Reaction Transport Systems Mesoscopic Foundations Fronts And Spatial Instabilities Springer Series In Synergetics

Mesoscopic physics deals with systems larger than single atoms but small enough to retain their quantum properties. The possibility to create and manipulate conductors of the nanometer scale has given birth to a set of phenomena that have revolutionized physics: quantum Hall effects, persistent currents, weak localization, Coulomb blockade, etc. This Special Issue tackles the latest developments in the field. Contributors discuss time-dependent transport, quantum pumping, nanoscale heat engines and motors, molecular junctions, electron–electron correlations in confined systems, quantum thermo-electrics and current fluctuations. The works included herein represent an up-to-date account of exciting research with a broad impact in both fundamental and applied topics.

This book presents cutting-edge research on the use of physical and mathematical formalisms to model and quantitatively analyze biological phenomena ranging from microscopic to macroscopic systems. The systems discussed in this compilation cover protein folding pathways, gene regulation in prostate cancer, quorum sensing in bacteria to mathematical and physical descriptions to analyze anomalous diffusion in patchy environments and the physical mechanisms that drive active motion in large sets of particles, both fundamental descriptions that can be applied to different phenomena in biology. All chapters are written by well-known experts on their respective research fields with a vast amount of scientific discussion and references in order the interested reader can pursue a further reading. Given these features, we consider Quantitative Models for Microscopic to Macroscopic Biological Macromolecules and Tissues as an excellent and up-to-date resource and reference for advanced undergraduate students, graduate students and junior researchers interested in the latest developments at the intersection of physics, mathematics, molecular biology, and computational sciences. Such research field, without hesitation, is one of the most interesting, challenging and active of this century and the next.

The Advanced School on Quantum Foundations and Open Quantum Systems was an exceptional combination of lectures. These comprise lectures in standard physics and investigations on the foundations of quantum physics.On the one hand it included lectures on quantum information, quantum open systems, quantum transport and quantum solid state. On the other hand it included lectures on quantum measurement, models for elementary particles, sub-quantum structures and aspects on the philosophy and principles of quantum physics.The special program of this school offered a broad outlook on the current and near future fundamental research in theoretical physics.The lectures are at the level of PhD students.

Opening with a brief historical account of electron transport from Ohm's law through transport in semiconductor nanostructures, this book discusses topics related to electronic quantum transport. The book is written for graduate students and researchers in the field of mesoscopic semiconductors or in semiconductor nanostructures. Highlights include review of the cryogenic scanning

probe techniques applied to semiconductor nanostructures.

The theme of the present volume "Multiscale Analysis" has been introduced about a decade ago and is now reaching a stage where a first balance can be made and further research directions should be decided. Contributions have been carefully selected to ensure the reader will not be confronted with quantum mechanics at one side of the spectrum nor with chemical plants or even the environment on the other side. Maintaining a strong connection with reality i.e. experimental data was another selection criterion. Experimental validation remains the corner stone of any theoretical development and very powerful experimentel techniques are emerging. Areas covered include discussing in depth an important example of experimental techniques. Coming from the medical world, Magnetic Resonance techniques can now provide even quantitative answers to problems our community is faced with. The modeling issue is discussed further. Finally, the limitations of the classic reactor engineering models are outlined. * Original reviews * Leading chemical engineers as authors * Update on biomaterials use * Novel subject on use of biomaterials in drug delivery and gene therapy * Mathematical modeling

This book explains the state-of-the-art algorithms used to simulate biological dynamics. Each technique is theoretically introduced and applied to a set of modeling cases. Starting from basic simulation algorithms, the book also introduces more advanced techniques that support delays, diffusion in space, or that are based on hybrid simulation strategies. This is a valuable self-contained resource for graduate students and practitioners in computer science, biology and bioinformatics. An appendix covers the mathematical background, and the authors include further reading sections in each chapter.

Some aspects of the physics of many-body systems arbitrarily away from equilibrium, mainly the characterization and irreversible evolution of their macroscopic state, are considered. The present status of phenomenological irreversible thermodynamics is described. An approach for building a statistical thermodynamics - dubbed Informational-Statistical-Thermodynamics - based on a non-equilibrium statistical ensemble formalism is presented. The formalism can be considered as encompassed within the scope of the so-called Predictive Statistical Mechanics, in which the predictability of future states in terms of the knowledge of present and past states, and the question of historicity in the case of systems with complex behaviour, is its main characteristic. The book is recommended for researchers in the area of non-equilibrium statistical mechanics and thermodynamics, as well as a textbook for advanced courses for graduate students in the area of condensed matter physics.

The articles in this volume summarize the research results obtained in the former SFB 359 "Reactive Flow, Diffusion and Transport" which has been supported by the DFG over the period 1993-2004. The main subjects are physical-chemical processes sharing the difficulty of interacting diffusion, transport and reaction which cannot be considered separately. The modeling and simulation within this book is accompanied by experiments.

This self-contained text describes the underlying theory and approximate quantum models of real nanodevices for nanotechnology applications.

The book provides an introduction to deterministic (and some stochastic) modeling of spatiotemporal phenomena in ecology, epidemiology,

and neural systems. A survey of the classical models in the fields with up to date applications is given. The book begins with detailed description of how spatial dynamics/diffusive processes influence the dynamics of biological populations. These processes play a key role in understanding the outbreak and spread of pandemics which help us in designing the control strategies from the public health perspective. A brief discussion on the functional mechanism of the brain (single neuron models and network level) with classical models of neuronal dynamics in space and time is given. Relevant phenomena and existing modeling approaches in ecology, epidemiology and neuroscience are introduced, which provide examples of pattern formation in these models. The analysis of patterns enables us to study the dynamics of macroscopic and microscopic behaviour of underlying systems and travelling wave type patterns observed in dispersive systems. Moving on to virus dynamics, authors present a detailed analysis of different types models of infectious diseases including two models for influenza, five models for Ebola virus and seven models for Zika virus with diffusion and time delay. A Chapter is devoted for the study of Brain Dynamics (Neural systems in space and time). Significant advances made in modeling the reaction-diffusion systems are presented and spatiotemporal patterning in the systems is reviewed. Development of appropriate mathematical models and detailed analysis (such as linear stability, weakly nonlinear analysis, bifurcation analysis, control theory, numerical simulation) are presented. Key Features Covers the fundamental concepts and mathematical skills required to analyse reaction-diffusion models for biological populations. Concepts are introduced in such a way that readers with a basic knowledge of differential equations and numerical methods can understand the analysis. The results are also illustrated with figures. Focuses on mathematical modeling and numerical simulations using basic conceptual and classic models of population dynamics, Virus and Brain dynamics. Covers wide range of models using spatial and non-spatial approaches. Covers single, two and multispecies reaction-diffusion models from ecology and models from bio-chemistry. Models are analysed for stability of equilibrium points, Turing instability, Hopf bifurcation and pattern formations. Uses Mathematica for problem solving and MATLAB for pattern formations. Contains solved Examples and Problems in Exercises. The Book is suitable for advanced undergraduate, graduate and research students. For those who are working in the above areas, it provides information from most of the recent works. The text presents all the fundamental concepts and mathematical skills needed to build models and perform analyses.

Ongoing developments in nanofabrication technology and the availability of novel materials have led to the emergence and evolution of new topics for mesoscopic research, including scanning-tunnelling microscopic studies of few-atom metallic clusters, discrete energy level spectroscopy, the prediction of Kondo-type physics in the transport properties of quantum dots, time dependent effects, and the properties of interacting systems, e.g. of Luttinger liquids. The overall understanding of each of these areas is still incomplete; nevertheless, with the foundations laid by studies in the more traditional systems there is no doubt that these new areas will advance mesoscopic electron transport to a new phenomenological level, both experimentally and theoretically. Mesoscopic Electron Transport highlights selected areas in the field, provides a comprehensive review of such systems, and also serves as an introduction to the new and developing areas of mesoscopic electron transport.

This book discusses fundamental problems in quantum physics, with emphasis on quantum coherence and decoherence. Papers coveting the wide range of quantum physics are included: atom optics, quantum optics, quantum computing, quantum information, cryptography, macroscopic quantum phenomena, mesoscopic physics, physics of precise measurements, and fundamental problems in quantum physics. The book will serve not only as a good introduction to quantum coherence and decoherence for newcomers in this field, but also as a reference for experts.

This book provides a self-contained presentation of the physical and mathematical laws governing complex systems. Complex systems arising in natural, engineering, environmental, life and social sciences are approached from a unifying point of view using an array of methodologies such as microscopic and macroscopic level formulations, deterministic and probabilistic tools, modeling and simulation. The book can be used as a textbook by graduate students, researchers and teachers in science, as well as non-experts who wish to have an overview of one of the most open, markedly interdisciplinary and fast-growing branches of present-day science. Contents:The Phenomenology of Complex Systems:Complexity, a New ParadigmSignatures of ComplexityOnset of ComplexityFour Case StudiesSumming UpDeterministic View:Dynamical Systems, Phase Space, StabilityLevels of DescriptionNormal FormsThe Limit of UniversalityDeterministic ChaosEmergenceCoupling-Induced ComplexityModeling Complexity Beyond Physical ScienceProbabilistic Description:Need for a Probabilistic ApproachProbability Distributions and Their Evolution LawsThe Retrieval of UniversalityComplexity in the Probabilistic DescriptionEmergence RevisitedTransitions Between StatesSimulating Complex SystemsDisorder-Generated ComplexityComplexity, Entropy and Information:Information EntropyDynamical EntropiesInformation Entropy ProductionLarge Deviations, Fluctuation Theorems and the Probabilistic Properties of Time SequencesAlgorithmic Complexity and ComputationDynamical Systems as Information Sources: Scaling Rules and SelectionFurther Information MeasuresSumming UpPrediction:Communicating with a Complex SystemClassical Approaches and Their LimitationsNonlinear Data AnalysisThe Monitoring of Complex FieldsThe Predictability HorizonRecurrenceExtreme EventsSelected Topics:The Arrow of TimeNanosystemsAtmospheric DynamicsClimate DynamicsNetworksPerspectives on Biological ComplexityEquilibrium Versus Nonequilibrium in Complexity and Self-OrganizationEpistemological Insights from Complex SystemsOutlook. The Future of Complexity Readership: Graduate students, researchers, academics and professionals interested in nonlinear science. Keywords:Nonlinear Dynamics;Chaos;Self-Organization;Emergence;Probability and Information;Predictability;Non-Equilibrium Systems;Irreversibility;Systems BiologyKey Features:A unique vision highlighting complexity as part of fundamental science and a clear, unifying presentation of the concepts and tools needed to analyze complex systemsIllustrates the interdisciplinary dimension of complexity research through representative examples pertaining to problems of current concernNew edition, including a large collection of exercises and problems with hints for solution and an updated survey of the literatureReviews: “The book can be used as a textbook by graduate students, researchers and teachers in science, as well as non-experts who wish to have an overview of the field.” Zentralblatt MATH

Discover the many facets of non-equilibrium thermodynamics. The first part of this book describes the current thermodynamic formalism recognized as the classical theory. The second part focuses on different approaches. Throughout the presentation, the emphasis is on problem-solving applications. To help build your understanding, some problems have been analyzed using several formalisms to underscore their differences and their similarities.

This book focuses on modeling the anomalous diffusion phenomena, being ubiquitous in the natural world. Both the microscopic models (stochastic processes) and macroscopic models (partial differential equations) have been built up. The relationships between the two kinds of models are clarified, and based on these models, some statistical observables are analyzed. From statistics to mathematics, the built models show their power with their associated applications.This book is important for students to develop basic skills to be able to succeed in their future research. In addition to introducing the related models or methods, it also provides the corresponding applications and simulation results, which will attract more readers ranging from mathematicians to physicists or chemists, to name a few.

The Phase Field Crystal (PFC) model incorporates microscopic structural details into a mesoscopic continuum theory. Methods for fast

propagation of PFC interfaces are discussed in this book. They can handle a wide range of thermal gradients, supersaturations and supercoolings, including applications such as selective laser melting. The reader will find theoretical treatment in the first half, while the latter half discusses numerical models.

Focusing on a description of the technologies and methodologies for computer-aided conceptual design, this book covers the design, modeling and simulation of micropower generation devices. The articles are authored by internationally recognized experts in the field, who take the reader from fundamentals and design aspects to numerous power generation strategies and system engineering. The comprehensive coverage also extends to fuel processing, energy conversion, material and heat management, device operation, economics and quality control. For materials scientists, chemists, physicists, process engineers and those in power technology.

This book presents generalized heat-conduction laws which, from a mesoscopic perspective, are relevant to new applications (especially in nanoscale heat transfer, nanoscale thermoelectric phenomena, and in diffusive-to-ballistic regime) and at the same time keep up with the pace of current microscopic research. The equations presented in the book are compatible with generalized formulations of nonequilibrium thermodynamics, going beyond the local-equilibrium. The book includes six main chapters, together with a preface and a final section devoted to the future perspectives, as well as an extensive bibliography.

This is the second edition of the book “Thermodynamics of Fluids under Flow,” which was published in 2000 and has now been corrected, expanded and updated. This is a companion book to our other title Extended irreversible thermodynamics (D. Jou, J. Casas-Vázquez and G. Lebon, Springer, 4th edition 2010), and of the textbook Understanding non-equilibrium thermodynamics (G. Lebon, D. Jou and J. Casas-Vázquez, Springer, 2008. The present book is more specialized than its counterpart, as it focuses its attention on the non-equilibrium thermodynamics of flowing fluids, incorporating non-trivial thermodynamic contributions of the flow, going beyond local equilibrium theories, i.e., including the effects of internal variables and of external forcing due to the flow. Whereas the book's first edition was much more focused on polymer solutions, with brief glimpses into ideal and real gases, the present edition covers a much wider variety of systems, such as: diluted and concentrated polymer solutions, polymer blends, laminar and turbulent superfluids, phonon hydrodynamics and heat transport in nanosystems, nuclear collisions, far-from-equilibrium ideal gases, and molecular solutions. It also deals with a variety of situations, emphasizing the non-equilibrium flow contribution: temperature and entropy in flowing ideal gases, shear-induced effects on phase transitions in real gases and on polymer solutions, stress-induced migration and its application to flow chromatography, Taylor dispersion, anomalous diffusion in flowing systems, the influence of the flow on chemical reactions, and polymer degradation. The new edition is not only broader in scope, but more educational in character, and with more emphasis on applications, in keeping with our times. It provides many examples of how a deeper theoretical understanding may bring new and more efficient applications, forging links between theoretical progress and practical aims. This updated version expands on the trusted content of its predecessor, making it more interesting and useful for a larger audience.

Quantum transport is a diverse field, sometimes combining seemingly contradicting concepts - quantum and classical, conduction and insulating - within a single nanodevice. Quantum transport is an essential and challenging part of nanoscience, and understanding its concepts and methods is vital to the successful fabrication of devices at the nanoscale. This textbook is a comprehensive introduction to the rapidly developing field of quantum transport. The authors present the comprehensive theoretical background, and explore the groundbreaking experiments that laid the foundations of the field. Ideal for graduate students, each section contains control questions and exercises to check readers' understanding of the topics covered. Its broad scope and in-depth analysis of selected topics will appeal to researchers and professionals working in nanoscience.

Introduces many-body theory of modern quantum statistical mechanics to graduate students in physics, chemistry, engineering and biology.

This book presents the fundamental theory for non-standard diffusion problems in movement ecology. Lévy processes and anomalous diffusion have shown to be both powerful and useful tools for qualitatively and quantitatively describing a wide variety of spatial population ecological phenomena and dynamics, such as invasion fronts and search strategies. Adopting a self-contained, textbook-style approach, the authors provide the elements of statistical physics and stochastic processes on which the modeling of movement ecology is based and systematically introduce the physical characterization of ecological processes at the microscopic, mesoscopic and macroscopic levels. The explicit definition of these levels and their interrelations is particularly suitable to coping with the broad spectrum of space and time scales involved in bio-ecological problems. Including numerous exercises (with solutions), this text is aimed at graduate students and newcomers in this field at the interface of theoretical ecology, mathematical biology and physics.

The fast progress in many areas of research related to non-equilibrium ther- dynamics has prompted us to write a fourth edition of this book. Like in the previous editions, our main concern is to open the subject to the widest au- ence, including students, teachers, and researchers in physics, chemistry, engine- ing, biology, and materials sciences. Our objective is to present a general view on several open problems arising in non-equilibrium situations, and to afford a wide perspective of applications illustrating their practical outcomes and con- quences. A better comprehension of the foundations is generally correlated to an increase of the range of applications, implying mutual feedback and cross fert- ization. Truly, thermodynamic methods are widely used in many areas of science but, surprisingly, the active dynamism of thermodynamics as a ?eld on its own is not suf?ciently perceived outside a relatively reduced number of specialized researchers. Extended irreversible thermodynamics (EIT) goes beyond the classical f- malisms based on the local equilibrium hypothesis; it was also referred to in an earlier publication by the authors (Lebon et al. 1992) as a thermodynamics of the third type, as it provides a bridge between classical irreversible thermodynamics and rational thermodynamics, enlarging at the same time their respective range of application. The salient feature of the theory is that the ?uxes are incorporated into the set of basic variables.

This book examines the present and future of soft computer techniques. It explains how to use the latest technological tools, such

as multicore processors and graphics processing units, to implement highly efficient intelligent system methods using a general purpose computer.

Random walks often provide the underlying mesoscopic mechanism for transport phenomena in physics, chemistry and biology. In particular, anomalous transport in branched structures has attracted considerable attention. Combs are simple caricatures of various types of natural branched structures that belong to the category of loopless graphs. The comb model was introduced to understand anomalous transport in percolation clusters. Comb-like models have been widely adopted to describe kinetic processes in various experimental applications in medical physics and biophysics, chemistry of polymers, semiconductors, and many other interdisciplinary applications. The authors present a random walk description of the transport in specific comb geometries, ranging from simple random walks on comb structures, which provide a geometrical explanation of anomalous diffusion, to more complex types of random walks, such as non-Markovian continuous-time random walks. The simplicity of comb models allows to perform a rigorous analysis and to obtain exact analytical results for various types of random walks and reaction-transport processes.

Powerful analytical tools from statistical physics, guided by field observations are applied to spread of epidemics and movement ecology.

This multi-author reference work provides a unique introduction to the currently emerging, highly interdisciplinary field of those transport processes that cannot be described by using standard methods of statistical mechanics. It comprehensively summarizes topics ranging from mathematical foundations of anomalous dynamics to the most recent experiments in this field. In so doing, this monograph extracts and emphasizes common principles and methods from many different disciplines while providing up-to-date coverage of this new field of research, considering such diverse applications as plasma physics, glassy material, cell science, and socio-economic aspects. The book will be of interest to both theorists and experimentalists in nonlinear dynamics, statistical physics and stochastic processes. It also forms an ideal starting point for graduate students moving into this area. 18 chapters written by internationally recognized experts in this field provide in-depth introductions to fundamental aspects of anomalous transport.

A geometric process is a simple monotone process that was first introduced by the author in 1988. It is a generalization of renewal process. This book captures the extensive research work on geometric processes that has been done since then in both probability and statistics theory and various applications. Some results are published for the first time. A reference book for researchers and a handbook for practioners, it is also a useful textbook for postgraduate or senior undergraduate students.

This book discusses fundamental problems in quantum physics, with emphasis on quantum coherence and

decoherence. Papers covering the wide range of quantum physics are included: atom optics, quantum optics, quantum computing, quantum information, cryptography, macroscopic quantum phenomena, mesoscopic physics, physics of precise measurements, and fundamental problems in quantum physics. The book will serve not only as a good introduction to quantum coherence and decoherence for newcomers in this field, but also as a reference for experts. Contents:Quantum Computing:Decoherence and Dephasing in Spin-Based Solid State Quantum Computers (S Das Sarma et al.)Quantum-State Manipulations in a Cooper-Pair Box (Y Nakamura et al.)Quantum State Engineering and Josephson Junctions: Charge and Flux Detectors (Yu Makhlin et al.)Quantum Information, Quantum Teleportation, and Entanglement:High-Fidelity Experimental Quantum Teleportation and Entanglement Swapping (A Zeilinger et al.)Experimental Realization of Continuous-Variable Teleportation (A Furusawa)Quantum Optics:Entanglement Manipulation with Atoms and Photons in a Cavity (S Haroche)Generation of Single Photons and Entangled Photon Pairs from a Quantum Dot (Y Yamamoto et al.)Twin Photon Beams for Single Photon Generation (S Takeuchi)Bose-Einstein Condensation and Atom Interferometry:Quantized Vortices in a Bose-Einstein Condensate (J Dalibard et al.)Vortex Excitations in a Bose-Einstein Condensate (S Inouye et al.)Mesoscopic Magnets:Environmental Effects on Quantum Reversal of Mesoscopic Spins (B Barbara et al.)Resistance of Geometrically Confined Magnetic Domain Wall (T Ono et al.)Single Electronics and Superconductors:A Single-Photon Detector in the Far-Infrared Range (O Astafiev et al.)Nanoscale Physics and Atomics:Quantized Conductance of Gold Nanowire Studied by UHV-Electron Microscope with STM (K Takayanagi)Quantum Transport:Quantum Transport in Two-Dimensional Electron Gas in Ultra-Short Period Lateral Superlattices (Y Iye et al.)Enhanced Tunnel Magnetoresistance in Ferromagnetic Single Electron Transistor (R Matsuda et al.)Precise Measurements:Oscillation Phenomena in High Energy Physics: CP Violation in B-Meson Decays and Long Baseline Neutrino Oscillation (K Nakamura)Dynamic Observation of Vortices in High-Tc Superconductors (A Tonomura)Precision Optical Frequency Metrology Using Pulsed Lasers (Th Udem et al.)Interferometric Gravitational Wave Detector in Japan (N Mio)Fundamental Problems in Quantum Physics:Quantum Information Aspects of Black Hole (A Hosoya)and other papers Readership: Undergraduates, graduate students and researchers in quantum physics, atomic physics and optics. Keywords:

This book is an introduction to the dynamics of reaction-diffusion systems, with a focus on fronts and stationary spatial patterns. Emphasis is on systems that are non-standard in the sense that either the transport is not simply classical diffusion (Brownian motion) or the system is not homogeneous. A important feature is the derivation of the basic phenomenological equations from the mesoscopic system properties. Topics addressed include transport with inertia, described by persistent random walks and hyperbolic reaction-transport equations and transport by anomalous diffusion,

in particular subdiffusion, where the mean square displacement grows sublinearly with time. In particular reaction-diffusion systems are studied where the medium is in turn either spatially inhomogeneous, compositionally heterogeneous or spatially discrete. Applications span a vast range of interdisciplinary fields and the systems considered can be as different as human or animal groups migrating under external influences, population ecology and evolution, complex chemical reactions, or networks of biological cells. Several chapters treat these applications in detail.
The book contains review articles on recent advances in first-passage phenomena and applications contributed by leading international experts. It is intended for graduate students and researchers who are interested in learning about this intriguing and important topic. Contents:Arrival Statistics and Exploration Properties of Mortal Walkers (S B Yuste, E Abad and K Lindenberg)First Passage of a Randomly Accelerated Particle (T W Burkhardt)First Passage Problems in Anomalous Diffusion (A Rosso and A Zoia)First-Passage Times of Intermittent Random Walks (O Bénichou and R Voituriez)First-Passage Phenomena on Finite Inhomogeneous Networks (E Agliari and D Cassi)Effective Spectral Dimension in Scale-Free Networks (S Hwang, D-S Lee and B Kahng)First-Passage Statistics for Random Walks in Bounded Domains (R Voituriez and O Bénichou)First Passage Behavior of Multi-Dimensional Fractional Brownian Motion and Application to Reaction Phenomena (J-H Jeon, A V Chechkin and R Metzler)Trajectory-to-Trajectory Fluctuations in First-Passage Phenomena in Bounded Domains (T G Mattos, C Mejía-Monasterio, R Metzler, G Oshanin and G Schehr)Exact Record and Order Statists of Random Walk via First-Passage Ideas (G Schehr and S N Majumdar)First Passage in a Conical Geometry and Ordering of Brownian Particles (E Ben-Naim and P L Krapivsky)First Passage Time Problems in Biophysical Jump Processes with Fast Kinetics (P C Bressloff and J M Newby)First Passage Problems in Biology (T Chou and M R D'Orsogna)The Effect of Detection Mechanisms on Spatial Search and Foraging (D Campos and V Méndez)Search in Random Media with Lévy Flights (E Gelenbe and O H Abdelrahman)Exit Strategies: Visual Search and the Quitting Time Problem (T S Horowitz)Statistical Physics of Evolutionary Trajectories on Fitness Landscapes (M Manhart and A V Morozov)Some Applications of First-Passage Ideas to Finance (R Chicheportiche and J-P Bouchaud)First-Passage and Extremes in Socio-Economic Systems (J Masoliver and J Perelló)Transport and the First-Passage Time Problem with Application to Cold Atoms in Optical Traps (E Barkai and D A Kessler)The Excursion Set Theory in Cosmology (M Maggiore and A Riottoo)Self-Organized Escape Processes of Linear Chains in Nonlinear Potentials (T Gross, D Hennig and L Schimansky-Geier)Efficient Monte Carlo Methods for Simulating Diffusion-Reaction Processes in Complex Systems (D S Grebenkov) Readership: Researchers in stochastic processes, statistical physics, and mathematical physics. Key Features:Comprehensive update of the classical book by Sidney RednerApplications to wide-ranging and active fields of researchWell-known authors in the fieldKeywords:First Passage;Stochastic

Processes;Diffusion;Biophysics;Non-Equilibrium Statistical Mechanics;Complex Systems;Econophysics

The book covers recent developments in the theory of non-equilibrium thermodynamics and its applications. Four chapters are devoted to the foundations; an overview chapter is followed by recent results addressing the underlying principles of the theory. The applications are concerned with bulk systems, with heterogeneous systems where interfaces are central and with process units in industry where entropy production minimization is useful. There is also a collection of chapters under the heading mesoscopic non-equilibrium thermodynamics, giving in the end an overview of extensions of the theory into the non-linear regime. Bringing the literature up to date and detailing new approaches in this area of research, it is aimed at a predominantly, but not exclusively, academic audience of practitioners of thermodynamics and energy conversion.

Partial differential equations (PDEs) have been used in theoretical ecology research for more than eighty years. Nowadays, along with a variety of different mathematical techniques, they remain as an efficient, widely used modelling framework; as a matter of fact, the range of PDE applications has even become broader. This volume presents a collection of case studies where applications range from bacterial systems to population dynamics of human riots.

This volume provides the latest developments in the field of fractional dynamics, which covers fractional (anomalous) transport phenomena, fractional statistical mechanics, fractional quantum mechanics and fractional quantum field theory. The contributors are selected based on their active and important contributions to their respective topics. This volume is the first of its kind that covers such a comprehensive range of topics in fractional dynamics. It will point out to advanced undergraduate and graduate students, and young researchers the possible directions of research in this subject. In addition to those who intend to work in this field and those already in the field, this volume will also be useful for researchers not directly involved in the field, but want to know the current status and trends of development in this subject. This latter group includes theoretical chemists, mathematical biologists and engineers.

This book is a printed edition of the Special Issue "Progress in Mathematical Ecology" that was published in Mathematics

This book reviews advanced nanotechnology in food, health, water and agriculture. In food, nanobiosensors display an unprecedented efficiency for the detection of allergens, genetically modified organisms and pathogens. In agriculture, nanofertilisers improve plant nutrition by releasing nutrients slowly and steadily. Nanomaterials synthesised using biomass such as fungi are further found remarkable to clean waters polluted by heavy metals. However, as newly introduced materials in the environment, nanoparticles may exhibit toxic effects, which are reviewed in this book. In the context of climate change, methods for water desalinisation are also presented.

In addition to explaining and modeling unexplored phenomena in nature and society, chaos uses vital parts of nonlinear

dynamical systems theory and established chaotic theory to open new frontiers and fields of study. Handbook of Applications of Chaos Theory covers the main parts of chaos theory along with various applications to diverse areas. Expert contributors from around the world show how chaos theory is used to model unexplored cases and stimulate new applications. Accessible to scientists, engineers, and practitioners in a variety of fields, the book discusses the intermittency route to chaos, evolutionary dynamics and deterministic chaos, and the transition to phase synchronization chaos. It presents important contributions on strange attractors, self-exciting and hidden attractors, stability theory, Lyapunov exponents, and chaotic analysis. It explores the state of the art of chaos in plasma physics, plasma harmonics, and overtone coupling. It also describes flows and turbulence, chaotic interference versus decoherence, and an application of microwave networks to the simulation of quantum graphs. The book proceeds to give a detailed presentation of the chaotic, rogue, and noisy optical dissipative solitons; parhelic-like circle and chaotic light scattering; and interesting forms of the hyperbolic prism, the Poincaré disc, and foams. It also covers numerous application areas, from the analysis of blood pressure data and clinical digital pathology to chaotic pattern recognition to economics to musical arts and research.