dot x = f(x)$. Therefore, all problems usually studied in the theory of ordinary differential equations (existence and continuation of solutions, dependence on initial conditions and parameters, etc.) can be studied for differential inclusions as well. Since a differential inclusion usually has many solutions starting at a given point, new types of problems arise, such as investigation of topological properties of the set of solutions, selection of solutions with given properties, and many others. Differential inclusions play an important role as a tool in the study of various dynamical processes described by equations with a discontinuous or multivalued right-hand side, occurring, in particular, in the study of dynamics of economical, social, and biological macrosystems. They also are very useful in proving existence theorems in control theory. This text provides an introductory treatment to the theory of differential inclusions. The reader is only required to know ordinary differential equations, theory of functions, and functional analysis on the elementary level. Chapter 1 contains a brief introduction to convex analysis. Chapter 2 considers set-valued maps. Chapter 3 is devoted to the Mordukhovich version of nonsmooth analysis. Chapter 4 contains the main existence theorems and gives an idea of the approximation techniques used throughout the text. Chapter 5 is devoted to the viability problem, i.e., the problem of selection of a solution to a differential inclusion that is contained in a given set. Chapter 6 considers the controllability problem. Chapter 7 discusses extremal problems for differential inclusions. Chapter 8 presents stability theory, and Chapter 9 deals with the stabilization problem.

ORDINARY DIFFERENTIAL EQUATIONS

Courier Corporation **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.**

FOUNDATIONS OF THE CLASSICAL THEORY OF PARTIAL DIFFERENTIAL EQUATIONS

Springer Science & Business Media **From the reviews: "...I think the volume is a great success ... a welcome addition to the literature ..." The Mathematical Intelligencer, 1993 "... It is comparable in scope with the great Courant-Hilbert Methods of Mathematical Physics, but it is much shorter, more up to date of course, and contains more elaborate analytical machinery...." The Mathematical Gazette, 1993**

SECOND ORDER DIFFERENTIAL EQUATIONS

SPECIAL FUNCTIONS AND THEIR CLASSIFICATION

Springer Science & Business Media **Second Order Differential Equations presents a classical piece of theory concerning hypergeometric special functions as solutions of second-order linear differential equations. The theory is presented in an entirely self-contained way, starting with an introduction of the solution of the second-order differential equations and then focusingon the systematic treatment and classification of these solutions. Each chapter contains a set of problems which help reinforce the theory. Some of the preliminaries are covered in appendices at the end of the book, one of which provides an introduction to Poincaré-Perron theory, and the appendix also contains a new way of analyzing the asymptomatic behavior of solutions of differential equations. This textbook is appropriate for advanced undergraduate and graduate students in Mathematics, Physics, and Engineering interested in Ordinary and Partial Differntial Equations. A solutions manual is available online.**

DIFFERENTIAL EQUATIONS

Springer **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.**

THEORY OF CAUSAL DIFFERENTIAL EQUATIONS

Springer Science & Business Media **The problems of modern society are both complex and inter-disciplinary. Despite the - parent diversity of problems, however, often tools developed in one context are adaptable to an entirely different situation. For example, consider the well known Lyapunov’s second method. This interesting and fruitful technique has gained increasing signi?cance and has given decisive impetus for modern development of stability theory of discrete and dynamic system. It is now recognized that the concept of Lyapunov function and theory of diff- ential inequalities can be utilized to investigate qualitative and quantitative properties of a variety of nonlinear problems. Lyapunov function serves as a vehicle to transform a given complicated system into a simpler comparison system. Therefore, it is enough to study the properties of the**

simpler system to analyze the properties of the complicated system via an appropriate Lyapunov function and the comparison principle. It is in this perspective, the present monograph is dedicated to the investigation of the theory of causal differential equations or differential equations with causal operators, which are nonanticipative or abstract Volterra operators. As we shall see in the ?rst chapter, causal differential equations include a variety of dynamic systems and consequently, the theory developed for CDEs (Causal Differential Equations) in general, covers the theory of several dynamic systems in a single framework.

OSCILLATION THEORY FOR NEUTRAL DIFFERENTIAL EQUATIONS WITH DELAY

CRC Press **With neutral differential equations, any lack of smoothness in initial conditions is not damped and so they have proven to be difficult to solve. Until now, there has been little information to help with this problem. Oscillation Theory for Neutral Differential Equations with Delay fills a vacuum in qualitative theory of functional differential equations of neutral type. With much of the presented material previously unavailable outside Eastern Europe, this authoritative book provides a stimulus to research the oscillatory and asymptotic properties of these equations. It examines equations of first, second, and higher orders as well as the asymptotic behavior for tending toward infinity. These results are then generalized for partial differential equations of neutral type. The book also describes the historical development of the field and discusses applications in mathematical models of processes and phenomena in physics, electrical control and engineering, physical chemistry, and mathematical biology. This book is an important tool not only for mathematicians, but also for specialists in many fields including physicists, engineers, and biologists. It may be used as a graduate-level textbook or as a reference book for a wide range of subjects, from radiophysics to electrical and control engineering to biological science.**