

Runge Kutta Method Example Solution

Solving Differential Equations in R
Uncertain Differential Equations
A First Course in the Numerical Analysis of Differential Equations
Computer Mathematics
Fundamentals of Engineering Numerical Analysis
Probability, Markov Chains, Queues, and Simulation
Excel Scientific and Engineering Cookbook
Physics of Oscillations and Waves
A Step by Step Approach to the Modeling of Chemical Engineering Processes
Richardson Extrapolation
Computational Methods for Fluid Dynamics
Programming for Computations - Python
Numerical Methods for Ordinary Differential Equations
Exponential Fitting
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Strong Stability Preserving Runge-Kutta and Multistep Time Discretizations
A Primer on Scientific Programming with Python
Elementary Differential Equations
Numerical Methods for Engineers and Scientists Using MATLAB®
An Introduction to Numerical Methods
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Solving Ordinary Differential Equations I
Programming for Computations - MATLAB/Octave
Introduction to Differential Equations Using Sage
Numerical Mathematics and Computing
Modeling and Control of Uncertain Nonlinear Systems with Fuzzy Equations and Z-Number
The Numerical Solution of Differential-Algebraic Systems by Runge-Kutta Methods
The Numerical Analysis of Ordinary Differential Equations
Numerical Methods for Ordinary Differential Equations
Numerical Solutions of Initial Value Problems Using Mathematica
Solving ODEs with MATLAB

Solving Differential Equations in R

This book presents computer programming as a key method for solving mathematical problems. There are two versions of the book, one for MATLAB and one for Python. The book was inspired by the Springer book TCSE 6: A Primer on Scientific Programming with Python (by Langtangen), but the style is more accessible and concise, in keeping with the needs of engineering students. The book outlines the shortest possible path from no previous experience with programming to a set of skills that allows the students to write simple programs for solving common mathematical problems with numerical methods in engineering and science courses. The emphasis is on generic algorithms, clean design of programs, use of functions, and automatic tests for verification.

Uncertain Differential Equations

A new edition of this classic work, comprehensively revised to present exciting new developments in this important subject. The study of numerical methods for solving ordinary differential equations is constantly developing and regenerating, and this third edition of a popular classic volume, written by one of the world's leading experts in the field, presents an account of the subject which reflects both its historical and well-established place in computational science and its vital role as a

cornerstone of modern applied mathematics. In addition to serving as a broad and comprehensive study of numerical methods for initial value problems, this book contains a special emphasis on Runge-Kutta methods by the mathematician who transformed the subject into its modern form dating from his classic 1963 and 1972 papers. A second feature is general linear methods which have now matured and grown from being a framework for a unified theory of a wide range of diverse numerical schemes to a source of new and practical algorithms in their own right. As the founder of general linear method research, John Butcher has been a leading contributor to its development; his special role is reflected in the text. The book is written in the lucid style characteristic of the author, and combines enlightening explanations with rigorous and precise analysis. In addition to these anticipated features, the book breaks new ground by including the latest results on the highly efficient G-symplectic methods which compete strongly with the well-known symplectic Runge-Kutta methods for long-term integration of conservative mechanical systems. Key features: ?? Presents a comprehensive and detailed study of the subject ?? Covers both practical and theoretical aspects ?? Includes widely accessible topics along with sophisticated and advanced details ?? Offers a balance between traditional aspects and modern developments This third edition of Numerical Methods for Ordinary Differential Equations will serve as a key text for senior undergraduate and graduate courses in numerical analysis, and is an essential resource for research workers in applied mathematics, physics and engineering.

A First Course in the Numerical Analysis of Differential Equations

Unique book on Reaction-Advection-Diffusion problems

Computer Mathematics

Mathematical and computational introduction. The Euler method and its generalizations. Analysis of Runge-Kutta methods. General linear methods.

Fundamentals of Engineering Numerical Analysis

Numerical Methods for Ordinary Differential Equations is a self-contained introduction to a fundamental field of numerical analysis and scientific computation. Written for undergraduate students with a mathematical background, this book focuses on the analysis of numerical methods without losing sight of the practical nature of the subject. It covers the topics traditionally treated in a first course, but also highlights new and emerging themes. Chapters are broken down into 'lecture' sized pieces, motivated and illustrated by numerous theoretical and computational examples. Over 200 exercises are provided and these are starred according to their degree of difficulty. Solutions to all exercises are available to authorized instructors. The book covers key foundation topics: o Taylor series methods o Runge-Kutta methods o Linear multistep methods o Convergence o Stability and a range of modern themes: o Adaptive stepsize selection o Long term dynamics o Modified equations o Geometric integration o Stochastic differential equations The prerequisite of a basic university-level calculus class is assumed,

although appropriate background results are also summarized in appendices. A dedicated website for the book containing extra information can be found via www.springer.com

Probability, Markov Chains, Queues, and Simulation

An original, systematic-solution approach to uncertain nonlinear systems control and modeling using fuzzy equations and fuzzy differential equations. There are various numerical and analytical approaches to the modeling and control of uncertain nonlinear systems. Fuzzy logic theory is an increasingly popular method used to solve inconvenience problems in nonlinear modeling. Modeling and Control of Uncertain Nonlinear Systems with Fuzzy Equations and Z-Number presents a structured approach to the control and modeling of uncertain nonlinear systems in industry using fuzzy equations and fuzzy differential equations. The first major work to explore methods based on neural networks and Bernstein neural networks, this innovative volume provides a framework for control and modeling of uncertain nonlinear systems with applications to industry. Readers learn how to use fuzzy techniques to solve scientific and engineering problems and understand intelligent control design and applications. The text assembles the results of four years of research on control of uncertain nonlinear systems with dual fuzzy equations, fuzzy modeling for uncertain nonlinear systems with fuzzy equations, the numerical solution of fuzzy equations with Z-numbers, and the numerical solution of fuzzy differential equations with Z-numbers. Using clear and accessible language to explain concepts and principles applicable to real-world scenarios, this book: Presents the modeling and control of uncertain nonlinear systems with fuzzy equations and fuzzy differential equations Includes an overview of uncertain nonlinear systems for non-specialists Teaches readers to use simulation, modeling and verification skills valuable for scientific research and engineering systems development Reinforces comprehension with illustrations, tables, examples, and simulations Modeling and Control of Uncertain Nonlinear Systems with Fuzzy Equations and Z-Number is suitable as a textbook for advanced students, academic and industrial researchers, and practitioners in fields of systems engineering, learning control systems, neural networks, computational intelligence, and fuzzy logic control.

Excel Scientific and Engineering Cookbook

A concise introduction to numerical methods and the mathematical framework needed to understand their performance. Numerical Solution of Ordinary Differential Equations presents a complete and easy-to-follow introduction to classical topics in the numerical solution of ordinary differential equations. The book's approach not only explains the presented mathematics, but also helps readers understand how these numerical methods are used to solve real-world problems. Unifying perspectives are provided throughout the text, bringing together and categorizing different types of problems in order to help readers comprehend the applications of ordinary differential equations. In addition, the authors' collective academic experience ensures a coherent and accessible discussion of key topics, including: Euler's method Taylor and Runge-Kutta methods General error analysis for multi-step methods Stiff differential equations Differential algebraic equations Two-point boundary value problems Volterra integral equations Each chapter features

problem sets that enable readers to test and build their knowledge of the presented methods, and a related Web site features MATLAB® programs that facilitate the exploration of numerical methods in greater depth. Detailed references outline additional literature on both analytical and numerical aspects of ordinary differential equations for further exploration of individual topics. Numerical Solution of Ordinary Differential Equations is an excellent textbook for courses on the numerical solution of differential equations at the upper-undergraduate and beginning graduate levels. It also serves as a valuable reference for researchers in the fields of mathematics and engineering.

Physics of Oscillations and Waves

Applied Engineering Analysis Tai-Ran Hsu, San Jose State University, USA A resource book applying mathematics to solve engineering problems Applied Engineering Analysis is a concise textbook which demonstrates how to apply mathematics to solve engineering problems. It begins with an overview of engineering analysis and an introduction to mathematical modeling, followed by vector calculus, matrices and linear algebra, and applications of first and second order differential equations. Fourier series and Laplace transform are also covered, along with partial differential equations, numerical solutions to nonlinear and differential equations and an introduction to finite element analysis. The book also covers statistics with applications to design and statistical process controls. Drawing on the author's extensive industry and teaching experience, spanning 40 years, the book takes a pedagogical approach and includes examples, case studies and end of chapter problems. It is also accompanied by a website hosting a solutions manual and PowerPoint slides for instructors. Key features: Strong emphasis on deriving equations, not just solving given equations, for the solution of engineering problems. Examples and problems of a practical nature with illustrations to enhance student's self-learning. Numerical methods and techniques, including finite element analysis. Includes coverage of statistical methods for probabilistic design analysis of structures and statistical process control (SPC). Applied Engineering Analysis is a resource book for engineering students and professionals to learn how to apply the mathematics experience and skills that they have already acquired to their engineering profession for innovation, problem solving, and decision making.

A Step by Step Approach to the Modeling of Chemical Engineering Processes

With emphasis on modern techniques, Numerical Methods for Differential Equations: A Computational Approach covers the development and application of methods for the numerical solution of ordinary differential equations. Some of the methods are extended to cover partial differential equations. All techniques covered in the text are on a program disk included with the book, and are written in Fortran 90. These programs are ideal for students, researchers, and practitioners because they allow for straightforward application of the numerical methods described in the text. The code is easily modified to solve new systems of equations. Numerical Methods for Differential Equations: A Computational Approach also contains a reliable and inexpensive global error code for those

interested in global error estimation. This is a valuable text for students, who will find the derivations of the numerical methods extremely helpful and the programs themselves easy to use. It is also an excellent reference and source of software for researchers and practitioners who need computer solutions to differential equations.

Richardson Extrapolation

Highly recommended by CHOICE, previous editions of this popular textbook offered an accessible and practical introduction to numerical analysis. An Introduction to Numerical Methods: A MATLAB® Approach, Third Edition continues to present a wide range of useful and important algorithms for scientific and engineering applications. The authors use MATLAB to illustrate each numerical method, providing full details of the computer results so that the main steps are easily visualized and interpreted. New to the Third Edition A chapter on the numerical solution of integral equations A section on nonlinear partial differential equations (PDEs) in the last chapter Inclusion of MATLAB GUIs throughout the text The book begins with simple theoretical and computational topics, including computer floating point arithmetic, errors, interval arithmetic, and the root of equations. After presenting direct and iterative methods for solving systems of linear equations, the authors discuss interpolation, spline functions, concepts of least-squares data fitting, and numerical optimization. They then focus on numerical differentiation and efficient integration techniques as well as a variety of numerical techniques for solving linear integral equations, ordinary differential equations, and boundary-value problems. The book concludes with numerical techniques for computing the eigenvalues and eigenvectors of a matrix and for solving PDEs. CD-ROM Resource The accompanying CD-ROM contains simple MATLAB functions that help students understand how the methods work. These functions provide a clear, step-by-step explanation of the mechanism behind the algorithm of each numerical method and guide students through the calculations necessary to understand the algorithm. Written in an easy-to-follow, simple style, this text improves students' ability to master the theoretical and practical elements of the methods. Through this book, they will be able to solve many numerical problems using MATLAB.

Computational Methods for Fluid Dynamics

Homework help! Worked-out solutions to select problems in the text.

Programming for Computations - Python

This book provides a pragmatic, methodical and easy-to-follow presentation of numerical methods and their effective implementation using MATLAB, which is introduced at the outset. The author introduces techniques for solving equations of a single variable and systems of equations, followed by curve fitting and interpolation of data. The book also provides detailed coverage of numerical differentiation and integration, as well as numerical solutions of initial-value and boundary-value problems. The author then presents the numerical solution of the matrix eigenvalue problem, which entails approximation of a few or all eigenvalues of a matrix. The last chapter is devoted to numerical solutions of partial differential

equations that arise in engineering and science. Each method is accompanied by at least one fully worked-out example showing essential details involved in preliminary hand calculations, as well as computations in MATLAB.

Numerical Methods for Ordinary Differential Equations

In this textbook a combination of standard mathematics and modern numerical methods is used to describe a wide range of natural wave phenomena, such as sound, light and water waves, particularly in specific popular contexts, e.g. colors or the acoustics of musical instruments. It introduces the reader to the basic physical principles that allow the description of the oscillatory motion of matter and classical fields, as well as resulting concepts including interference, diffraction, and coherence. Numerical methods offer new scientific insights and make it possible to handle interesting cases that can't readily be addressed using analytical mathematics; this holds true not only for problem solving but also for the description of phenomena. Essential physical parameters are brought more into focus, rather than concentrating on the details of which mathematical trick should be used to obtain a certain solution. Readers will learn how time-resolved frequency analysis offers a deeper understanding of the interplay between frequency and time, which is relevant to many phenomena involving oscillations and waves. Attention is also drawn to common misconceptions resulting from uncritical use of the Fourier transform. The book offers an ideal guide for upper-level undergraduate physics students and will also benefit physics instructors. Program codes in Matlab and Python, together with interesting files for use in the problems, are provided as free supplementary material.

Exponential Fitting

This new book updates the exceptionally popular Numerical Analysis of Ordinary Differential Equations. "This book is an indispensable reference for any researcher."-American Mathematical Society on the First Edition. Features: * New exercises included in each chapter. * Author is widely regarded as the world expert on Runge-Kutta methods * Didactic aspects of the book have been enhanced by interspersing the text with exercises. * Updated Bibliography.

Numerical Methods for Ordinary Differential Equations

Scientists and engineers are mainly using Richardson extrapolation as a computational tool for increasing the accuracy of various numerical algorithms for the treatment of systems of ordinary and partial differential equations and for improving the computational efficiency of the solution process by the automatic variation of the time-stepsizes. A third issue, the stability of the computations, is very often the most important one and, therefore, it is the major topic studied in all chapters of this book. Clear explanations and many examples make this text an easy-to-follow handbook for applied mathematicians, physicists and engineers working with scientific models based on differential equations. Contents The basic properties of Richardson extrapolation Richardson extrapolation for explicit Runge-Kutta methods Linear multistep and predictor-corrector methods Richardson extrapolation for some implicit methods Richardson extrapolation for splitting

techniques Richardson extrapolation for advection problems Richardson extrapolation for some other problems General conclusions

Mathematical Modeling in Chemical Engineering

In this work, Parviz Moin introduces numerical methods and shows how to develop, analyse, and use them. A thorough and practical text, it is intended as a first course in numerical analysis.

Numerical Methods for Differential Equations

This informative reference offers an overview of the techniques used to solve problems in fluid mechanics on computers and describes in detail those most often used in practice. Advanced techniques in computational fluid dynamics are presented, including direct and large-eddy simulation of turbulence, multigrid methods, parallel computing, moving grids, boundary-fitted grids, and free surface flows. 100 illus.

Numerical Solution of Ordinary Differential Equations

This text has been written in clear and accurate language that students can read and comprehend. The author has minimized the number of explicitly stated theorems and definitions, in favor of dealing with concepts in a more conversational manner. This is illustrated by over 250 worked out examples. The problems are extremely high quality and are regarded as one of the text's many strengths. This book also allows the instructor to select the level of technology desired. Trench has simplified this by using the symbols C and L. C exercises call for computation and/or graphics, and L exercises are laboratory exercises that require extensive use of technology. Several sections include informal advice on the use of technology. The instructor who prefers not to emphasize technology can ignore these exercises.

Numerical Solution of Ordinary Differential Equations

This volume contains the proceedings of the Eighth Asian Symposium on Computer Mathematics (ASCM 2007), which was held at the Grand Plaza Park Hotel City Hall, Singapore, December 15–17, 2007. Previous ASCM meetings were held in Beijing, China (1995), Kobe, Japan (1996), Lanzhou, China (1998), Chiang Mai, Thailand (2000), Matsuyama, Japan (2001), Beijing, China (2003), and Seoul, Korea (2005). Amongst 65 submissions by authors from 20 mostly Asian countries, the Program Committee selected 23 regular papers and 13 posters for presentation at the symposium. The presentations and papers went through another round of reviewing after the symposium, and 22 regular papers and 7 short papers on posters were selected for the proceedings. The international Program Committee of ASCM 2007 had strong Asian participation, and the reviewing process was aided by numerous reviewers from around the world. I am very grateful to the Program Committee members and the reviewers for their work in evaluating the submissions before and after the conference. In addition to contributed papers, ASCM 2007 had three invited talks— by Rida Farouki on computational geometry,

by Xiaoyun Wang on cryptology, and by Georges Gonthier on a computer proof of the celebrated Four Color Theorem. I would like to thank the speakers for their excellent talks. A paper by Prof. Farouki and his coauthors is included in the proceedings. Prof.

Applied Engineering Analysis

Previous editions of this popular textbook offered an accessible and practical introduction to numerical analysis. An Introduction to Numerical Methods: A MATLAB® Approach, Fourth Edition continues to present a wide range of useful and important algorithms for scientific and engineering applications. The authors use MATLAB to illustrate each numerical method, providing full details of the computed results so that the main steps are easily visualized and interpreted. This edition also includes a new chapter on Dynamical Systems and Chaos.

Finite Difference Computing with PDEs

David Joyner and Marshall Hampton's lucid textbook explains differential equations using the free and open-source mathematical software Sage. Since its release in 2005, Sage has acquired a substantial following among mathematicians, but its first user was Joyner, who is credited with helping famed mathematician William Stein turn the program into a usable and popular choice. Introduction to Differential Equations Using Sage extends Stein's work by creating a classroom tool that allows both differential equations and Sage to be taught concurrently. It's a creative and forward-thinking approach to math instruction. Topics include: • First-Order Differential Equations • Incorporation of Newtonian Mechanics • Second-Order Differential Equations • The Annihilator Method • Using Linear Algebra with Differential Equations • Nonlinear Systems • Partial Differential Equations • Romeo and Juliet

An Introduction to Numerical Methods

The term differential-algebraic equation was coined to comprise differential equations with constraints (differential equations on manifolds) and singular implicit differential equations. Such problems arise in a variety of applications, e.g. constrained mechanical systems, fluid dynamics, chemical reaction kinetics, simulation of electrical networks, and control engineering. From a more theoretical viewpoint, the study of differential-algebraic problems gives insight into the behaviour of numerical methods for stiff ordinary differential equations. These lecture notes provide a self-contained and comprehensive treatment of the numerical solution of differential-algebraic systems using Runge-Kutta methods, and also extrapolation methods. Readers are expected to have a background in the numerical treatment of ordinary differential equations. The subject is treated in its various aspects ranging from the theory through the analysis to implementation and applications.

Elementary Differential Equations

This book presents computer programming as a key method for solving

mathematical problems. There are two versions of the book, one for MATLAB and one for Python. The book was inspired by the Springer book TCSE 6: A Primer on Scientific Programming with Python (by Langtangen), but the style is more accessible and concise, in keeping with the needs of engineering students. The book outlines the shortest possible path from no previous experience with programming to a set of skills that allows the students to write simple programs for solving common mathematical problems with numerical methods in engineering and science courses. The emphasis is on generic algorithms, clean design of programs, use of functions, and automatic tests for verification.

Numerical Solution of Time-Dependent Advection-Diffusion-Reaction Equations

Given the improved analytical capabilities of Excel, scientists and engineers everywhere are using it--instead of FORTRAN--to solve problems. And why not? Excel is installed on millions of computers, features a rich set of built-in analyses tools, and includes an integrated Visual Basic for Applications (VBA) programming language. No wonder it's today's computing tool of choice. Chances are you already use Excel to perform some fairly routine calculations. Now the Excel Scientific and Engineering Cookbook shows you how to leverage Excel to perform more complex calculations, too, calculations that once fell in the domain of specialized tools. It does so by putting a smorgasbord of data analysis techniques right at your fingertips. The book shows how to perform these useful tasks and others: Use Excel and VBA in general Import data from a variety of sources Analyze data Perform calculations Visualize the results for interpretation and presentation Use Excel to solve specific science and engineering problems Wherever possible, the Excel Scientific and Engineering Cookbook draws on real-world examples from a range of scientific disciplines such as biology, chemistry, and physics. This way, you'll be better prepared to solve the problems you face in your everyday scientific or engineering tasks. High on practicality and low on theory, this quick, look-up reference provides instant solutions, or "recipes," to problems both basic and advanced. And like other books in O'Reilly's popular Cookbook format, each recipe also includes a discussion on how and why it works. As a result, you can take comfort in knowing that complete, practical answers are a mere page-flip away.

Strong Stability Preserving Runge-Kutta and Multistep Time Discretizations

Outstanding text, oriented toward computer solutions, stresses errors in methods and computational efficiency. Problems — some strictly mathematical, others requiring a computer — appear at the end of each chapter.

A Primer on Scientific Programming with Python

lead the reader to a theoretical understanding of the subject without neglecting its practical aspects. The outcome is a textbook that is mathematically honest and rigorous and provides its target audience with a wide range of skills in both ordinary and partial differential equations." --Book Jacket.

Elementary Differential Equations

This book introduces readers to the basic concepts of and latest findings in the area of differential equations with uncertain factors. It covers the analytic method and numerical method for solving uncertain differential equations, as well as their applications in the field of finance. Furthermore, the book provides a number of new potential research directions for uncertain differential equation. It will be of interest to researchers, engineers and students in the fields of mathematics, information science, operations research, industrial engineering, computer science, artificial intelligence, automation, economics, and management science.

Numerical Methods for Engineers and Scientists Using MATLAB®

This book, first published in 2003, provides a concise but sound treatment of ODEs, including IVPs, BVPs, and DDEs.

An Introduction to Numerical Methods

This book treats modeling and simulation in a simple way, that builds on the existing knowledge and intuition of students. They will learn how to build a model and solve it using Excel. Most chemical engineering students feel a shiver down the spine when they see a set of complex mathematical equations generated from the modeling of a chemical engineering system. This is because they usually do not understand how to achieve this mathematical model, or they do not know how to solve the equations system without spending a lot of time and effort. Trying to understand how to generate a set of mathematical equations to represent a physical system (to model) and solve these equations (to simulate) is not a simple task. A model, most of the time, takes into account all phenomena studied during a Chemical Engineering course. In the same way, there is a multitude of numerical methods that can be used to solve the same set of equations generated from the modeling, and many different computational languages can be adopted to implement the numerical methods. As a consequence of this comprehensiveness and combinatorial explosion of possibilities, most books that deal with this subject are very extensive and embracing, making need for a lot of time and effort to go through this subject. It is expected that with this book the chemical engineering student and the future chemical engineer feel motivated to solve different practical problems involving chemical processes, knowing they can do that in an easy and fast way, with no need of expensive software.

A First Course in Numerical Analysis

Mathematics plays an important role in many scientific and engineering disciplines. This book deals with the numerical solution of differential equations, a very important branch of mathematics. Our aim is to give a practical and theoretical account of how to solve a large variety of differential equations, comprising ordinary differential equations, initial value problems and boundary value problems, differential algebraic equations, partial differential equations and delay differential equations. The solution of differential equations using R is the main

focus of this book. It is therefore intended for the practitioner, the student and the scientist, who wants to know how to use R for solving differential equations. However, it has been our goal that non-mathematicians should at least understand the basics of the methods, while obtaining entrance into the relevant literature that provides more mathematical background. Therefore, each chapter that deals with R examples is preceded by a chapter where the theory behind the numerical methods being used is introduced. In the sections that deal with the use of R for solving differential equations, we have taken examples from a variety of disciplines, including biology, chemistry, physics, pharmacokinetics. Many examples are well-known test examples, used frequently in the field of numerical analysis.

Solving Ordinary Differential Equations I

This work meets the need for an affordable textbook that helps in understanding numerical solutions of ODE. Carefully structured by an experienced textbook author, it provides a survey of ODE for various applications, both classical and modern, including such special applications as relativistic systems. The examples are carefully explained and compiled into an algorithm, each of which is presented independent of a specific programming language. Each chapter is rounded off with exercises.

Programming for Computations - MATLAB/Octave

This book is open access under a CC BY 4.0 license. This easy-to-read book introduces the basics of solving partial differential equations by means of finite difference methods. Unlike many of the traditional academic works on the topic, this book was written for practitioners. Accordingly, it especially addresses: the construction of finite difference schemes, formulation and implementation of algorithms, verification of implementations, analyses of physical behavior as implied by the numerical solutions, and how to apply the methods and software to solve problems in the fields of physics and biology.

Introduction to Differential Equations Using Sage

Exponential Fitting is a procedure for an efficient numerical approach of functions consisting of weighted sums of exponential, trigonometric or hyperbolic functions with slowly varying weight functions. This book is the first one devoted to this subject. Operations on the functions described above like numerical differentiation, quadrature, interpolation or solving ordinary differential equations whose solution is of this type, are of real interest nowadays in many phenomena as oscillations, vibrations, rotations, or wave propagation. The authors studied the field for many years and contributed to it. Since the total number of papers accumulated so far in this field exceeds 200 and the fact that these papers are spread over journals with various profiles (such as applied mathematics, computer science, computational physics and chemistry) it was time to compact and to systematically present this vast material. In this book, a series of aspects is covered, ranging from the theory of the procedure up to direct applications and sometimes including ready to use programs. The book can also be used as a textbook for graduate students.

Numerical Mathematics and Computing

This book captures the state-of-the-art in the field of Strong Stability Preserving (SSP) time stepping methods, which have significant advantages for the time evolution of partial differential equations describing a wide range of physical phenomena. This comprehensive book describes the development of SSP methods, explains the types of problems which require the use of these methods and demonstrates the efficiency of these methods using a variety of numerical examples. Another valuable feature of this book is that it collects the most useful SSP methods, both explicit and implicit, and presents the other properties of these methods which make them desirable (such as low storage, small error coefficients, large linear stability domains). This book is valuable for both researchers studying the field of time-discretizations for PDEs, and the users of such methods.

Modeling and Control of Uncertain Nonlinear Systems with Fuzzy Equations and Z-Number

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.

The Numerical Solution of Differential-Algebraic Systems by Runge-Kutta Methods

The book contains a detailed account of numerical solutions of differential equations of elementary problems of Physics using Euler and 2nd order Runge-Kutta methods and Mathematica 6.0. The problems are motion under constant force (free fall), motion under Hooke's law force (simple harmonic motion), motion under combination of Hooke's law force and a velocity dependent damping force (damped harmonic motion) and radioactive decay law. Also included are uses of Mathematica in dealing with complex numbers, in solving system of linear equations, in carrying out differentiation and integration, and in dealing with matrices.

The Numerical Analysis of Ordinary Differential Equations

Probability, Markov Chains, Queues, and Simulation provides a modern and authoritative treatment of the mathematical processes that underlie performance modeling. The detailed explanations of mathematical derivations and numerous illustrative examples make this textbook readily accessible to graduate and advanced undergraduate students taking courses in which stochastic processes play a fundamental role. The textbook is relevant to a wide variety of fields, including computer science, engineering, operations research, statistics, and mathematics. The textbook looks at the fundamentals of probability theory, from

the basic concepts of set-based probability, through probability distributions, to bounds, limit theorems, and the laws of large numbers. Discrete and continuous-time Markov chains are analyzed from a theoretical and computational point of view. Topics include the Chapman-Kolmogorov equations; irreducibility; the potential, fundamental, and reachability matrices; random walk problems; reversibility; renewal processes; and the numerical computation of stationary and transient distributions. The M/M/1 queue and its extensions to more general birth-death processes are analyzed in detail, as are queues with phase-type arrival and service processes. The M/G/1 and G/M/1 queues are solved using embedded Markov chains; the busy period, residual service time, and priority scheduling are treated. Open and closed queueing networks are analyzed. The final part of the book addresses the mathematical basis of simulation. Each chapter of the textbook concludes with an extensive set of exercises. An instructor's solution manual, in which all exercises are completely worked out, is also available (to professors only). Numerous examples illuminate the mathematical theories. Carefully detailed explanations of mathematical derivations guarantee a valuable pedagogical approach. Each chapter concludes with an extensive set of exercises.

Numerical Methods for Ordinary Differential Equations

The book serves as a first introduction to computer programming of scientific applications, using the high-level Python language. The exposition is example and problem-oriented, where the applications are taken from mathematics, numerical calculus, statistics, physics, biology and finance. The book teaches "Matlab-style" and procedural programming as well as object-oriented programming. High school mathematics is a required background and it is advantageous to study classical and numerical one-variable calculus in parallel with reading this book. Besides learning how to program computers, the reader will also learn how to solve mathematical problems, arising in various branches of science and engineering, with the aid of numerical methods and programming. By blending programming, mathematics and scientific applications, the book lays a solid foundation for practicing computational science. From the reviews: Langtangen does an excellent job of introducing programming as a set of skills in problem solving. He guides the reader into thinking properly about producing program logic and data structures for modeling real-world problems using objects and functions and embracing the object-oriented paradigm. Summing Up: Highly recommended. F. H. Wild III, *Choice*, Vol. 47 (8), April 2010 Those of us who have learned scientific programming in Python 'on the streets' could be a little jealous of students who have the opportunity to take a course out of Langtangen's Primer." John D. Cook, *The Mathematical Association of America*, September 2011 This book goes through Python in particular, and programming in general, via tasks that scientists will likely perform. It contains valuable information for students new to scientific computing and would be the perfect bridge between an introduction to programming and an advanced course on numerical methods or computational science. Alex Small, *IEEE, CiSE* Vol. 14 (2), March /April 2012 "This fourth edition is a wonderful, inclusive textbook that covers pretty much everything one needs to know to go from zero to fairly sophisticated scientific programming in Python" Joan Horvath, *Computing Reviews*, March 2015

Numerical Solutions of Initial Value Problems Using

Mathematica

A solid introduction to mathematical modeling for a range of chemical engineering applications, covering model formulation, simplification and validation. It explains how to describe a physical/chemical reality in mathematical language and how to select the type and degree of sophistication for a model. Model reduction and approximation methods are presented, including dimensional analysis, time constant analysis and asymptotic methods. An overview of solution methods for typical classes of models is given. As final steps in model building, parameter estimation and model validation and assessment are discussed. The reader is given hands-on experience of formulating new models, reducing the models and validating the models. The authors assume the knowledge of basic chemical engineering, in particular transport phenomena, as well as basic mathematics, statistics and programming. The accompanying problems, tutorials, and projects include model formulation at different levels, analysis, parameter estimation and numerical solution.

Solving ODEs with MATLAB

Authors Ward Cheney and David Kincaid show students of science and engineering the potential computers have for solving numerical problems and give them ample opportunities to hone their skills in programming and problem solving. NUMERICAL MATHEMATICS AND COMPUTING, 7th Edition also helps students learn about errors that inevitably accompany scientific computations and arms them with methods for detecting, predicting, and controlling these errors. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

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