Contact Mechanics Nanohub

Report on the current state of scientific knowledge about nanotechnologies, how they might be used in the future, and potential health, safety, environmental, ethical and societal implications.

This volume aims to document the most important worldwide accomplishments in converging knowledge and technology, including converging platforms, methods of convergence, societal implications, and governance in the last ten years. Convergence in knowledge, technology, and society is the accelerating, transformative interaction among seemingly distinct scientific disciplines, technologies, and communities to achieve mutual compatibility, synergism, and integration, and through this process to create added value for societal benefit. It is a movement that is recognized by scientists and thought leaders around the world as having the potential to provide far-reaching solutions to many of today’s complex knowledge, technology, and human development challenges. Four essential and interdependent convergence platforms of human activity are defined in the first part of this report: nanotechnology-biotechnology-information technology and cognitive science (“NBIC”) foundational tools; Earth-scale environmental systems; human-scale activities; and convergence methods for societal-scale activities. The report then presents the main implications of convergence for human physical potential, cognition and communication, productivity and societal outcomes, education and physical infrastructure, sustainability, and innovative and responsible governance. As a whole, the report presents a new model for convergence. To effectively take advantage of this potential, a proactive governance approach is suggested. The study identifies an international opportunity to develop and apply convergence for technological, economic, environmental, and societal benefits. The panel also suggests an opportunity in the United States for implementing a program aimed at focusing disparate R and D energies into a coherent activity - a "Societal Convergence Initiative”. This study received input from leading academic, industry, government, and NGO experts from the United States, Latin America, Europe, Asia, and Australia.

Superb introduction for nonspecialists covers Feynman diagrams, quasi particles, Fermi systems at finite temperature, superconductivity, vacuum amplitude, Dyson's equation, ladder approximation, and more. "A great delight." — Physics Today. 1974 edition.

Physics and Modeling of Tera- and Nano-Devices is a compilation of papers by well-respected researchers working in the field of physics and modeling of novel electronic and optoelectronic devices. The topics covered include devices based on carbon nanotubes, generation and detection of terahertz radiation in semiconductor structures including terahertz plasma oscillations and instabilities, terahertz photomixing in semiconductor heterostructures, spin and microwave-induced phenomena in low-dimensional systems, and various computational aspects of device modeling. Researchers as well as graduate and postgraduate students working in this field will benefit from reading this book.

The atomic force microscope (AFM) is a highly interdisciplinary instrument that enables measurements of samples in liquid, vacuum or air with unprecedented resolution. The intelligent use of this instrument requires knowledge from many distinct fields of study. These lecture notes aim to provide advanced undergraduates and beginning graduates in all fields of science and engineering with the required knowledge to sensibly use an AFM. Relevant background material is often reviewed in depth and summarized in a pedagogical, self-paced style to provide a fundamental understanding of the scientific principles underlying the use and operation of an AFM. Useful as a study guide to “Fundamentals of AFM”, an online video course available at https://nanohub.org/courses/AFM1/Suitable for Graduate/Undergraduate Independent Reading and Research Course in AFM (with the combination of book and online videos)

Simulation-Based Engineering and Science (SBE&S) cuts across disciplines, showing tremendous promise in areas from storm prediction and climate modeling to understanding the brain and the behavior of numerous other complex systems. In this groundbreaking volume, nine distinguished leaders assess the latest research trends, as a result of 52 site visits in Europe and Asia and hundreds of hours of expert interviews, and discuss the implications of their findings for the US government. The authors conclude that while the US remains the quantitative leader in SBE&S research and development, it is very much in danger of losing that edge to Europe and Asia. Commissioned by the National Science Foundation, this multifaceted study will capture the attention of Fortune 500 companies and policymakers.

For modeling the transport of carriers in nanoscale devices, a Green-function formalism is the most accurate approach. Due to the complexity of the formalism, one should have a deep understanding of the underlying principles and use smart approximations and numerical methods for solving the kinetic equations at a reasonable computational time. In this book the required concepts from quantum and statistical mechanics and numerical methods for calculating Green functions are presented. The Green function is studied in detail for systems both under equilibrium and under nonequilibrium conditions. Because the formalism enables rigorous modeling of different scattering mechanisms in terms of self-energies, but an exact evaluation of self-energies for realistic systems is not possible, their approximation and inclusion in the quantum kinetic equations of the Green functions are elaborated. All the elements of the kinetic equations, which are the device Hamiltonian, contact self-energies and scattering self-energies, are examined and efficient methods for their evaluation are explained. Finally, the application of these methods to study novel electronic devices such as nanotubes, graphene, Si-nanowires and low-dimensional thermoelectric devices and photodetectors are discussed.

The nanotech revolution waits for no man, woman...or child. To revitalize science, technology, engineering, and mathematics (STEM) performance, the U.S. educational system requires a practical strategy to better educate students about nanoscale science and engineering research. This is particularly important in grades K–12, the effective gestation point for future ideas and information. Optimize your use of free resources from the National Science Foundation The first book of its kind, Nanoscience Education, Workforce Training, and K–12 Resources promotes nano-awareness in both the public and private sectors, presenting an overview of the current obstacles that must be overcome within the complex U.S. educational system before any reform is possible. It’s a race against time—and other countries—and the fear is that U.S. students could lag behind for decades, with ineffective teaching and learning methods handicapping their ability to compete globally. Focusing on the application of new knowledge, this concise and highly readable book explores the transdisciplinary nature of nanoscience and its societal impact, also addressing workforce training and risk management. Illustrating the historical perspective of the complexity of K–12 education communities, it defines nanotechnology and evaluates pertinent global and national landscapes, presenting examples of successful change within them. This book is composed of four sections: Foundations—addresses the national educational matrix, exploring the scientific and social implications associated with the delay in adopting nanoscience education in public schools Teaching Nanotechnology—discusses the critical process of teaching K–12 students the skills to understand and evaluate emerging technologies they will encounter Nanoscience Resources and Programs—provides a wide overview of the resources offered by funded outreach programs from universities with nanoscience centers Framework Applied—analyzes the structure of national government programs and skill level recommendations for nanoeducation from the National Nanotechnology Initiatives This book offers plans of action and links to sustainable (largely free) development tools to help K–12 students acquire the skills to understand and evaluate emerging technologies. Promoting a holistic teaching approach that encompasses all aspects of science, the authors strive to help readers implement change so that decisions about resources and learning are no longer made "from the top down" by policymakers, but rather "from the bottom up" by teachers, parents, and students at the local level. Akhlesh Lakhtakia, one of the contributors to this volume, was recently featured on CNN in a discussion on solar energy.

This book presents the conceptual framework underlying the atomistic theory of matter, emphasizing those aspects that relate to current flow. This includes some of the most advanced concepts of non-equilibrium quantum statistical mechanics. No prior acquaintance with quantum mechanics is assumed. Chapter 1 provides a description of quantum transport in elementary terms accessible to a beginner. The book then

works its way from hydrogen to nanostructures, with extensive coverage of current flow. The final chapter summarizes the equations for quantum transport with illustrative examples showing how conductors evolve from the atomic to the ohmic regime as they get larger. Many numerical examples are used to provide concrete illustrations and the corresponding Matlab codes can be downloaded from the web. Videostreamed lectures, keyed to specific sections of the book, are also available through the web. This book is primarily aimed at senior and graduate students.

Cloud Computing: Theory and Practice provides students and IT professionals with an in-depth analysis of the cloud from the ground up. Beginning with a discussion of parallel computing and architectures and distributed systems, the book turns to contemporary cloud infrastructures, how they are being deployed at leading companies such as Amazon, Google and Apple, and how they can be applied in fields such as healthcare, banking and science. The volume also examines how to successfully deploy a cloud application across the enterprise using virtualization, resource management and the right amount of networking support, including content delivery networks and storage area networks. Developers will find a complete introduction to application development provided on a variety of platforms. Learn about recent trends in cloud computing in critical areas such as: resource management, security, energy consumption, ethics, and complex systems Get a detailed hands-on set of practical recipes that help simplify the deployment of a cloud based system for practical use of computing clouds along with an in-depth discussion of several projects Understand the evolution of cloud computing and why the cloud computing paradigm has a better chance to succeed than previous efforts in large-scale distributed computing

Cyberinfrastructure Vision for 21st Century Discovery is presented in a set of interrelated chapters that describe the various challenges and opportunities in the complementary areas that make up cyberinfrastructure: computing systems, data, information resources, networking, digitally enabled-sensors, instruments, virtual organizations, and observatories, along with an interoperable suite of software services and tools.

Whether you're already in the cloud, or determining whether or not it makes sense for your organization, Cloud Computing and Software Services: Theory and Techniques provides the technical understanding needed to develop and maintain state-of-the-art cloud computing and software services. From basic concepts and recent research findings to fut

This volume contains the proceedings of the 10th edition of the International Conference on Simulation of Semiconductor Processes and Devices (SISPAD 2004), held in Munich, Germany, on September 2-4, 2004. The conference program included 7 invited plenary lectures and 82 contributed papers for oral or poster presentation, which were carefully selected out of a total of 151 abstracts submitted from 14 countries around the world. Like the previous meetings, SISPAD 2004 provided a world-wide forum for the presentation and discussion of recent advances and developments in the theoretical description, physical modeling and numerical simulation and analysis of semiconductor fabrication processes, device operation and system performance. The variety of topics covered by the conference contributions reflects the physical effects and technological problems encountered in consequence of the progressively shrinking device dimensions and the ever-growing complexity in device technology.

Thermodynamics has benefited from nearly 100 years of parallel development with quantum mechanics. As a result, thermal physics has been considerably enriched in concepts, technique and purpose, and now has a dominant role in the developments of physics, chemistry and biology. This unique book explores the meaning and application of these developments using quantum theory as the starting point. The book links thermal physics and quantum mechanics in a natural way. Concepts are combined with interesting examples, and entire chapters are dedicated to applying the principles to familiar, practical and unusual situations. Together with end-of-chapter exercises, this book gives advanced undergraduate and graduate students a modern perception and appreciation for this remarkable subject.

Nanoscience is one of the most exciting areas of modern physical science as it encompasses a range of techniques rather than a single discipline. It stretches across the whole spectrum of science including: medicine and health, physics, engineering and chemistry. Providing a deep understanding of the behaviour of matter at the scale of individual atoms and molecules, it provides a crucial step towards future applications of nanotechnology. The remarkable improvements in both theoretical methods and computational techniques make it possible for modern computational nanoscience to achieve a new level of chemical accuracy. It is now a discipline capable of leading and guiding experimental efforts rather than just following others. Computational Nanoscience addresses modern challenges in computational science, within the context of the rapidly evolving field of nanotechnology. It satisfies the need for a comprehensive, yet concise and up-to-date, survey of new developments and applications presented by the world's leading academics. It documents major, recent advances in scientific computation, mathematical models and theory development that specifically target the applications in nanotechnology. Suitable for theoreticians, researchers and students, the book shows readers what computational nanoscience can achieve, and how it may be applied in their own work. The twelve chapters cover topics including the concepts behind recent breakthroughs, the development of cutting edge simulation tools, and the variety of new applications.

Integrated computational materials engineering (ICME) is an emerging discipline that can accelerate materials development and unify design and manufacturing. Developing ICME is a grand challenge that could provide significant economic benefit. To help develop a strategy for development of this new technology area, DOE and DoD asked the NRC to explore its benefits and promises, including the benefits of a comprehensive ICME capability; to establish a strategy for development and maintenance of an ICME infrastructure, and to make recommendations about how best to meet these opportunities. This book provides a vision for ICME, a review of case studies and lessons learned, an analysis of technological barriers, and an evaluation of ways to overcome cultural and organizational challenges to develop the discipline.

This book fills a gap by presenting our current knowledge and understanding of continuum-based concepts behind computational methods used for microstructure and process simulation of engineering materials above the atomic scale. The volume provides an excellent overview on the different methods, comparing the different methods in terms of their respective particular weaknesses and advantages. This trains readers to identify appropriate approaches to the new challenges that emerge every day in this exciting domain. Divided into three main parts, the first is a basic overview covering fundamental key methods in the field of continuum scale materials simulation. The second one then goes on to look at applications of these methods to the prediction of microstructures, dealing with explicit simulation examples, while the third part discusses example applications in the field of process simulation. By presenting a spectrum of different computational approaches to materials, the book aims to initiate the development of corresponding virtual laboratories in the industry in which these methods are exploited. As such, it addresses graduates and undergraduates, lecturers, materials scientists and engineers, physicists, biologists, chemists, mathematicians, and mechanical engineers.

Shape memory and superelastic alloys possess properties not present in ordinary metals meaning that they can be used for a variety of applications. Shape memory and superelastic alloys: Applications and technologies explores these applications discussing their key features and commercial performance. Readers will gain invaluable information and insight into the current and potential future applications of shape memory alloys. Part one covers the properties and processing of shape memory effect and superelasticity in alloys for practical users with chapters covering the basic characteristics of Ti-Ni-based and Ti-Nb-based shape memory and superelastic (SM/SE) alloys, the development and commercialisation of TiNi and Cu-based alloys, industrial processing and device elements, design of SMA coil springs for actuators before a final overview on the development of SM and SE applications. Part two introduces SMA application technologies with chapters investigating SMAs in electrical applications, hot-water supply, construction and housing, automobiles and railways and aerospace

engineering before looking at the properties, processing and applications of Ferrous (Fe)-based SMAs. Part three focuses on the applications of superelastic alloys and explores their functions in the medical, telecommunications, clothing, sports and leisure industries. The appendix briefly describes the history and activity of the Association of Shape Memory Alloys (ASMA). With its distinguished editors and team of expert contributors, Shape memory and superelastic alloys: Applications and technologies is be a valuable reference tool for metallurgists as well as for designers, engineers and students involved in one of the many industries in which shape memory effect and superelasticity are used such as construction, automotive, medical, aerospace, telecommunications, water/heating, clothing, sports and leisure. Explores important applications of shape memory and superelastic alloys discussing their key features and commercial performance Assesses the properties and processing of shape memory effect and superelasticity in alloys for practical users with chapters covering the basic characteristics Introduces SMA application technologies investigating SMAs in electrical applications, hot-water supply, construction and housing, automobiles and railways and aerospace engineering

Everyone is familiar with the amazing performance of a modern smartphone, powered by a billion-plus nanotransistors, each having an active region that is barely a few hundred atoms long. The same amazing technology has also led to a deeper understanding of the nature of current flow and heat dissipation on an atomic scale which is of broad relevance to the general problems of non-equilibrium statistical mechanics that pervade many different fields.This book is based on a set of two online courses originally offered in 2012 on nanoHUB-U and more recently in 2015 on edX. In preparing the second edition the author decided to split it into parts A and B titled Basic Concepts and Quantum Transport respectively, along the lines of the two courses. A list of available video lectures corresponding to different sections of this volume is provided upfront.To make these lectures accessible to anyone in any branch of science or engineering, the author assume very little background beyond linear algebra and differential equations. However, the author will be discussing advanced concepts that should be of interest even to specialists, who are encouraged to look at his earlier books for additional technical details.

Designed for advanced undergraduate or first-year graduate courses in semiconductor or microelectronic fabrication, the third edition of Fabrication Engineering at the Micro and Nanoscale provides a thorough and accessible introduction to all fields of micro and nano fabrication.

For undergraduate courses in nanoelectronics. This is the first actual nanoelectronics textbook for undergraduate engineering and applied sciences students. It provides an introduction to nanoelectronics, as well as a self-contained overview of the necessary physical concepts — taking a fairly gentle but serious approach to a field that will be extremely important in the near future.

Throughout their college career, most engineering students have done problems and studies that are basically situated in the classical world. Some may have taken quantum mechanics as their chosen field of study. This book moves beyond the basics to highlight the full quantum mechanical nature of the transport of carriers through nanoelectronic structures. The book is unique in that addresses quantum transport only in the materials that are of interest to microelectronics—semiconductors, with their variable densities and effective masses. The author develops Green’s functions starting from equilibrium Green’s functions and going through modern time-dependent approaches to non-equilibrium Green’s functions, introduces relativistic bands for graphene and topological insulators and discusses the quantum transport changes that these bands induce, and discusses applications such as weak localization and phase breaking processes, resonant tunneling diodes, single-electron tunneling, and entanglement. Furthermore, he also explains modern ensemble Monte Carlo approaches to simulation of various approaches to quantum transport and the hydrodynamic approaches to quantum transport. All in all, the book describes all approaches to quantum transport in semiconductors, thus becoming an essential textbook for advanced graduate students in electrical engineering or physics.

A. Basic concepts. Why electrons flow ; The elastic resistor ; Ballistic and diffusive transport ; Conductance from fluctuation ; Energy band model ; The nanotransistor ; Diffusion equation for ballistic transport ; Boltzmann equation ; Electrochemical potentials and quasi-Fermi levels ; Hall effect ; Smart contacts ; Thermoelectricity ; Phonon transport ; Second law ; Fuel value of information

Fundamentals and Applications of Nanophotonics includes a comprehensive discussion of the field of nanophotonics, including key enabling technologies that have the potential to drive economic growth and impact numerous application domains such as ICT, the environment, healthcare, military, transport, manufacturing, and energy. This book gives readers the theoretical underpinnings needed to understand the latest advances in the field. After an introduction to the area, chapters two and three cover the essential topics of electrodynamics, quantum mechanics, and computation as they relate to nanophotonics. Subsequent chapters explore materials for nanophotonics, including nanoparticles, photonic crystals, nanosilicon, nanocarbon, III-V, and II-VI semiconductors. In addition, fabrication and characterization techniques are addressed, along with the importance of plasmonics, and the applications of nanophotonics in devices such as lasers, LEDs, and photodetectors. Covers electrodynamics, quantum mechanics and computation as these relate to nanophotonics Reviews materials, fabrication and characterization techniques for nanophotonics Describes applications of the technology such as lasers, LEDs and photodetectors

The book gives a streamlined introduction to quantum mechanics while describing the basic mathematical structures underpinning this discipline. Starting with an overview of key physical experiments illustrating the origin of the physical foundations, the book proceeds with a description of the basic notions of quantum mechanics and their mathematical content. It then makes its way to topics of current interest, specifically those in which mathematics plays an important role. The more advanced topics presented include many-body systems, modern perturbation theory, path integrals, the theory of resonances, quantum statistics, mean-field theory, second quantization, the theory of radiation (non-relativistic quantum electrodynamics), and the renormalization group. With different selections of chapters, the book can serve as a text for an introductory, intermediate, or advanced course in quantum mechanics. The last four chapters could also serve as an introductory course in quantum field theory.

Advances in semiconductor technology have made possible the fabrication of structures whose dimensions are much smaller than the mean free path of an electron. This book gives a thorough account of the theory of electronic transport in such mesoscopic systems. After an initial chapter covering fundamental concepts, the transmission function formalism is presented, and used to describe three key topics in mesoscopic physics: the quantum Hall effect; localisation; and double-barrier tunnelling. Other sections include a discussion of optical analogies to mesoscopic phenomena, and the book concludes with a description of the non-equilibrium Green's function formalism and its relation to the transmission formalism. Complete with problems and solutions, the book will be of great interest to graduate students of mesoscopic physics and nanoelectronic device engineering, as well as to established researchers in these fields.

The transistor is the key enabler of modern electronics. Progress in transistor scaling has pushed channel lengths to the nanometer regime where traditional approaches to device physics are less and less suitable. These lectures describe a way of understanding MOSFETs and other transistors that is much more suitable than traditional approaches when the critical dimensions are measured in nanometers. It uses a novel, “bottom-up approach” that agrees with traditional

methods when devices are large, but that also works for nano-devices. Surprisingly, the final result looks much like the traditional, textbook, transistor models, but the parameters in the equations have simple, clear interpretations at the nanoscale. The objective is to provide readers with an understanding of the essential physics of nanoscale transistors as well as some of the practical technological considerations and fundamental limits. This book is written in a way that is broadly accessible to students with only a very basic knowledge of semiconductor physics and electronic circuits. Complemented with online lecture by Prof Lundstrom: nanoHUB-U Nanoscale Transistor Contents:MOSFET Fundamentals:OverviewThe Transistor as a Black BoxThe MOSFET: A Barrier-Controlled DeviceMOSFET IV: Traditional ApproachMOSFET IV: The Virtual Source ModelMOS Electrostatics:Poisson Equation and the Depletion ApproximationGate Voltage and Surface PotentialMobile Charge: Bulk MOSMobile Charge: Extremely Thin SOI2D MOS ElectrostaticsThe VS Model RevisitedThe Ballistic MOSFET:The Landauer Approach to TransportThe Ballistic MOSFETThe Ballistic Injection VelocityConnecting the Ballistic and VS ModelsTransmission Theory of the MOSFET:Carrier Scattering and TransmissionTransmission Theory of the MOSFETConnecting the Transmission and VS ModelsVS Characterization of Transport in NanotransistorsLimits and Limitations Readership: Any student and professional with an undergraduate degree in the physical sciences or engineering.

In his 1959 address, "There is Plenty of Room at the Bottom," Richard P. Feynman speculated about manipulating materials atom by atom and challenged the technical community "to find ways of manipulating and controlling things on a small scale." This visionary challenge has now become a reality, with recent advances enabling atomistic-level tailoring and control of materials. Exemplifying Feynman’s vision, Handbook of Nanoscience, Engineering, and Technology, Third Edition continues to explore innovative nanoscience, engineering, and technology areas. Along with updating all chapters, this third edition extends the coverage of emerging nano areas even further. Two entirely new sections on energy and biology cover nanomaterials for energy storage devices, photovoltaics, DNA devices and assembly, digital microfluidic lab-on-a-chip, and much more. This edition also includes new chapters on nanomagnet logic, quantum transport at the nanoscale, terahertz emission from Bloch oscillator systems, molecular logic, electronic optics in graphene, and electromagnetic metamaterials. With contributions from top scientists and researchers from around the globe, this color handbook presents a unified, up-to-date account of the most promising technologies and developments in the nano field. It sets the stage for the next revolution of nanoscale manufacturing—where scalable technologies are used to manufacture large numbers of devices with complex functionalities.

Lessons from NanoelectronicsA New Perspective on TransportWorld Scientific Publishing Company

Starting with the simplest semiclassical approaches and ending with the description of complex fully quantum-mechanical methods for quantum transport analysis of state-of-the-art devices, Computational Electronics: Semiclassical and Quantum Device Modeling and Simulation provides a comprehensive overview of the essential techniques and methods for effectively analyzing transport in semiconductor devices. With the transistor reaching its limits and new device designs and paradigms of operation being explored, this timely resource delivers the simulation methods needed to properly model state-of-the-art nanoscale devices. The first part examines semiclassical transport methods, including drift-diffusion, hydrodynamic, and Monte Carlo methods for solving the Boltzmann transport equation. Details regarding numerical implementation and sample codes are provided as templates for sophisticated simulation software. The second part introduces the density gradient method, quantum hydrodynamics, and the concept of effective potentials used to account for quantum-mechanical space quantization effects in particle-based simulators. Highlighting the need for quantum transport approaches, it describes various quantum effects that appear in current and future devices being mass-produced or fabricated as a proof of concept. In this context, it introduces the concept of effective potential used to approximately include quantum-mechanical space-quantization effects within the semiclassical particle-based device simulation scheme. Addressing the practical aspects of computational electronics, this authoritative resource concludes by addressing some of the open questions related to quantum transport not covered in most books. Complete with self-study problems and numerous examples throughout, this book supplies readers with the practical understanding required to create their own simulators.

This book describes the research of Bowden, Yoffe and their collaborators on explosive initiation. What Bowden and Yoffe showed was that explosives are ignited almost invariably by thermal processes and though other processes have been identified their work still holds.

Due to its nondestructive imaging power, scanning tunneling microscopy has found major applications in the fields of physics, chemistry, engineering, and materials science. This book provides a comprehensive treatment of scanning tunneling and atomic force microscopy, with full coverage of the imaging mechanism, instrumentation, and sample applications. The work is the first single-author reference on STM and presents much valuable information previously available only as proceedings or collections of review articles. It contains a 32-page section of remarkable STM images, and is organized as a self-contained work, with all mathematical derivations fully detailed. As a source of background material and current data, the book will be an invaluable resource for all scientists, engineers, and technicians using the imaging abilities of STM and AFM. It may also be used as a textbook in senior-year and graduate level STM courses, and as a supplementary text in surface science, solid-state physics, materials science, microscopy, and quantum mechanics.

A clear, concise and rigorous textbook covering phase transitions in the context of advances in electronic structure and statistical mechanics.

This book deals with the adhesion, friction and contact mechanics of living organisms. Further, it presents the remarkable adhesive abilities of the living organisms which inspired the design of novel micro- and nanostructured adhesives that can be used in various applications, such as climbing robots, reusable tapes, and biomedical bandages. The technologies for both the synthesis and construction of bio-inspired adhesive micro- and nanostructures, as well as their performance, are discussed in

detail. Representatives of several animal groups, such as insects, spiders, tree frogs, and lizards, are able to walk on (and therefore attach to) tilted, vertical surfaces, and even ceilings in different environments. Studies have demonstrated that their highly specialized micro- and nanostructures, in combination with particular surface chemistries, are responsible for this impressive and reversible adhesion. These structures can maximize the formation of large effective contact areas on surfaces of varying roughness and chemical composition under different environmental conditions.

To push MOSFETs to their scaling limits and to explore devices that may complement or even replace them at molecular scale, a clear understanding of device physics at nanometer scale is necessary. Nanoscale Transistors provides a description on the recent development of theory, modeling, and simulation of nanotransistors for electrical engineers, physicists, and chemists working on nanoscale devices. Simple physical pictures and semi-analytical models, which were validated by detailed numerical simulations, are provided for both evolutionary and revolutionary nanotransistors. After basic concepts are reviewed, the text summarizes the essentials of traditional semiconductor devices, digital circuits, and systems to supply a baseline against which new devices can be assessed. A nontraditional view of the MOSFET using concepts that are valid at nanoscale is developed and then applied to nanotube FET as an example of how to extend the concepts to revolutionary nanotransistors. This practical guide then explore the limits of devices by discussing conduction in single molecules

These lecture notes provide a detailed treatment of the thermal energy storage and transport by conduction in natural and fabricated structures. Thermal energy in two carriers, i.e. phonons and electrons — are explored from first principles. For solid-state transport, a common Landauer framework is used for heat flow. Issues including the quantum of thermal conductance, ballistic interface resistance, and carrier scattering are elucidated. Bulk material properties, such as thermal and electrical conductivity, are derived from particle transport theories, and the effects of spatial confinement on these properties are established.

Material properties emerge from phenomena on scales ranging from Angstroms to millimeters, and only a multiscale treatment can provide a complete understanding. Materials researchers must therefore understand fundamental concepts and techniques from different fields, and these are presented in a comprehensive and integrated fashion for the first time in this book. Incorporating continuum mechanics, quantum mechanics, statistical mechanics, atomistic simulations and multiscale techniques, the book explains many of the key theoretical ideas behind multiscale modeling. Classical topics are blended with new techniques to demonstrate the connections between different fields and highlight current research trends. Example applications drawn from modern research on the thermo-mechanical properties of crystalline solids are used as a unifying focus throughout the text. Together with its companion book, Continuum Mechanics and Thermodynamics (Cambridge University Press, 2011), this work presents the complete fundamentals of materials modeling for graduate students and researchers in physics, materials science, chemistry and engineering.

Essential Advanced Physics is a series comprising four parts: Classical Mechanics, Classical Electrodynamics, Quantum Mechanics and Statistical Mechanics. Each part consists of two volumes, Lecture Notes and Problems with Solutions, further supplemented by an additional collection of test problems and solutions available to qualifying university instructors. This volume, Classical Electrodynamics: Lecture Notes is intended to be the basis for a two-semester graduate-level course on electricity and magnetism, including not only the interaction and dynamics charged point particles, but also properties of dielectric, conducting, and magnetic media. The course also covers special relativity, including its kinematics and particle-dynamics aspects, and electromagnetic radiation by relativistic particles.

This book is the result of the first International Conference ICT Innovations 2009. The ICT Innovations conference is the primary scientific action of the Macedonian Society on Information and Communication Technologies (ICT-ACT). It promotes the publication of scientific results of the international community related to innovative fundamental and applied research in ICT. Today, ICT has enlarged its horizons and it is practiced under multidisciplinary contexts that introduce new challenges to theore- cal and technical approaches. The ICT Innovations 2009 conference gathered academics, professionals and pr- titioners reporting their valuable experiences in developing solutions and systems in the industrial and business arena especially innovative commercial implementations, novel applications of technology, and experience in applying recent research advances to practical situations, in any ICT areas. The conference focuses on issues concerning a variety of ICT fields like: • Multimedia Information Systems • Artificial Intelligence • Pervasive and Ubiquitous Computing • Eco and Bio Informatics • Internet and Web Applications and Services • Wireless and Mobile Communications and Services • Computer Networks, Security and Cryptography • Distributed Systems, GRID and Cloud Computing ICT Innovations 2009 Conference was held in Ohrid, Macedonia, in September 28-30, 2009. Local arrangements provided by the members of the Macedonian Society on Information and Communication Technologies – ICT-ACT, mainly consisting of teaching and research staff of Computer Science Department at Faculty of Electrical Engineering and Information Technologies and Institute of Informatics at Faculty of Natural Sciences, both at Ss. Cyril and Methodius University in Skopje, Macedonia.

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