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treated in more detail. They are just
specimen of larger classes of

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schemes. Essentially, we have to distinguish between semi-analytical methods, discretization methods, and lumped circuit models. The semi-analytical methods and the discretization methods start directly from Maxwell's equations. Semi-

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analytical methods are concentrated on the analytical level: They use a computer only to evaluate expressions and to solve resulting linear algebraic problems. The best known semi-analytical methods are the mode matching

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method, which is described in subsection 2. 1, the method of integral equations, and the method of moments. In the method of integral equations, the given boundary value problem is transformed into an integral

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equation with the aid of a suitable
Green's function. In the method of
moments, which includes the mode
matching method as a special case,
the solution function is represented
by a linear combination of
appropriately weighted basis func

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tions. The treatment of complex geometrical structures is very difficult for these methods or only possible after geometric simplifications: In the method of integral equations, the Greens function has to satisfy the boundary

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conditions. In the mode matching method, it must be possible to decompose the domain into subdomains in which the problem can be solved analytically, thus allowing to find the basis functions. Nevertheless, there are some ap

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lications for which the semi-analytic methods are the best suited solution methods. For example, an application from accelerator physics used the mode matching technique (see subsection 5. 4).

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Describes the components of a computer and explains the calculations used in solving problems with a digital computer.

Bibliogs

This work addresses the increasingly important role of

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numerical methods in science and engineering. It combines traditional and well-developed topics with other material such as interval arithmetic, elementary functions, operator series, convergence acceleration, and continued

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This book constitutes the thoroughly refereed post-conference proceedings of the 8th International Conference on Numerical Methods and Applications, NMA 2014, held in

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Borovets, Bulgaria, in August 2014. The 34 revised full papers presented were carefully reviewed and selected from 56 submissions for inclusion in this book. The papers are organized in the following topical sections: Monte

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Carlo and quasi-Monte Carlo methods; metaheuristics for optimization problems; advanced numerical methods for scientific computing; advanced numerical techniques for PDEs and applications; solving large

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engineering and scientific problems with advanced mathematical models; numerical simulations and back analysis in civil and mechanical engineering.

Simulation and modeling using numerical methods is one of the

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key instruments in any scientific work. In the field of photonics, a wide range of numerical methods are used for studying both fundamental optics and applications such as design, development, and optimization of photonic

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components. Modeling is key for developing improved photonic devices and reducing development time and cost. Choosing the appropriate computational method for a photonics modeling problem requires a clear understanding of

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the pros and cons of the available numerical methods. Numerical Methods in Photonics presents six of the most frequently used methods: FDTD, FDFD, 1+1D nonlinear propagation, modal method, Green ' s function, and

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FEM. After an introductory chapter outlining the basics of Maxwell ' s equations, the book includes self-contained chapters that focus on each of the methods. Each method is accompanied by a review of the mathematical principles in which it

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is based, along with sample scripts, illustrative examples of characteristic problem solving, and exercises. MATLAB® is used throughout the text. This book provides a solid basis to practice writing your own codes. The

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theoretical formulation is
complemented by sets of exercises,
which allow you to grasp the
essence of the modeling tools.
This book introduces advanced
numerical-functional analysis to
beginning computer science

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researchers. The reader is assumed to have had basic courses in numerical analysis, computer programming, computational linear algebra, and an introduction to real, complex, and functional analysis. Although

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the book is of a theoretical nature, each chapter contains several new theoretical results and important applications in engineering, in dynamic economics systems, in input-output system, in the solution of nonlinear and linear differential

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equations, and optimization problem.

This book focuses on various aspects of dynamic game theory, presenting state-of-the-art research and serving as a testament to the vitality and growth of the field of

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dynamic games and their applications. The selected contributions, written by experts in their respective disciplines, are outgrowths of presentations originally given at the 13th International Symposium of

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Dynamic Games and Applications held in Wrocław. The book covers a variety of topics, ranging from theoretical developments in game theory and algorithmic methods to applications, examples, and analysis in fields as varied as

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environmental management,
finance and economics,
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manner, this comprehensive
textbook brings together both basic

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and advanced concepts of numerical methods in a single volume. Important topics including error analysis, nonlinear equations, systems of linear equations, interpolation and interpolation for Equal intervals and bivariate

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interpolation are discussed comprehensively. The textbook is written to cater to the needs of undergraduate students of mathematics, computer science, mechanical engineering, civil engineering and information

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technology for a course on numerical methods/numerical analysis. The text simplifies the understanding of the concepts through exercises and practical examples. Pedagogical features including solved examples and

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unsolved exercises are interspersed throughout the book for better understanding.

[6th International Conference, NAA 2016, Lozenetz, Bulgaria, June 15-22, 2016, Revised Selected Papers](#)

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Applications 7th International
Conference, NMA 2010, Borovets,
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This book constitutes the thoroughly
refereed post-conference proceedings
of the 9th International Conference on

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Numerical Methods and Applications, NMA 2018, held in Borovets, Bulgaria, in August 2018. The 56 revised regular papers presented were carefully reviewed and selected from 61 submissions for inclusion in this book. The papers are organized in the following topical sections: numerical

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search and optimization; problem-driven numerical method: motivation and application, numerical methods for fractional diffusion problems; orthogonal polynomials and numerical quadratures; and Monte Carlo and Quasi-Monte Carlo methods. Multiphysics Modeling: Numerical

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Methods and Engineering Applications:
Tsinghua University Press
Computational Mechanics Series
describes the basic principles and
methods for multiphysics modeling,
covering related areas of physics such
as structure mechanics, fluid dynamics,
heat transfer, electromagnetic field, and

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noise. The book provides the latest information on basic numerical methods, also considering coupled problems spanning fluid-solid interaction, thermal-stress coupling, fluid-solid-thermal coupling, electromagnetic solid thermal fluid coupling, and structure-noise coupling.

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multiphysics problems Covers the multiphysics details not touched upon in broader numerical methods references, including load transfer between physics, element level strong coupling, and interface strong coupling, amongst others Discusses practical applications throughout and tackles real-life

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This undergraduate textbook integrates the teaching of numerical methods and programming with problems from core chemical engineering subjects.

Manual of numerical methods in

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concrete aims to present a unified approach for the available mathematical models of concrete, linking them to finite element analysis and to computer programs in which special provisions are made for concrete plasticity, cracking and crushing with and without concrete

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aggregate interlocking. Creep, temperature, and shrinkage formulations are included and geared to various concrete constitutive models. This book stems from the long standing teaching experience of the authors in the courses on Numerical Methods in Engineering and Numerical Methods for

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Partial Differential Equations given to undergraduate and graduate students of Politecnico di Milano (Italy), EPFL Lausanne (Switzerland), University of Bergamo (Italy) and Emory University (Atlanta, USA). It aims at introducing students to the numerical approximation of Partial Differential

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Equations (PDEs). One of the difficulties of this subject is to identify the right trade-off between theoretical concepts and their actual use in practice. With this collection of examples and exercises we try to address this issue by illustrating "academic" examples which focus on

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basic concepts of Numerical Analysis as well as problems derived from practical application which the student is encouraged to formalize in terms of PDEs, analyze and solve. The latter examples are derived from the experience of the authors in research project developed in collaboration with

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scientists of different fields (biology, medicine, etc.) and industry. We wanted this book to be useful both to readers more interested in the theoretical aspects and those more concerned with the numerical implementation.

A much-needed guide on how to use

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numerical methods to solve practical engineering problems Bridging the gap between mathematics and engineering, Numerical Analysis with Applications in Mechanics and Engineering arms readers with powerful tools for solving real-world problems in mechanics, physics, and civil and mechanical

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engineering. Unlike most books on numerical analysis, this outstanding work links theory and application, explains the mathematics in simple engineering terms, and clearly demonstrates how to use numerical methods to obtain solutions and interpret results. Each chapter is

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devoted to a unique analytical methodology, including a detailed theoretical presentation and emphasis on practical computation. Ample numerical examples and applications round out the discussion, illustrating how to work out specific problems of mechanics, physics, or engineering.

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Integration of ordinary and partial
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*the methods directly in the medium that suits you best. Balanced discussion of mathematical principles and engineering applications
Detailed step-by-step exercises and practical engineering examples to help engineering students and other readers fully grasp the concepts*

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Concepts are explained through flowcharts and simple MATLAB codes to help you develop additional programming skills

In the dynamic digital age, the widespread use of computers has transformed engineering and science. A realistic and successful

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solution of an engineering problem usually begins with an accurate physical model of the problem and a proper understanding of the assumptions employed. With computers and appropriate software we can model and analyze complex physical systems and problems.

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However, efficient and accurate use of numerical results obtained from computer programs requires considerable background and advanced working knowledge to avoid blunders and the blind acceptance of computer results. This book provides the background and

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knowledge necessary to avoid these pitfalls, especially the most commonly used numerical methods employed in the solution of physical problems. It offers an in-depth presentation of the numerical methods for scales from nano to macro in nine self-contained

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*chapters with extensive problems
and up-to-date references, covering:
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simulation and computation
Weighted residuals methods Finite
difference methods Finite element
methods Finite strip/layer/prism
methods Boundary element methods*

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*Meshless methods Molecular
dynamics Multiphysics problems
Multiscale methods*

*This book presents applications of
Newton-like and other similar
methods to solve abstract functional
equations involving fractional
derivatives. It focuses on Banach*

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space-valued functions of a real domain - studied for the first time in the literature. Various issues related to the modeling and analysis of fractional order systems continue to grow in popularity, and the book provides a deeper and more formal analysis of selected issues that are

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relevant to many areas - including decision-making, complex processes, systems modeling and control - and deeply embedded in the fields of engineering, computer science, physics, economics, and the social and life sciences. The book offers a valuable resource for researchers

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and graduate students, and can also be used as a textbook for seminars on the above-mentioned subjects. All chapters are self-contained and can be read independently. Further, each chapter includes an extensive list of references.

Numerical Methods for Differential

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Systems: Recent Developments in Algorithms, Software, and Applications reviews developments in algorithms, software, and applications of numerical methods for differential systems. Topics covered include numerical algorithms for ordinary and partial

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*differential equations (ODE/PDEs);
theoretical approaches to the
solution of nonlinear algebraic and
boundary value problems via
associated differential systems;
integration algorithms for initial-
value ODEs with particular emphasis
on stiff systems; finite difference*

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algorithms; and general- and special-purpose computer codes for ODE/PDEs. Comprised of 15 chapters, this book begins with an introduction to high-order A-stable averaging algorithms for stiff differential systems, followed by a discussion on second derivative

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multistep formulas based on g -splines; numerical integration of linearized stiff ODEs; and numerical solution of large systems of stiff ODEs in a modular simulation framework. Subsequent chapters focus on numerical methods for mass action kinetics; a systematized

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collection of codes for solving two-point boundary value problems; general software for PDEs; and the choice of algorithms in automated method of lines solution of PDEs. The final chapter is devoted to quality software for ODEs. This monograph should be of interest to

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*mathematicians, chemists, and
chemical engineers.*

*This book provides a thorough guide
to the use of numerical methods in
energy systems and applications. It
presents methods for analysing
engineering applications for energy
systems, discussing finite difference,*

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finite element, and other advanced numerical methods. Solutions to technical problems relating the application of these methods to energy systems are also thoroughly explored. Readers will discover diverse perspectives of the contributing authors and extensive

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discussions of issues including: • a wide variety of numerical methods concepts and related energy systems applications; • systems equations and optimization, partial differential equations, and finite difference method; • methods for solving nonlinear equations, special

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methods, and their mathematical implementation in multi-energy sources;• numerical investigations of electrochemical fields and devices; and• issues related to numerical approaches and optimal integration of energy consumption. This is a highly informative and carefully

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presented book, providing scientific and academic insight for readers with an interest in numerical methods and energy systems.

Owing to the developments and applications of computer science, mathematicians began to take a serious interest in the applications of

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number theory to numerical analysis about twenty years ago. The progress achieved has been both important practically as well as satisfactory from the theoretical view point. It'or example, from the seventeenth century till now, a great deal of effort was made in developing

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methods for approximating single integrals and there were only a few works on multiple quadrature until the 1950's. But in the past twenty years, a number of new methods have been devised of which the number theoretic method is an effective one. The number theoretic

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method may be described as follows. We use number theory to construct a sequence of uniformly distributed sets in the s dimensional unit cube G , where $s \sim 2$. Then we use the sequence to reduce a difficult analytic problem to an arithmetic problem which may be calculated by

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computer. For example, we may use the arithmetic mean of the values of integrand in a given uniformly distributed set of G to approximate the definite integral over G such that the principal order of the error term is shown to be of the best possible kind, if the integrand satisfies

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fies certain conditions.

Offers a comprehensive textbook for a course in numerical methods, numerical analysis and numerical techniques for undergraduate engineering students.

*Numerical Analysis for Engineers:
Methods and Applications*

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demonstrates the power of numerical methods in the context of solving complex engineering and scientific problems. The book helps to prepare future engineers and assists practicing engineers in understanding the fundamentals of numerical methods, especially their

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applications, limitations, and potentials. Each chapter contains many computational examples, as well as a section on applications that contain additional engineering examples. Each chapter also includes a set of exercise problems. The problems are designed to meet the

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needs of instructors in assigning homework and to help students with practicing the fundamental concepts. Although the book was developed with emphasis on engineering and technological problems, the numerical methods can also be used to solve problems in other fields of

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the powerful mathematical and statistical tools used in the field of finance The use of mathematical models and numerical techniques is a practice employed by a growing number of applied mathematicians working on

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applications in finance. Reflecting this development, Numerical Methods in Finance and Economics: A MATLAB?-Based Introduction, Second Edition bridges the gap between financial theory and computational practice

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while showing readers how to utilize MATLAB?--the powerful numerical computing environment--for financial applications. The author provides an essential foundation in finance and numerical analysis in addition

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to background material for students from both engineering and economics perspectives. A wide range of topics is covered, including standard numerical analysis methods, Monte Carlo methods to simulate systems

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methods, while illustrating underlying algorithmic concepts in concrete terms. Newly featured in the Second Edition: * In-depth treatment of Monte Carlo methods with due attention paid to variance reduction strategies *

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New appendix on AMPL in order to better illustrate the optimization models in Chapters 11 and 12 * New chapter on binomial and trinomial lattices * Additional treatment of partial differential equations with two

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space dimensions * Expanded treatment within the chapter on financial theory to provide a more thorough background for engineers not familiar with finance * New coverage of advanced optimization methods

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and applications later in the text
Numerical Methods in Finance
and Economics: A
MATLAB?-Based Introduction,
Second Edition presents basic
treatments and more specialized
literature, and it also uses

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algebraic languages, such as AMPL, to connect the pencil-and-paper statement of an optimization model with its solution by a software library. Offering computational practice in both financial engineering and

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economics fields, this book equips practitioners with the necessary techniques to measure and manage risk.

To harness the full power of computer technology, economists need to use a broad range of

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mathematical techniques. In this book, Kenneth Judd presents techniques from the numerical analysis and applied mathematics literatures and shows how to use them in economic analyses. The book is divided into five parts.

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Part I provides a general introduction. Part II presents basics from numerical analysis on \mathbb{R}^n , including linear equations, iterative methods, optimization, nonlinear equations, approximation methods,

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numerical integration and differentiation, and Monte Carlo methods. Part III covers methods for dynamic problems, including finite difference methods, projection methods, and numerical dynamic programming.

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Part IV covers perturbation and asymptotic solution methods. Finally, Part V covers applications to dynamic equilibrium analysis, including solution methods for perfect foresight models and rational expectation models. A

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website contains supplementary material including programs and answers to exercises.

This book constitutes the thoroughly refereed post-conference proceedings of the 7th International Conference on

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Numerical Methods and Applications, NMA 2010, held in Borovets, Bulgaria, in August 2010. The 60 revised full papers presented together with 3 invited papers were carefully reviewed and selected from numerous

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submissions for inclusion in this book. The papers are organized in topical sections on Monte Carlo and quasi-Monte Carlo methods, environmental modeling, grid computing and applications, metaheuristics for optimization

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problems, and modeling and simulation of electrochemical processes.

Numerical Mathematics and Applications

This book explores the use of the concept of biorthogonality and

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discusses the various recurrence relations for the generalizations of the method of moments, the method of Lanczos, and the biconjugate gradient method. It is helpful for researchers in numerical analysis and

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approximation theory.

Rocks and soils can behave as discontinuous materials, both physically and mechanically, and for such discontinuous nature and behaviour there remain challenges in numerical modelling

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Application provides that knowledge. While it avoids intense mathematical detail, Numerical Methods for Engineering Application supplies more in-depth explanations of methods than found in the typical

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engineer's numerical "cookbook."
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integration problems. Ordinary
differential equations are
examined in great detail, as are

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three common types of partial differential equations--parabolic, elliptic, and hyperbolic. The author also explores a wide range of methods for solving initial and boundary value problems. This complete guide to numerical

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methods for solving engineering problems on computers provides:

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- * Valuable insights into how each method works and why it is the best choice
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algorithms and source code for all programs covered * Code from the book and problem-solving programs designed by the author available from the author's website Numerical Methods for Engineering Application is a

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valuable working resource for engineers and applied physicists. It also serves as an excellent upper-level text for physics and engineering students in courses on modern numerical methods. Applications of Numerical

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Methods in Molecular Spectroscopy provides a mathematical background, theoretical perspective, and review of spectral data processing methods. The book discusses methods of complex spectral

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profile separation into bands, factor analysis methods, methods of quantitative analysis in molecular spectroscopy and reflectance spectroscopy, and new data processing methods. Mathematical methods in special

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areas of molecular spectroscopy, such as color science, electron spin resonance, and nuclear magnetic resonance spectroscopies are also covered. The book will benefit researchers and postgraduate students in

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fields of chemistry, physics, and biology.

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The second edition of this book builds all the code example within a single project by incorporating new advancements in C# .NET technology and open-source math libraries. It also uses C# Interactive Window to test numerical

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computations without compiling or running the complete project code. The second edition includes three new chapters, including "Plotting", "Fourier Analysis" and "Math Expression Parser". As in the first edition, this book presents an in-

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depth exposition of the various numerical methods used in real-world scientific and engineering computations. It emphasizes the practical aspects of C# numerical methods and mathematical functions programming, and

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discusses various techniques in details to enable you to implement these numerical methods in your .NET application. Ideal for scientists, engineers, and students who would like to become more adept at numerical methods, the

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second edition of this book covers the following content: - Overview of C# programming. - The mathematical background and fundamentals of numerical methods. - plotting the computation results using a 3D chart control. -

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comprehensive overview of the fundamental theories, numerical methods, and iterative processes encountered in difference calculus. Explores classical problems such as orthological polynomials, the Euclidean algorithm, roots of

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polynomials, and well-conditioning." Theory and Applications of Numerical Analysis is a self-contained Second Edition, providing an introductory account of the main topics in numerical analysis. The book emphasizes

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