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Applications of Heat, Mass and Fluid Boundary
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Fluid interfaces are promising candidates for confining different types of materials, e.g., polymers, surfactants, colloids, and even small molecules, to be used in designing new functional materials with reduced dimensionality. The development of such materials requires a deepening of the physicochemical bases underlying the formation of layers at fluid interfaces as well as on the characterization of their structures and properties. This is of particular importance because the constraints associated with the assembly of materials at the interface lead to the emergence of equilibrium and features of dynamics in the interfacial systems, which are far removed from those conventionally found in traditional materials. This Special Issue is devoted to studies on the fundamental and applied aspects of fluid interfaces, and attempts to provide a comprehensive perspective on the current status of the research field. Most of the problems arising in science and engineering are nonlinear. They are inherently difficult to solve. Traditional analytical approximations are valid only for weakly nonlinear problems, and often break down for problems with strong nonlinearity. This book presents the current theoretical developments and applications of the Keller-box method to nonlinear problems. The first half of the book addresses basic concepts to understand the theoretical framework for the method. In the second half

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of the book, the authors give a number of examples of coupled nonlinear problems that have been solved by means of the Keller-box method. The particular area of focus is on fluid flow problems governed by nonlinear equation.

This book constitutes the proceedings of the 11th International Conference on Advances in Swarm Intelligence, ICSI 2020, held in July 2020 in Belgrade, Serbia. Due to the COVID-19 pandemic the conference was held virtually. The 63 papers included in this volume were carefully reviewed and selected from 127 submissions. The papers are organized in 12 cohesive topical sections as follows: Swarm intelligence and nature-inspired computing; swarm-based computing algorithms for optimization; particle swarm optimization; ant colony optimization; brain storm optimization algorithm; bacterial foraging optimization; genetic algorithm and evolutionary computation; multi-objective optimization; machine learning; data mining; multi-agent system and robotic swarm, and other applications.

A new, definitive perspective of electrokinetic and colloidtransport processes Responding to renewed interest in the subject of electrokinetics,Electrokinetic and Colloid Transport Phenomena is a timely overviewof the latest research and applications in this field for both thebeginner and the professional. An outgrowth of an earlier text (bycoauthor Jacob Masliyah), this self-contained reference provides anup-to-date summary of the literature on electrokinetic and colloidtransport phenomena as well as direct pedagogical insight into thedevelopment of the subject over the past several

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decades. A distinct departure from standard colloid science monographs, *Electrokinetic and Colloid Transport Phenomena* presents the most salient features of the theory in a simple and direct manner, allowing the book to serve as a stepping-stone for further learning and study. In addition, the book uniquely discusses numerical simulation of electrokinetic problems and demonstrates the use of commercial finite element software for solving these multiphysics problems. Among the topics covered are: * Mathematical preliminaries * Colloidal systems * Electrostatics and application of electrostatics * Electric double layer * Electroosmosis and streaming potential * Electrophoresis and sedimentation potential * London-Van der Waals forces and the DLVO theory * Coagulation and colloid deposition * Numerical simulation of electrokinetic phenomena * Applications of electrokinetic phenomena

Because this thorough reference does not require advanced mathematical knowledge, it enables a graduate or a senior undergraduate student approaching the subject for the first time to easily interpret the theories. On the other hand, the application of relevant mathematical principles and the worked examples are extremely useful to established researchers and professionals involved in a wide range of areas, including electroosmosis, streaming potential, electrophoretic separations, industrial practices involving colloids and complex fluids, environmental remediation, suspensions, and microfluidic systems.

The aim of the School on Rheology of Complex fluids is to bring together young researchers and teachers from

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educational and R&D institutions, and expose them to the basic concepts and research techniques used in the study of rheological behavior of complex fluids. The lectures will be delivered by well-recognized experts. The book contents will be based on the lecture notes of the school.

This Special Issue contains articles include, but not limited to, empirical, analytical, or design-oriented approaches to the following topics: Monitoring of carrying capacity and mechanisms for managing tourist flows in rural areas; Systems and tools to measure the social, economic, and environmental sustainability of rural tourism; Integration between public tourism policies and private strategies in the promotion and implementation of sustainable practices; Policies for promoting public participation in the planning and development of sustainable rural tourism; The impacts of tourism on traditional agricultural activities; Identity enhancement of the territory and its productions; "Good practices" in the implementation of rural tourism sustainability.

Thin film processes are significantly incorporated in manufacturing display panels, secondary batteries, fuel/solar cells, catalytic films, membranes, adhesives, and other commodity films. This Special Issue on "Thin Film Processes" of Processes listed recent progress on thin-film processes, covering theoretical considerations, experimental observations, and computational techniques. Articles in this Issue consider comprehensive studies on thin film processes and related materials.

This book presents the diverse and rapidly expanding

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field of Entropy Generation Minimization (EGM), the method of thermodynamic optimization of real devices. The underlying principles of the EGM method - also referred to as "thermodynamic optimization," "thermodynamic design," and "finite time thermodynamics" - are thoroughly discussed, and the method's applications to real devices are clearly illustrated. The EGM field has experienced tremendous growth during the 1980s and 1990s. This book places EGM's growth in perspective by reviewing both sides of the field - engineering and physics. Special emphasis is given to chronology and to the relationship between the more recent work and the pioneering work that outlined the method and the field. Entropy Generation Minimization combines the fundamental principles of thermodynamics, heat transfer, and fluid mechanics. EGM applies these principles to the modeling and optimization of real systems and processes that are characterized by finite size and finite time constraints, and are limited by heat and mass transfer and fluid flow irreversibilities. Entropy Generation Minimization provides a straightforward presentation of the principles of the EGM method, and features examples that elucidate concepts and identify recent EGM advances in engineering and physics. Modern advances include the optimization of storage by melting and solidification; heat exchanger design; power from hot-dry-rock deposits; the on & off operation of defrosting refrigerators and power plants with fouled heat exchangers; the production of ice and other solids; the maximization of power output in simple power plant models with heat transfer

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irreversibilities; the minimization of refrigerator power input in simple models; and the optimal collection and use of solar energy.

Since most of the problems arising in science and engineering are nonlinear, they are inherently difficult to solve. Traditional analytical approximations are valid only for weakly nonlinear problems and often fail when used for problems with strong nonlinearity. "Nonlinear Flow Phenomena and Homotopy Analysis: Fluid Flow and Heat Transfer" presents the current theoretical developments of the analytical method of homotopy analysis. This book not only addresses the theoretical framework for the method, but also gives a number of examples of nonlinear problems that have been solved by means of the homotopy analysis method. The particular focus lies on fluid flow problems governed by nonlinear differential equations. This book is intended for researchers in applied mathematics, physics, mechanics and engineering. Both Kuppalapalle Vajravelu and Robert A. Van Gorder work at the University of Central Florida, USA.

Application of Control Volume Based Finite Element Method (CVFEM) for Nanofluid Flow and Heat Transfer discusses this powerful numerical method that uses the advantages of both finite volume and finite element methods for the simulation of multi-physics problems in complex geometries, along with its applications in heat transfer and nanofluid flow. The book applies these methods to solve various applications of nanofluid in heat transfer enhancement. Topics covered include magnetohydrodynamic flow, electrohydrodynamic flow

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and heat transfer, melting heat transfer, and nanofluid flow in porous media, all of which are demonstrated with case studies. This is an important research reference that will help readers understand the principles and applications of this novel method for the analysis of nanofluid behavior in a range of external forces. Explains governing equations for nanofluid as working fluid Includes several CVFEM codes for use in nanofluid flow analysis Shows how external forces such as electric fields and magnetic field effects nanofluid flow Applications of Nanofluid for Heat Transfer Enhancement explores recent progress in computational fluid dynamic and nonlinear science and its applications to nanofluid flow and heat transfer. The opening chapters explain governing equations and then move on to discussions of free and forced convection heat transfers of nanofluids. Next, the effect of nanofluid in the presence of an electric field, magnetic field, and thermal radiation are investigated, with final sections devoted to nanofluid flow in porous media and application of nanofluid for solidification. The models discussed in the book have applications in various fields, including mathematics, physics, information science, biology, medicine, engineering, nanotechnology, and materials science. Presents the latest information on nanofluid free and force convection heat transfer, of nanofluid in the presence of thermal radiation, and nanofluid in the presence of an electric field Provides an understanding of the fundamentals in new numerical and analytical methods Includes codes for each modeling method discussed, along with advice on how to best apply them

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Unlike other analytic techniques, the Homotopy Analysis Method (HAM) is independent of small/large physical parameters. Besides, it provides great freedom to choose equation type and solution expression of related linear high-order approximation equations. The HAM provides a simple way to guarantee the convergence of solution series. Such uniqueness differentiates the HAM from all other analytic approximation methods. In addition, the HAM can be applied to solve some challenging problems with high nonlinearity. This book, edited by the pioneer and founder of the HAM, describes the current advances of this powerful analytic approximation method for highly nonlinear problems. Coming from different countries and fields of research, the authors of each chapter are top experts in the HAM and its applications. Contents: Chance and Challenge: A Brief Review of Homotopy Analysis Method (S-J Liao) Predictor Homotopy Analysis Method (PHAM) (S Abbasbandy and E Shivanian) Spectral Homotopy Analysis Method for Nonlinear Boundary Value Problems (S Motsa and P Sibanda) Stability of Auxiliary Linear Operator and Convergence-Control Parameter (R A Van Gorder) A Convergence Condition of the Homotopy Analysis Method (M Turkyilmazoglu) Homotopy Analysis Method for Some Boundary Layer Flows of Nanofluids (T Hayat and M Mustafa) Homotopy Analysis Method for Fractional Swift–Hohenberg Equation (S Das and K Vishal) HAM-Based Package NOPH for Periodic Oscillations of Nonlinear Dynamic Systems (Y-P Liu) HAM-Based Mathematica Package BVPh 2.0 for Nonlinear Boundary Value Problems (Y-L Zhao and S-J

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Liao) Readership: Graduate students and researchers in applied mathematics, physics, nonlinear mechanics, engineering and finance. Keywords: Analytic Approximation Method; Nonlinear; Homotopy; Applied Mathematics Key Features: The method described in the book can overcome almost all restrictions of other analytic approximation method for nonlinear problems This book is the first in homotopy analysis method, covering the newest advances, contributed by many top experts in different fields

Featuring contributions by leading researchers in the field, Nanoparticle Heat Transfer and Fluid Flow explores heat transfer and fluid flow processes in nanomaterials and nanofluids, which are becoming increasingly important across the engineering disciplines. The book covers a wide range, from biomedical and energy conversion applications to materials properties, and addresses aspects that are essential for further progress in the field, including numerical quantification, modeling, simulation, and presentation. Topics include: A broad review of nanofluid applications, including industrial heat transfer, biomedical engineering, electronics, energy conversion, membrane filtration, and automotive An overview of thermofluids and their importance in biomedical applications and heat-transfer enhancement A deeper look at biomedical applications such as nanoparticle hyperthermia treatments for cancers Issues in energy conversion from dispersed forms to more concentrated and utilizable forms Issues in nanofluid properties, which are less predictable and less repeatable than those of other media that participate in

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fluid flow and heat transfer Advances in computational fluid dynamic (CFD) modeling of membrane filtration at the microscale The role of nanofluids as a coolant in microchannel heat transfer for the thermal management of electronic equipment The potential enhancement of natural convection due to nanoparticles Examining key topics and applications in nanoscale heat transfer and fluid flow, this comprehensive book presents the current state of the art and a view of the future. It offers a valuable resource for experts as well as newcomers interested in developing innovative modeling and numerical simulation in this growing field.

Free Convective Heat Transfer is a thorough survey of various kinds of free-convective flows and heat transfer. Reference data are accompanied by a large number of photographs originating from different optical visualization methods illustrating the different types of flow. The formulas derived from numerical and analytical investigations are valuable tools for engineering calculations. They are written in their most compact and general form in order to allow for an extensive range of different variants of boundary and initial conditions, which, in turn, leads to a wide applicability to different flow types. Some specific engineering problems are solved in the book as exemplary applications of these formulas.

This volume is the first of two containing selected papers from the International Conference on Advances in Mathematical Sciences (ICAMS), held at the Vellore Institute of Technology in December 2017. This meeting brought together researchers from around the world to

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share their work, with the aim of promoting collaboration as a means of solving various problems in modern science and engineering. The authors of each chapter present a research problem, techniques suitable for solving it, and a discussion of the results obtained. These volumes will be of interest to both theoretical- and application-oriented individuals in academia and industry. Papers in Volume I are dedicated to active and open areas of research in algebra, analysis, operations research, and statistics, and those of Volume II consider differential equations, fluid mechanics, and graph theory. Convection in Porous Media, 4th Edition, provides a user-friendly introduction to the subject, covering a wide range of topics, such as fibrous insulation, geological strata, and catalytic reactors. The presentation is self-contained, requiring only routine mathematics and the basic elements of fluid mechanics and heat transfer. The book will be of use not only to researchers and practicing engineers as a review and reference, but also to graduate students and others entering the field. The new edition features approximately 1,750 new references and covers current research in nanofluids, cellular porous materials, strong heterogeneity, pulsating flow, and more.

From the reviews: "The book has a broad and general coverage of both the mathematics and the numerical methods well suited for graduate students." Applied Mechanics Reviews #1 "This is a very well written book. The topics are developed with separate headings making the matter easily understandable. Computer programs are also included for many problems together with a separate chapter dealing with the application of computer programs to heat transfer problems. This enhances the utility of the book."

Zentralblatt für Mathematik #1

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Energy and Sustainability V is the proceedings of the 5th International Conference on Energy and Sustainability, held by the Wessex Institute of Technology. The modern world is highly dependent on the exploitation of fossil fuels. More recently, resources depletion and severe environmental effects deriving from the continuous use of these fuels has resulted in an increasing amount of interest in renewable energy resources and the search for sustainable energy policies. The changes required to progress from an economy mainly based on hydrocarbons to one taking advantage of sustainable energy resources are massive and require considerable scientific research as well as engineering systems. The effect also involves collaboration between different disciplines in order to arrive at optimum solutions, including buildings, energy networks, convenience systems, new energy storage solutions, waste to energy technologies, and many others. This book covers topics related to sustainability in energy and power production, storage, distribution and management. These include: Smart grids; Smart metering; Green ICT; Green buildings; Energy storage; Renewable energy resources; Plug-in Hybrid Vehicles (PHEV); Biofuels (solid, liquid, gas); Waste to energy; CO₂ capturing and management; Energy and transportation; Environmental risk; Energy policies; Greener power plant technologies; Hydrogen recovery techniques; Sustainable energy production.

Spectral methods are well-suited to solve problems modeled by time-dependent partial differential equations: they are fast, efficient and accurate and widely used by mathematicians and practitioners. This class-tested 2007 introduction, the first on the subject, is ideal for graduate courses, or self-study. The authors describe the basic theory of spectral methods, allowing the reader to understand the techniques through numerous examples as well as more rigorous developments.

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They provide a detailed treatment of methods based on Fourier expansions and orthogonal polynomials (including discussions of stability, boundary conditions, filtering, and the extension from the linear to the nonlinear situation).

Computational solution techniques for integration in time are dealt with by Runge-Kutta type methods. Several chapters are devoted to material not previously covered in book form, including stability theory for polynomial methods, techniques for problems with discontinuous solutions, round-off errors and the formulation of spectral methods on general grids. These will be especially helpful for practitioners.

Thermodynamics is one of the most exciting branches of physical chemistry which has greatly contributed to the modern science. Being concentrated on a wide range of applications of thermodynamics, this book gathers a series of contributions by the finest scientists in the world, gathered in an orderly manner. It can be used in post-graduate courses for students and as a reference book, as it is written in a language pleasing to the reader. It can also serve as a reference material for researchers to whom the thermodynamics is one of the area of interest.

Introduction to nanofluids--their properties, synthesis, characterization, and applications Nanofluids are attracting a great deal of interest with their enormous potential to provide enhanced performance properties, particularly with respect to heat transfer. In response, this text takes you on a complete journey into the science and technology of nanofluids. The authors cover both the chemical and physical methods for synthesizing nanofluids, explaining the techniques for creating a stable suspension of nanoparticles. You get an overview of the existing models and experimental techniques used in studying nanofluids, alongside discussions of the challenges and problems associated with some of these models. Next, the authors set forth and explain the heat

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transfer applications of nanofluids, including microelectronics, fuel cells, and hybrid-powered engines. You also get an introduction to possible future applications in large-scale cooling and biomedicine. This book is the work of leading pioneers in the field, one of whom holds the first U.S. patent for nanofluids. They have combined their own first-hand knowledge with a thorough review of the literature. Among the key topics are: * Synthesis of nanofluids, including dispersion techniques and characterization methods * Thermal conductivity and thermo-physical properties * Theoretical models and experimental techniques * Heat transfer applications in microelectronics, fuel cells, and vehicle engines This text is written for researchers in any branch of science and technology, without any prerequisite. It therefore includes some basic information describing conduction, convection, and boiling of nanofluids for those readers who may not have adequate background in these areas. Regardless of your background, you'll learn to develop nanofluids not only as coolants, but also for a host of new applications on the horizon.

Over the past two decades, there has been increased attention in the research of nanofluid due to its widely expanded domain in many industrial and technological applications. Major advances in the modeling of key topics such as nanofluid, MHD, heat transfer, convection, porous media, Newtonian/non-Newtonian fluids have been made and finally published in the special issue on recent developments in nanofluids for Applied Sciences. The present attempt is to edit the special issue in a book form. Although, this book is not a formal textbook even than it will definitely be useful for research students and university teachers in overcoming the difficulties occurring in the said topic while dealing with the nonlinear governing equations. On one side the real world problems in mathematics, physics, biomechanics,

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engineering and other disciplines of sciences are mostly described by the set of nonlinear equations whereas on the other hand, it is often more difficult to get an analytic solution or even a numerical one. This book has successfully handled this challenging job with latest techniques. In addition the findings of the simulation are logically realistic and meet the standard of sufficient scientific value.

Control volume finite element methods (CVFEM) bridge the gap between finite difference and finite element methods, using the advantages of both methods for simulation of multi-physics problems in complex geometries. In Hydrothermal Analysis in Engineering Using Control Volume Finite Element Method, CVFEM is covered in detail and applied to key areas of thermal engineering. Examples, exercises, and extensive references are used to show the use of the technique to model key engineering problems such as heat transfer in nanofluids (to enhance performance and compactness of energy systems), hydro-magnetic techniques in materials and bioengineering, and convective flow in fluid-saturated porous media. The topics are of practical interest to engineering, geothermal science, and medical and biomedical sciences. Introduces a detailed explanation of Control Volume Finite Element Method (CVFEM) to provide for a complete understanding of the fundamentals Demonstrates applications of this method in various fields, such as nanofluid flow and heat transfer, MHD, FHD, and porous media Offers complete familiarity with the governing equations in which nanofluid is used as a working fluid Discusses the governing equations of MHD and FHD Provides a number of extensive examples throughout the book Bonus appendix with sample computer code

Micropolar fluids are fluids with microstructure. They belong to a class of fluids with nonsymmetric stress tensor that we shall call polar fluids, and include, as a special case, the well-

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established Navier-Stokes model of classical fluids that we shall call ordinary fluids. Physically, micropolar fluids may represent fluids consisting of rigid, randomly oriented (or spherical) particles suspended in a viscous medium, where the deformation of fluid particles is ignored. The model of micropolar fluids introduced in [65] by C. A. Eringen is worth studying as a very well balanced one. First, it is a well-founded and significant generalization of the classical Navier-Stokes model, covering, both in theory and applications, many more phenomena than the classical one. Moreover, it is elegant and not too complicated, in other words, man ageable to both mathematicians who study its theory and physicists and engineers who apply it. The main aim of this book is to present the theory of micropolar fluids, in particular its mathematical theory, to a wide range of readers. The book also presents two applications of micropolar fluids, one in the theory of lubrication and the other in the theory of porous media, as well as several exact solutions of particular problems and a numerical method. We took pains to make the presentation both clear and uniform.

This book describes the state of the art at the interface between energy and environmental research. The contributing authors are some of the world leaders in research and education on energy and environmental topics. The coverage is worth noting for its breadth and depth. Written by leaders in research and education, this book is an excellent text or supplement for undergraduate and graduate courses on energy engineering and environmental science. This book, divided in two volumes, originates from Techno-Societal 2020: the 3rd International Conference on Advanced Technologies for Societal Applications, Maharashtra, India, that brings together faculty members of various engineering colleges to solve Indian regional relevant problems under the guidance of eminent researchers from various reputed

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organizations. The focus of this volume is on technologies that help develop and improve society, in particular on issues such as advanced and sustainable technologies for manufacturing processes, environment, livelihood, rural employment, agriculture, energy, transport, sanitation, water, education. This conference aims to help innovators to share their best practices or products developed to solve specific local problems which in turn may help the other researchers to take inspiration to solve problems in their region. On the other hand, technologies proposed by expert researchers may find applications in different regions. This offers a multidisciplinary platform for researchers from a broad range of disciplines of Science, Engineering and Technology for reporting innovations at different levels.

This book comprises selected papers from the International Conference on Numerical Heat Transfer and Fluid Flow (NHTFF 2018), and presents the latest developments in computational methods in heat and mass transfer. It also discusses numerical methods such as finite element, finite difference, and finite volume applied to fluid flow problems. Providing a good balance between computational methods and analytical results applied to a wide variety of problems in heat transfer, transport and fluid mechanics, the book is a valuable resource for students and researchers working in the field of heat transfer and fluid dynamics.

Convective Flow and Heat Transfer from Wavy Surfaces: Viscous Fluids, Porous Media, and Nanofluids addresses the wavy irregular surfaces in heat transfer devices. Fluid flow and heat transfer studies from wavy surfaces have received attention, since they add complexity and require special mathematical techniques. This book considers the flow and heat transfer characteristics from wavy surfaces, providing an understanding of convective behavioral changes.

Rotating flow is critically important across a wide range of

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scientific, engineering and product applications, providing design and modeling capability for diverse products such as jet engines, pumps and vacuum cleaners, as well as geophysical flows. Developed over the course of 20 years' research into rotating fluids and associated heat transfer at the University of Sussex Thermo-Fluid Mechanics Research Centre (TFMRC), Rotating Flow is an indispensable reference and resource for all those working within the gas turbine and rotating machinery industries. Traditional fluid and flow dynamics titles offer the essential background but generally include very sparse coverage of rotating flows—which is where this book comes in. Beginning with an accessible introduction to rotating flow, recognized expert Peter Childs takes you through fundamental equations, vorticity and vortices, rotating disc flow, flow around rotating cylinders and flow in rotating cavities, with an introduction to atmospheric and oceanic circulations included to help deepen understanding. Whilst competing resources are weighed down with complex mathematics, this book focuses on the essential equations and provides full workings to take readers step-by-step through the theory so they can concentrate on the practical applications. A detailed yet accessible introduction to rotating flows, illustrating the differences between flows where rotation is significant and highlighting the non-intuitive nature of rotating flow fields Written by world-leading authority on rotating flow, Peter Childs, making this a unique and authoritative work Covers the essential theory behind engineering applications such as rotating discs, cylinders, and cavities, with natural phenomena such as atmospheric and oceanic flows used to explain underlying principles Provides a rigorous, fully worked mathematical account of rotating flows whilst also including numerous practical examples in daily life to highlight the relevance and prevalence of different flow types Concise summaries of the results of important research

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and lists of references included to direct readers to significant further resources

The book presents high-quality papers presented at 3rd International Conference on Applications of Fluid Dynamics (ICAFD 2016) organized by Department of Applied Mathematics, ISM Dhanbad, Jharkhand, India in association with Fluid Mechanics Group, University of Botswana, Botswana. The main theme of the Conference is "Sustainable Development in Africa and Asia in context of Fluid Dynamics and Modeling Approaches". The book is divided into seven sections covering all applications of fluid dynamics and their allied areas such as fluid dynamics, nanofluid, heat and mass transfer, numerical simulations and investigations of fluid dynamics, magnetohydrodynamics flow, solute transport modeling and water jet, and miscellaneous. The book is a good reference material for scientists and professionals working in the field of fluid dynamics.

This book comprises select proceedings of the International Conference on Recent Innovations and Developments in Mechanical Engineering (IC-RIDME 2018). The book contains peer reviewed articles covering thematic areas such as fluid mechanics, renewable energy, materials and manufacturing, thermal engineering, vibration and acoustics, experimental aerodynamics, turbo machinery, and robotics and mechatronics. Algorithms and methodologies of real-time problems are described in this book. The contents of this book will be useful for both academics and industry professionals.

Applications of Heat, Mass and Fluid Boundary Layers brings together the latest research on boundary layers where there has been remarkable advancements in recent years. This book highlights relevant concepts and solutions to energy issues and environmental sustainability by combining fundamental theory on boundary layers with real-world

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industrial applications from, among others, the thermal, nuclear and chemical industries. The book's editors and their team of expert contributors discuss many core themes, including advanced heat transfer fluids and boundary layer analysis, physics of fluid motion and viscous flow, thermodynamics and transport phenomena, alongside key methods of analysis such as the Merk-Chao-Fagbenle method. This book's multidisciplinary coverage will give engineers, scientists, researchers and graduate students in the areas of heat, mass, fluid flow and transfer a thorough understanding of the technicalities, methods and applications of boundary layers, with a unified approach to energy, climate change and a sustainable future. Presents up-to-date research on boundary layers with very practical applications across a diverse mix of industries Includes mathematical analysis to provide detailed explanation and clarity Provides solutions to global energy issues and environmental sustainability

This book features original research articles on the topic of mathematical modelling and fractional differential equations. The contributions, written by leading researchers in the field, consist of chapters on classical and modern dynamical systems modelled by fractional differential equations in physics, engineering, signal processing, fluid mechanics, and bioengineering, manufacturing, systems engineering, and project management. The book offers theory and practical applications for the solutions of real-life problems and will be of interest to graduate level students, educators, researchers, and scientists interested in mathematical modelling and its diverse applications. Features Presents several recent developments in the theory and applications of fractional calculus Includes chapters on different analytical and numerical methods dedicated to several mathematical equations Develops methods for the mathematical models

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which are governed by fractional differential equations
Provides methods for models in physics, engineering, signal processing, fluid mechanics, and bioengineering
Discusses real-world problems, theory, and applications

This book contains original research papers presented at the International Conference on Mathematical Modelling and Scientific Computing, held at the Indian Institute of Technology Indore, India, on 19–21 July 2018. Organized into 30 chapters, the book presents the recent progress and the most advanced innovations, trends, and real-world challenges encountered and solutions embraced in the applications of mathematics and scientific computing. The book will be of interests to a wide variety of researchers, students and the practicing engineers working in diverse areas of science and engineering, ranging from applied and computational mathematics, vibration problem, computer science, and numerical optimization to physics, chemistry, biology, electrical, civil, mechanical, chemical, seismology, aerospace, and medical sciences. The aim of the conference is to bring together leading academicians, scientists, researchers, engineers, and industry partners from all over the globe to exchange and share their experiences and research results on various aspects of applied mathematics and scientific computation, like, differential equation, modeling, simulation, dynamical systems, numerical analysis, matrix theory, inverse problems, and solid and fluid mechanics, computational engineering.

Since the 1980s, attention has increased in the research of fluid mechanics due to its wide application in industry and phycology. Major advances have occurred in the modeling of key topics such Newtonian and non-Newtonian fluids, nanoparticles, thermal management, and physiological fluid phenomena in biological systems, which have been published in this Special Issue on symmetry and fluid mechanics for

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Symmetry. Although, this book is not a formal textbook, it will be useful for university teachers, research students, and industrial researchers and for overcoming the difficulties that occur when considering the nonlinear governing equations. For such types of equations, obtaining an analytic or even a numerical solution is often more difficult. This book addresses this challenging job by outlining the latest techniques. In addition, the findings of the simulation are logically realistic and meet the standard of sufficient scientific value.

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