Fitzpatrick Advanced Calculus 2nd Edition

A Passage to Modern Analysis is an extremely well-written and reader-friendly invitation to real analysis. An introductory text for students of mathematics and its applications at the advanced undergraduate and beginning graduate level, it strikes an especially good balance between depth of coverage and accessible exposition. The examples, problems, and exposition open up a student's intuition but still provide coverage of deep areas of real analysis. A yearlong course from this text provides a solid foundation for further study or application of real analysis at the graduate level. A Passage to Modern Analysis is grounded solidly in the analysis of R and Rn, but at appropriate points it introduces and discusses the more general settings of inner product spaces, normed spaces, and metric spaces. The last five chapters offer a bridge to fundamental topics in advanced areas such as ordinary differential equations, Fourier series and partial differential equations, Lebesgue measure and the Lebesgue integral, and Hilbert space. Thus, the book introduces interesting and useful developments beyond Euclidean space where the concepts of analysis play important roles, and it prepares readers for further study of those developments.

As one of the classical statistical regression techniques, and often the first to be taught to new students, least squares fitting can be a very effective tool in data analysis. Given measured data, we establish a relationship between independent and dependent variables so that we can use the data predictively. The main concern of Least Squares Data Fitting with Applications is how to do this on a computer with efficient and robust computational methods for linear and nonlinear relationships. The presentation also establishes a link between the statistical setting and the computational issues. In a number of applications, the accuracy and efficiency of the least squares fit is central, and Per Christian Hansen, Víctor Pereyra, and Godela Scherer survey modern computational methods and illustrate them in fields ranging from engineering and environmental sciences to geophysics. Anyone working with problems of linear and nonlinear least squares fitting will find this book invaluable as a hands-on guide, with accessible text and carefully explained problems. Included are • an overview of computational methods together with their properties and advantages • topics from statistical regression analysis that help readers to understand and evaluate the computed solutions • many examples that illustrate the techniques and algorithms Least Squares Data Fitting with Applications can be used as a textbook for advanced undergraduate or graduate courses and professionals in the sciences and in engineering.

Advanced Calculus is intended as a text for courses that furnish the backbone of the student's undergraduate education in mathematical analysis. The goal is to rigorously present the fundamental concepts within the context of illuminating examples and stimulating exercises. This book is self-contained and starts with the creation of basic tools using the completeness axiom. The continuity, differentiability, integrability, and power series representation properties of functions of a single variable are established. The next few chapters describe the topological and metric properties of Euclidean space. These are the basis of a rigorous treatment of differential calculus (including the Implicit Function Theorem and Lagrange Multipliers) for mappings between Euclidean spaces and integration for functions of several real variables. Special attention has been paid to the motivation for proofs. Selected topics, such as the Picard Existence Theorem for differential equations, have been included in such a way that selections may be made while preserving a fluid presentation of the essential material. Supplemented with numerous exercises, Advanced Calculus is a perfect book for undergraduate students of analysis.

This book gives a mathematical treatment of the introduction to qualitative differential equations and discrete dynamical systems. The treatment includes theoretical proofs, methods of calculation, and applications. The two parts of the book, continuous time of differential equations and discrete time of dynamical systems, can be covered independently in one semester each or combined together into a year long course. The material on differential equations introduces the qualitative or geometric approach through a treatment of linear systems in any dimension. There follows chapters where equilibria are the most important feature, where scalar (energy) functions is the principal tool, where periodic orbits appear, and finally, chaotic systems of differential equations. The many different approaches are systematically introduced through examples and theorems. The material on discrete dynamical systems starts with maps of one variable and proceeds to systems in higher dimensions. The treatment starts with examples where the periodic points can be found explicitly and then introduces symbolic dynamics to analyze where they can be shown to exist but not given in explicit form. Chaotic systems are presented both mathematically and more computationally using Lyapunov exponents. With the one-dimensional maps as models, the multidimensional maps cover the same material in higher dimensions. This higher dimensional material is less computational and more conceptual and theoretical. The final chapter on fractals introduces various dimensions which is another computational tool for measuring the complexity of a system. It also treats iterated function systems which give examples of complicated sets. In the second edition of the book, much of the material has been rewritten to clarify the presentation. Also, some new material has been included in both parts of the book. This book can be used as a textbook for an advanced undergraduate course on ordinary differential equations and/or dynamical systems. Prerequisites are standard courses in calculus (single variable and multivariable), linear algebra, and introductory differential equations.

This text—based on the author's popular courses at Pomona College—provides a readable, student-friendly, and somewhat sophisticated introduction to abstract algebra. It is aimed at sophomore or junior undergraduates who are seeing the material for the first time. In addition to the usual definitions and theorems, there is ample discussion to help students build intuition and learn how to think about the abstract concepts. The book has over 1300 exercises and mini-projects of varying degrees of difficulty, and, to facilitate active learning and self-study, hints and short answers for many of the problems are provided. There are full solutions to over 100 problems in order to augment the text and to model the writing of solutions. Lattice diagrams are used throughout to visually demonstrate results and proof techniques. The book covers groups, rings, and fields. In group theory, group actions are the unifying theme and are introduced early. Ring theory is motivated by what is needed for solving Diophantine equations, and, in field theory, Galois theory and the solvability of polynomials take center stage. In each area, the text goes deep enough to demonstrate the power of abstract thinking and to convince the reader that the subject is full of unexpected results.

Mathematical analysis is often referred to as generalized calculus. But it is much more than that. This book has been written in the belief that emphasizing the inherent nature of a mathematical discipline helps students to understand it better. With this in mind, and focusing on the essence of analysis, the text is divided into two parts based on the way they are related to calculus: completion and abstraction. The first part describes those aspects of analysis which complete a corresponding area of calculus theoretically, while the second part concentrates on the way analysis generalizes some aspects of calculus to a more general framework. Presenting the contents in this way has an important advantage: students first learn the most important aspects of analysis on the classical space R and fill in the gaps of their calculus-based knowledge. Then they proceed to a step-by-step development of an abstract theory, namely, the theory of metric spaces which studies such crucial notions as limit, continuity, and convergence in a wider context. The readers are assumed to have passed courses in one- and several-variable calculus and an elementary course on the foundations of mathematics. A large variety of exercises and the inclusion of informal interpretations of many results and examples will greatly facilitate the reader's study of the subject.

This textbook and treatise begins with classical real variables, develops the Lebesgue theory abstractly and for Euclidean space, and analyzes the structure of measures. The authors' vision of modern real analysis is seen in their fascinating historical commentary and perspectives with other fields. There are comprehensive treatments of the role of absolute continuity, the evolution of the Riesz representation theorem to Radon measures and distribution theory, weak convergence of measures and the Dieudonné–Grothendieck theorem, modern differentiation theory, fractals and self-similarity, rearrangements and maximal functions, and surface and Hausdorff measures. There are hundreds of illuminating exercises, and extensive, focused appendices on functional and Fourier analysis. The presentation is ideal for the classroom, self-study, or professional reference.

Designed for students having no previous experience with rigorous proofs, this text can be used immediately after standard calculus courses. It is highly recommended for anyone planning to study advanced analysis, as well as for future secondary school teachers. A limited number of concepts involving the real line and functions on the real line are studied, while many abstract ideas, such as metric spaces and ordered systems, are avoided completely. A thorough treatment of sequences of numbers is used as a basis for studying standard calculus topics, and optional sections invite students to study such topics as metric spaces and Riemann-Stieltjes integrals.

Real Analysis: A Constructive Approach Through Interval Arithmetic presents a careful treatment of calculus and its theoretical underpinnings from the constructivist point of view. This leads to an important and unique feature of this book: All existence proofs are direct, so showing that the numbers or functions in question exist means exactly that they can be explicitly calculated. For example, at the very beginning, the real numbers are shown to exist because they are constructed from the rationals using interval arithmetic. This approach, with its clear analogy to scientific measurement with tolerances, is taken throughout the book and makes the subject especially relevant and appealing to students with an interest in computing, applied mathematics, the sciences, and engineering. The first part of the book contains all the usual material in a standard one-semester course in analysis of functions of a single real variable: continuity (uniform, not pointwise), derivatives, integrals, and convergence. The second part contains enough more technical material—including an introduction to complex variables and Fourier series—to fill out a full-year course. Throughout the book the emphasis on rigorous and direct proofs is supported by an abundance of examples, exercises, and projects—many with hints—at the end of every section. The exposition is informal but exceptionally clear and well motivated throughout.

Linear Algebra for the Young Mathematician is a careful, thorough, and rigorous introduction to linear algebra. It adopts a conceptual point of view, focusing on the notions of vector spaces and linear transformations, and it takes pains to provide proofs that bring out the essential ideas of the subject. It begins at the beginning, assuming no prior knowledge of the subject, but goes quite far, and it includes many topics not usually treated in introductory linear algebra texts, such as Jordan canonical form and the spectral theorem. While it concentrates on the finite-dimensional case, it treats the infinite-dimensional case as well. The book illustrates the centrality of linear algebra by providing numerous examples of its application within mathematics. It contains a wide variety of both conceptual and computational exercises at all levels, from the relatively straightforward to the quite challenging. Readers of this book will not only come away with the knowledge that the results of linear algebra are true, but also with a deep understanding of why they are true.

This textbook is suitable for a course in advanced calculus that promotes active learning through problem solving. It can be used as a base for a Moore method or inquiry based class, or as a guide in a traditional classroom setting where lectures are organized around the presentation of problems and solutions. This book is appropriate for any student who has taken (or is concurrently taking) an introductory course in calculus. The book includes sixteen appendices that review some indispensable prerequisites on techniques of proof writing with special attention to the notation used the course.

This book provides the essential foundations of both linear and nonlinear analysis necessary for understanding and working in twenty-first century applied and computational mathematics. In addition to the standard topics, this text includes several key concepts of modern applied mathematical analysis that should be, but are not typically, included in advanced undergraduate and beginning graduate mathematics curricula. This material is the introductory foundation upon which algorithm analysis, optimization, probability, statistics, differential equations, machine learning, and control theory are built. When used in concert with the free supplemental lab materials, this text teaches students both the theory and the computational practice of modern mathematical analysis. Foundations of Applied Mathematics, Volume 1: Mathematical Analysis includes several key topics not usually treated in courses at this level, such as uniform contraction mappings, the continuous linear extension theorem, Daniell?Lebesgue integration, resolvents, spectral resolution theory, and pseudospectra. Ideas are developed in a mathematically rigorous way and students are provided with powerful tools and beautiful ideas that yield a number of nice proofs, all of which contribute to a deep understanding of advanced analysis and linear algebra. Carefully thought out exercises and examples are built on each other to reinforce and retain concepts and ideas and to achieve greater depth. Associated lab materials are available that expose students to applications and numerical computation and reinforce the theoretical ideas taught in the text. The text and labs combine to make students technically proficient and to answer the age-old question, "When am I going to use this?

This book provides a compact course in modern cryptography. The mathematical foundations in algebra, number theory and probability are presented with a focus on their cryptographic applications. The text provides rigorous definitions and follows the provable security approach. The most relevant cryptographic schemes are covered, including block ciphers, stream ciphers, hash functions, message authentication codes, public-key encryption, key establishment, digital signatures and elliptic curves. The current developments in post-quantum cryptography are also explored, with separate chapters on quantum computing, lattice-based and code-based cryptosystems. Many examples, figures and exercises, as well as SageMath (Python) computer code, help the reader to understand the concepts and applications of modern cryptography. A special focus is on algebraic structures, which are used in many cryptographic constructions and also in post-quantum systems. The essential mathematics and the modern approach to cryptography and security prepare the reader for more advanced studies. The text requires only a first-year course in mathematics (calculus and linear algebra) and is also accessible to computer scientists and engineers. This book is suitable as a textbook for undergraduate and graduate courses in cryptography as well as for self-study.

A Useful Guide to the Interrelated Areas of Differential Equations, Difference Equations, and Queueing Models Difference and Differential Equations with Applications in Queueing Theory presents the unique connections between the methods and applications of differential equations, difference equations, and Markovian queues. Featuring a comprehensive collection of topics that are used in stochastic processes, particularly in queueing theory, the book thoroughly discusses the relationship to systems of linear differential difference equations. The book demonstrates the applicability that queueing theory has in a variety of fields including telecommunications, traffic engineering, computing, and the design of factories, shops, offices, and hospitals. Along with the needed prerequisite fundamentals in probability, statistics, and Laplace transform, Difference and Differential Equations with Applications in Queueing Theory provides: A discussion on splitting, delayed-service, and delayed feedback for single-server, multiple-server, parallel, and series queue models Applications in queue models whose solutions require differential difference equations and generating function methods Exercises at the end of each chapter along with select answers The book is an excellent resource for researchers and practitioners in applied mathematics, operations research, engineering, and industrial engineering, as well as a useful text for upper-undergraduate and graduate-level courses in applied mathematics, differential and difference equations, queueing theory, probability, and stochastic processes.

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Fourier Series, Fourier Transforms, and Function Spaces is designed as a textbook for a second course or capstone course in analysis for advanced undergraduate or beginning graduate students. By assuming the existence and properties of the Lebesgue integral, this book makes it possible for students who have previously taken only one course in real analysis to learn Fourier analysis in terms of Hilbert spaces, allowing for both a deeper and more elegant approach. This approach also allows junior and senior undergraduates to study topics like PDEs, quantum mechanics, and signal processing in a rigorous manner. Students interested in statistics (time series), machine learning (kernel methods), mathematical physics (quantum mechanics), or electrical engineering (signal processing) will find this book useful. With 400 problems, many of which guide readers in developing key theoretical concepts themselves, this text can also be adapted to self-study or an inquiry-based approach. Finally, of course, this text can also serve as motivation and preparation for students going on to further study in analysis.

Real Analysis is a shorter version of the author's Advanced Calculus text, and contains just the first nine chapters from the longer text. It provides a rigorous treatment of the fundamental concepts of mathematical analysis for functions of a single variable in a clear, direct way. The author wants students to leave the course with an appreciation of the subject's coherence and significance, and an understanding of the ideas that underlie mathematical analysis.

This text develops linear algebra with the view that it is an important gateway connecting elementary mathematics to more advanced subjects, such as advanced calculus, systems of differential equations, differential geometry, and group representations. The purpose of this book is to provide a treatment of this subject in sufficient depth to prepare the reader to tackle such further material. The text starts with vector spaces, over the sets of real and complex numbers, and linear transformations between such vector spaces. Later on, this setting is extended to general fields. The reader will be in a position to appreciate the early material on this more general level with minimal effort. Notable features of the text include a treatment of determinants, which is cleaner than one often sees, and a high degree of contact with geometry and analysis, particularly in the chapter on linear algebra on inner product spaces. In addition to studying linear algebra over general fields, the text has a chapter on linear algebra over rings. There is also a chapter on special structures, such as quaternions, Clifford algebras, and octonions.

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This undergraduate text takes a novel approach to the standard introductory material on groups, rings, and fields. At the heart of the text is a semi-historical journey through the early decades of the subject as it emerged in the revolutionary work of Euler, Lagrange, Gauss, and Galois. Avoiding excessive abstraction whenever possible, the text focuses on the central problem of studying the solutions of polynomial equations. Highlights include a proof of the Fundamental Theorem of Algebra, essentially due to Euler, and a proof of the constructability of the regular 17-gon, in the manner of Gauss. Another novel feature is the introduction of groups through a meditation on the meaning of congruence in the work of Euclid. Everywhere in the text, the goal is to make clear the links connecting abstract algebra to Euclidean geometry, high school algebra, and trigonometry, in the hope that students pursuing a career as secondary mathematics educators will carry away a deeper and richer understanding of the high school mathematics curriculum. Another goal is to encourage students, insofar as possible in a textbook format, to build the course for themselves, with exercises integrally embedded in the text of each chapter.

The book “Single variable Differential and Integral Calculus” is an interesting text book for students of mathematics and physics programs, and a reference book for graduate students in any engineering field. This book is unique in the field of mathematical analysis in content and in style. It aims to define, compare and discuss topics in single variable differential and integral calculus, as well as giving application examples in important business fields. Some elementary concepts such as the power of a set, cardinality, measure theory, measurable functions are introduced. It also covers real and complex numbers, vector spaces, topological properties of sets, series and sequences of functions (including complex-valued functions and functions of a complex variable), polynomials and interpolation and extrema of functions. Although analysis is based on the single variable models and applications, theorems and examples are all set to be converted to multi variable extensions. For example, Newton, Riemann, Stieltjes and Lebesque integrals are studied together and compared.

This book on two-dimensional geometry uses a problem-solving approach to actively engage students in the learning process. The aim is to guide readers through the story of the subject, while giving them room to discover and partially construct the story themselves. The book bridges the study of plane geometry and the study of curves and surfaces of non-constant curvature in three-dimensional Euclidean space. One useful feature is that the book can be adapted to suit different audiences. The first half of the text covers plane geometry without and with Euclid's Fifth Postulate, followed by a brief synthetic treatment of spherical geometry through the excess angle formula. This part only requires a background in high school geometry and basic trigonometry and is suitable for a quarter course for future high school geometry teachers. A brief foray into the second half could complete a semester course. The second half of the text gives a uniform treatment of all the complete, simply connected, two-dimensional geometries of constant curvature, one geometry for each real number (its curvature), including their groups of isometries, geodesics, measures of lengths and areas, as well as formulas for areas of regions bounded by polygons in terms of the curvature of the geometry and the sum of the interior angles of the polygon. A basic knowledge of real linear algebra and calculus of several (real) variables is useful background for this portion of the text.

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Optimization Theory is an active area of research with numerous applications; many of the books are designed for engineering classes, and thus have an emphasis on problems from such fields. Covering much of the same material, there is less emphasis on coding and detailed applications as the intended audience is more mathematical. There are still several important problems discussed (especially scheduling problems), but there is more emphasis on theory and less on the nuts and bolts of coding. A constant theme of the text is the “why” and the “how” in the subject. Why are we able to do a calculation efficiently? How should we look at a problem? Extensive effort is made to motivate the mathematics and isolate how one can apply ideas/perspectives to a variety of problems. As many of the key algorithms in the subject require too much time or detail to analyze in a first course (such as the run-time of the Simplex Algorithm), there are numerous comparisons to simpler algorithms which students have either seen or can quickly learn (such as the Euclidean algorithm) to motivate the type of results on run-time savings.

Now with an extensive introduction to fractal geometry Revised and updated, Encounters with Chaos and Fractals, Second Edition provides an accessible introduction to chaotic dynamics and fractal geometry for readers with a calculus background. It incorporates important mathematical concepts associated with these areas and backs up the definitions and results with motivation, examples, and applications. Laying the groundwork for later chapters, the text begins with examples of mathematical behavior exhibited by chaotic systems, first in one dimension and then in two and three dimensions. Focusing on fractal geometry, the author goes on to introduce famous infinitely complicated fractals. He analyzes them and explains how to obtain computer renditions of them. The book concludes with the famous Julia sets and the Mandelbrot set. With more than enough material for a one-semester course, this book gives readers an appreciation of the beauty and diversity of applications of chaotic dynamics and fractal geometry. It shows how these subjects continue to grow within mathematics and in many other disciplines.

Spaces is a modern introduction to real analysis at the advanced undergraduate level. It is forward-looking in the sense that it first and foremost aims to provide students with the concepts and techniques they need in order to follow more advanced courses in mathematical analysis and neighboring fields. The only prerequisites are a solid understanding of calculus and linear algebra. Two introductory chapters will help students with the transition from computation-based calculus to theory-based analysis. The main topics covered are metric spaces, spaces of continuous functions, normed spaces, differentiation in normed spaces, measure and integration theory, and Fourier series. Although some of the topics are more advanced than what is usually found in books of this level, care is taken to present the material in a way that is suitable for the intended audience: concepts are carefully introduced and motivated, and proofs are presented in full detail. Applications to differential equations and Fourier analysis are used to illustrate the power of the theory, and exercises of all levels from routine to real challenges help students develop their skills and understanding. The text has been tested in classes at the University of Oslo over a number of years.

Summary: This is a book on single variable calculus including most of the important applications of calculus. It also includes proofs of all theorems presented, either in the text itself, or in an appendix. It also contains an introduction to vectors and vector products which is developed further in Volume 2. While the book does include all the proofs of the theorems, many of the applications are presented more simply and less formally than is often the case in similar titles.

This is a book on many variable calculus. It is the second volume of a set of two. It includes proofs of all theorems presented, either in the text itself, or in an appendix. It also includes a sufficient introduction to linear algebra to allow the accurate presentation of many variable calculus.The use of elementary linear algebra in presenting the topics of multi- variable calculus is more extensive than usual in this book. It makes many of these topics easier to understand and remember. The book will prepare readers for more advanced math courses and also for courses in physical science.

Is there always a prime number between n and $2n$? Where, approximately, is the millionth prime? And just what does calculus have to do with answering either of these questions? It turns out that calculus has a lot to do with both questions, as this book can show you. The theme of the book is approximations. Calculus is a powerful tool because it allows us to approximate complicated functions with simpler ones. Indeed, replacing a function locally with a linear--or higher order--approximation is at the heart of calculus. The real star of the book, though, is the task of approximating the number of primes up to a number x. This leads to the famous Prime Number Theorem--and to the answers to the two questions about primes. While emphasizing the role of approximations in calculus, most major topics are addressed, such as derivatives, integrals, the Fundamental Theorem of Calculus, sequences, series, and so on. However, our particular point of view also leads us to many unusual topics: curvature, Pade approximations, public key cryptography, and an analysis of the logistic equation, to name a few. The reader takes an active role in developing the material by solving problems. Most topics are broken down into a series of manageable problems, which guide you to an understanding of the important ideas. There is also ample exposition to fill in background material and to get you thinking appropriately about the concepts. Approximately Calculus is intended for the reader who has already had an introduction to calculus, but wants to engage the concepts and ideas at a deeper level. It is suitable as a text for an honors or alternative second semester calculus course.

Linear algebra and matrix theory are fundamental tools for almost every area of mathematics, both pure and applied. This book combines coverage of core topics with an introduction to some areas in which linear algebra plays a key role, for example, block designs, directed graphs, error correcting codes, and linear dynamical systems. Notable features include a discussion of the Weyr characteristic and Weyr canonical forms, and their relationship to the better-known Jordan canonical form; the use of block cyclic matrices and directed graphs to prove Frobenius's theorem on the structure of the eigenvalues of a nonnegative, irreducible matrix; and the inclusion of such combinatorial topics as BIBDs, Hadamard matrices, and strongly regular graphs. Also included are McCoy's theorem about matrices with property P, the Bruck-Ryser-Chowla theorem on the existence of block designs, and an introduction to Markov chains. This book is intended for those who are familiar with the linear algebra covered in a typical first course and are interested in learning more advanced results.

Advanced CalculusAmerican Mathematical Soc.

This book presents material suitable for an undergraduate course in elementary number theory from a computational perspective. It seeks to not only introduce students to the standard topics in elementary number theory, such as prime factorization and modular arithmetic, but also to develop their ability to formulate and test precise conjectures from experimental data. Each topic is motivated by a question to be answered, followed by some experimental data, and, finally, the statement and proof of a theorem. There are numerous opportunities throughout the chapters and exercises for the students to engage in (guided) open-ended exploration. At the end of a course using this book, the students will understand how mathematics is developed from asking questions to gathering data to formulating and proving theorems. The mathematical prerequisites for this book are few. Early chapters contain topics such as integer divisibility, modular arithmetic, and applications to cryptography, while later chapters contain more specialized topics, such as Diophantine approximation, number theory of dynamical systems, and number theory with polynomials. Students of all levels will be drawn in by the patterns and relationships of number theory uncovered through data driven exploration.

The text covers a broad spectrum between basic and advanced complex variables on the one hand and between theoretical and applied or computational material on the other hand. With careful selection of the emphasis put on the various sections, examples, and exercises, the book can be used in a one- or two-semester course for undergraduate mathematics majors, a one-semester course for engineering or physics majors, or a one-semester course for first-year mathematics graduate students. It has been tested in all three settings at the University of Utah. The exposition is clear, concise, and lively. There is a clean and modern approach to Cauchy's theorems and Taylor series expansions, with rigorous proofs but no long and tedious arguments. This is followed by the rich harvest of easy consequences of the existence of power series expansions. Through the central portion of the text, there is a careful and extensive treatment of residue theory and its application to computation of integrals, conformal mapping and its applications to applied problems, analytic continuation, and the proofs of the Picard theorems. Chapter 8 covers material on infinite products and zeroes of entire functions. This leads to the final chapter which is devoted to the Riemann zeta function, the Riemann Hypothesis, and a proof of the Prime Number Theorem.

The mathematical formulations of problems in physics, economics, biology, and other sciences are usually embodied in differential equations. The analysis of the resulting equations then provides new insight into the original problems. This book describes the tools for performing that analysis. The first chapter treats single differential equations, emphasizing linear and nonlinear first order equations, linear second order equations, and a class of nonlinear second order equations arising from Newton's laws. The first order linear theory starts with a self-contained presentation of the exponential and trigonometric functions, which plays a central role in the subsequent development of this chapter. Chapter 2 provides a mini-course on linear algebra, giving detailed treatments of linear transformations, determinants and invertibility, eigenvalues and eigenvectors, and generalized eigenvectors. This treatment is more detailed than that in most differential equations texts, and provides a solid foundation for the next two chapters. Chapter 3 studies linear systems of differential equations. It starts with the matrix exponential, melding material from Chapters 1 and 2, and uses this exponential as a key tool in the linear theory. Chapter 4 deals with nonlinear systems of differential equations. This uses all the material developed in the first three chapters and moves it to a deeper level. The chapter includes theoretical studies, such as the fundamental existence and uniqueness theorem, but also has numerous examples, arising from Newtonian physics, mathematical biology, electrical circuits, and geometrical problems. These studies bring in variational methods, a fertile source of nonlinear systems of differential equations. The reader who works through this book will be well prepared for advanced studies in dynamical systems, mathematical physics, and partial differential equations.

ADVANCED CALCULUS OF SEVERAL VARIABLES covers important topics of Transformations and topology on Euclidean in n-space Rn Functions of several variables, Differentiation in Rn, Multiple integrals and Integration in Rn. The topics have been presented in a simple clear and coherent style with a number of examples and exercises. Proofs have been made direct and simple. Unsolved problems just after relevant articles in the form of exercises and typical problems followed by suggestions have been given. This book will help the reader work on the problems of Numerical Analysis, Operations Research, Differential Equations and Engineering applications.