

Advanced Semiconductor Fundamentals Solution Manual

The Third Edition of the standard textbook and reference in the field of semiconductor devices. This classic book has set the standard for advanced study and reference in the semiconductor device field. Now completely updated and reorganized to reflect the tremendous advances in device concepts and performance, this Third Edition remains the most detailed and exhaustive single source of information on the most important semiconductor devices. It gives readers immediate access to detailed descriptions of the underlying physics and performance characteristics of all major bipolar, field-effect, microwave, photonic, and sensor devices. Designed for graduate textbook adoptions and reference needs, this new edition includes: A complete update of the latest developments New devices such as three-dimensional MOSFETs, MODFETs, resonant-tunneling diodes, semiconductor sensors, quantum-cascade lasers, single-electron transistors, real-space transfer devices, and more Materials completely reorganized Problem sets at the end of each chapter All figures reproduced at the highest quality Physics of Semiconductor Devices, Third Edition offers engineers, research scientists, faculty, and students a practical basis for understanding the most important devices in use today and for evaluating future device performance and limitations. A Solutions Manual is available from the editorial department.

Modern Semiconductor Devices for Integrated Circuits, First Edition introduces readers to the world of modern semiconductor devices with an emphasis on integrated circuit applications. KEY TOPICS: Electrons and Holes in Semiconductors; Motion and Recombination of Electrons and Holes; Device Fabrication Technology; PN and Metal–Semiconductor Junctions; MOS Capacitor; MOS Transistor; MOSFETs in ICs—Scaling, Leakage, and Other Topics; Bipolar Transistor. MARKET: Written by an experienced teacher, researcher, and expert in industry practices, this succinct and forward-looking text is appropriate for anyone interested in semiconductor devices for integrated circuits, and serves as a suitable reference text for practicing engineers.

This handbook will provide engineers with the principles, applications, and solutions needed to design and manage semiconductor manufacturing operations. Consolidating the many complex fields of semiconductor fundamentals and manufacturing into one volume by deploying a team of world class specialists, it allows the quick look up of specific manufacturing reference data across many subdisciplines.

This Solution Manual, a companion volume of the book, Fundamentals of Solid-State Electronics, provides the solutions to selected problems listed in the book. Most of the solutions are for the selected problems that had been assigned to the engineering undergraduate students who were taking an introductory device core course using this book. This Solution Manual also contains an extensive appendix which illustrates the application of the fundamentals to solutions of state-of-the-art transistor reliability problems which have been taught to advanced undergraduate and graduate students.

During the last decade many new concepts have been proposed for improving the performance of power MOSFETs. The results of this research are dispersed in the technical literature among journal articles and abstracts of conferences. Consequently, the information is not readily available to researchers and practicing engineers in the power device community. There is no cohesive treatment of the ideas to provide an assessment of the relative merits of the ideas. "Advanced Power MOSFET Concepts" provides an in-depth treatment of the physics of operation of advanced power MOSFETs. Analytical models for explaining the operation of all the advanced power MOSFETs will be developed. The results of numerical simulations will be provided to give additional insight into the device physics and validate the analytical models. The results of two-dimensional simulations will be provided to corroborate the analytical models and give greater insight into the device operation.

Unlike books currently on the market, this book attempts to satisfy two goals: combine circuits and electronics into a single, unified treatment, and establish a strong connection with the contemporary world of digital systems. It will introduce a new way of looking not only at the treatment of circuits, but also at the treatment of introductory coursework in engineering in general. Using the concept of "abstraction," the book attempts to form a bridge between the world of physics and the world of large computer systems. In particular, it attempts to unify electrical engineering and computer science as the art of creating and exploiting successive abstractions to manage the complexity of building useful electrical systems. Computer systems are simply one type of electrical systems. +Balances circuits theory with practical digital electronics applications. +Illustrates concepts with real devices. +Supports the popular circuits and electronics course on the MIT OpenCourse Ware from which professionals worldwide study this new approach. +Written by two educators well known for their innovative teaching and research and their collaboration with industry. +Focuses on contemporary MOS technology.

The use of COSMOS for the analysis and solution of structural dynamics problems is introduced in this new edition. The COSMOS program was selected from among the various professional programs available because it has the capability of solving complex problems in structures, as well as in other engineering fields such as Heat Transfer, Fluid Flow, and Electromagnetic Phenomena. COSMOS includes routines for Structural Analysis, Static, or Dynamics with linear or nonlinear behavior (material nonlinearity or large displacements), and can be used most efficiently in the microcomputer. The larger version of COSMOS has the capacity for the analysis of structures modeled up to 64,000 nodes. This fourth edition uses an introductory version that has a capability limited to 50 nodes or 50 elements. This version is included in the supplement, STRUCTURAL DYNAMICS USING COSMOS 1. The sets of educational programs in Structural Dynamics and Earthquake Engineering that accompanied the third edition have now been extended and updated. These sets include programs to determine the response in the time or frequency domain using the FFT (Fast Fourier Transform) of structures modeled as a single oscillator. Also included is a program to determine the response of an inelastic system with elastoplastic behavior and a program for the development of seismic response spectral charts. A set of seven computer programs is included for modeling structures as two-dimensional and three dimensional frames and trusses.

From theory and fundamentals to the latest advances in computational and experimental modal analysis, this is the definitive, updated reference on structural dynamics. This edition updates Professor Craig's classic introduction to structural dynamics, which has been an invaluable resource for practicing engineers and a textbook for undergraduate and graduate courses in vibrations and/or structural dynamics. Along with comprehensive coverage of structural dynamics fundamentals, finite-element-based computational methods, and dynamic testing methods, this Second Edition includes new and expanded coverage of computational methods, as well as introductions to more advanced topics, including experimental modal analysis and "active structures." With a systematic approach, it presents solution techniques that apply to various engineering disciplines. It discusses single degree-of-freedom (SDOF) systems, multiple degrees-of-freedom (MDOF) systems, and continuous systems in depth; and includes numeric evaluation of modes and frequency of MDOF systems; direct integration methods for dynamic response of SDOF systems and MDOF systems; and component mode synthesis. Numerous illustrative examples help engineers apply the techniques and methods to challenges they face in the real world. MATLAB(r) is extensively used throughout the book, and many of the .m-files are made available on the book's Web site. Fundamentals of Structural Dynamics, Second Edition is an indispensable reference and "refresher course" for engineering professionals; and a textbook for seniors or graduate students in mechanical engineering, civil engineering, engineering mechanics, or aerospace engineering.

Learn the basic properties and designs of modern VLSI devices, as well as the factors affecting performance, with this thoroughly updated second edition. The first edition has been widely

adopted as a standard textbook in microelectronics in many major US universities and worldwide. The internationally renowned authors highlight the intricate interdependencies and subtle trade-offs between various practically important device parameters, and provide an in-depth discussion of device scaling and scaling limits of CMOS and bipolar devices. Equations and parameters provided are checked continuously against the reality of silicon data, making the book equally useful in practical transistor design and in the classroom. Every chapter has been updated to include the latest developments, such as MOSFET scale length theory, high-field transport model and SiGe-base bipolar devices.

This is a first undergraduate textbook in Solid State Physics or Condensed Matter Physics. While most textbooks on the subject are extremely dry, this book is written to be much more exciting, inspiring, and entertaining.

A comprehensive introduction to the burgeoning field of photonics The field of photonics is finding increasing applications across a broad range of industries. While many other books provide an overview of the subject, Fundamentals of Light Sources and Lasers closes a clear gap in the current literature by concentrating on the principles of laser operation as well as providing coverage of important concepts necessary to fully understand the principles involved. The scope of the book includes everything a professional needs to get up to speed in the field, as well as all the material necessary to serve as an excellent introductory laser course for students. Ideal for self-study as well as structured coursework, the book offers thorough coverage of: * The nature of light and atomic emission * Basic quantum mechanics and laser processes * Cavity optics, fast-pulse production, and nonlinear optical phenomena * Laser technology, including visible gas lasers, UV gas lasers, infrared gas lasers, solid-state lasers, semiconductor lasers and tunable dye lasers Extensive real-world case studies are included to help readers appreciate the practical applications of the material covered. * An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department.

Fundamentals of Semiconductor Devices provides a realistic and practical treatment of modern semiconductor devices. A solid understanding of the physical processes responsible for the electronic properties of semiconductor materials and devices is emphasized. With this emphasis, the reader will appreciate the underlying physics behind the equations derived and their range of applicability. The author's clear writing style, comprehensive coverage of the core material, and attention to current topics are key strengths of this book.

The devices described in "Advanced MOS-Gated Thyristor Concepts" are utilized in microelectronics production equipment, in power transmission equipment, and for very high power motor control in electric trains, steel-mills, etc. Advanced concepts that enable improving the performance of power thyristors are discussed here, along with devices with blocking voltage capabilities of 5,000-V, 10,000-V and 15,000-V. Throughout the book, analytical models are generated to allow a simple analysis of the structures and to obtain insight into the underlying physics. The results of two-dimensional simulations are provided to corroborate the analytical models and give greater insight into the device operation.

The new edition of the most detailed and comprehensive single-volume reference on major semiconductor devices The Fourth Edition of Physics of Semiconductor Devices remains the standard reference work on the fundamental physics and operational characteristics of all major bipolar, unipolar, special microwave, and optoelectronic devices. This fully updated and expanded edition includes approximately 1,000 references to original research papers and review articles, more than 650 high-quality technical illustrations, and over two dozen tables of material parameters. Divided into five parts, the text first provides a summary of semiconductor properties, covering energy band, carrier concentration, and transport properties. The second part surveys the basic building blocks of semiconductor devices, including p-n junctions, metal-semiconductor contacts, and metal-insulator-semiconductor (MIS) capacitors. Part III examines bipolar transistors, MOSFETs (MOS field-effect transistors), and other field-effect transistors such as JFETs (junction field-effect transistors) and MESFETs (metal-semiconductor field-effect transistors). Part IV focuses on negative-resistance and power devices. The book concludes with coverage of photonic devices and sensors, including light-emitting diodes (LEDs), solar cells, and various photodetectors and semiconductor sensors. This classic volume, the standard textbook and reference in the field of semiconductor devices: Provides the practical foundation necessary for understanding the devices currently in use and evaluating the performance and limitations of future devices Offers completely updated and revised information that reflects advances in device concepts, performance, and application Features discussions of topics of contemporary interest, such as applications of photonic devices that convert optical energy to electric energy Includes numerous problem sets, real-world examples, tables, figures, and illustrations; several useful appendices; and a detailed solutions manual Explores new work on leading-edge technologies such as MODFETs, resonant-tunneling diodes, quantum-cascade lasers, single-electron transistors, real-space-transfer devices, and MOS-controlled thyristors Physics of Semiconductor Devices, Fourth Edition is an indispensable resource for design engineers, research scientists, industrial and electronics engineering managers, and graduate students in the field.

Fundamentals of Power Semiconductor Devices provides an in-depth treatment of the physics of operation of power semiconductor devices that are commonly used by the power electronics industry. Analytical models for explaining the operation of all power semiconductor devices are shown. The treatment here focuses on silicon devices but includes the unique attributes and design requirements for emerging silicon carbide devices. The book will appeal to practicing engineers in the power semiconductor device community.

An engaging writing style and a strong focus on the physics make this graduate-level textbook a must-have for electromagnetism students.

A practical guide to semiconductor manufacturing from process control to yield modeling and experimental design Fundamentals of Semiconductor Manufacturing and Process Control covers all issues involved in manufacturing microelectronic devices and circuits, including fabrication sequences, process control, experimental design, process modeling, yield modeling, and CIM/CAM systems. Readers are introduced to both the theory and practice of all basic manufacturing concepts. Following an overview of manufacturing and technology, the text explores process monitoring methods, including those that focus on product wafers and those that focus on the equipment used to produce wafers. Next, the text sets forth some fundamentals of statistics and yield modeling, which set the foundation for a detailed discussion of how statistical process control is used to analyze quality and improve yields. The discussion of statistical experimental design offers readers a powerful approach for systematically varying controllable process conditions and determining their impact on output parameters that measure quality. The authors introduce process modeling concepts, including several advanced process control topics such as run-by-run, supervisory control, and process and equipment diagnosis. Critical coverage includes the following: * Combines process control and semiconductor manufacturing * Unique treatment of system and software technology and management of overall

manufacturing systems * Chapters include case studies, sample problems, and suggested exercises * Instructor support includes electronic copies of the figures and an instructor's manual Graduate-level students and industrial practitioners will benefit from the detailed examination of how electronic materials and supplies are converted into finished integrated circuits and electronic products in a high-volume manufacturing environment. An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department. An Instructor Support FTP site is also available.

Mechanics of Machinery describes the analysis of machines, covering both the graphical and analytical methods for examining the kinematics and dynamics of mechanisms with low and high pairs. This text, developed and updated from a version published in 1973, includes analytical analysis for all topics discussed, allowing for the use of math software

The most up-to-date book available on the physics of photonic devices This new edition of Physics of Photonic Devices incorporates significant advancements in the field of photonics that have occurred since publication of the first edition (Physics of Optoelectronic Devices). New topics covered include a brief history of the invention of semiconductor lasers, the Lorentz dipole method and metal plasmas, matrix optics, surface plasma waveguides, optical ring resonators, integrated electroabsorption modulator-lasers, and solar cells. It also introduces exciting new fields of research such as: surface plasmonics and micro-ring resonators; the theory of optical gain and absorption in quantum dots and quantum wires and their applications in semiconductor lasers; and novel microcavity and photonic crystal lasers, quantum-cascade lasers, and GaN blue-green lasers within the context of advanced semiconductor lasers. Physics of Photonic Devices, Second Edition presents novel information that is not yet available in book form elsewhere. Many problem sets have been updated, the answers to which are available in an all-new Solutions Manual for instructors. Comprehensive, timely, and practical, Physics of Photonic Devices is an invaluable textbook for advanced undergraduate and graduate courses in photonics and an indispensable tool for researchers working in this rapidly growing field.

Excellent teaching and resource material . . . it is concise, coherently structured, and easy to read . . . highly recommended for students, engineers, and researchers in all related fields."

-Corrosion on the First Edition of Fundamentals of Electrochemical Deposition From computer hardware to automobiles, medical diagnostics to aerospace, electrochemical deposition plays a crucial role in an array of key industries. Fundamentals of Electrochemical Deposition, Second Edition is a comprehensive introduction to one of today's most exciting and rapidly evolving fields of practical knowledge. The most authoritative introduction to the field so far, the book presents detailed coverage of the full range of electrochemical deposition processes and technologies, including: * Metal-solution interphase * Charge transfer across an interphase * Formation of an equilibrium electrode potential * Nucleation and growth of thin films * Kinetics and mechanisms of electrodeposition * Electroless deposition * In situ characterization of deposition processes * Structure and properties of deposits * Multilayered and composite thin films * Interdiffusion in thin film * Applications in the semiconductor industry and the field of medicine This new edition updates the prior edition to address the new developments in the science and its applications, with new chapters on innovative applications of electrochemical deposition in semiconductor technology, magnetism and microelectronics, and medical instrumentation. Added coverage includes such topics as binding energy, nanoclusters, atomic force, and scanning tunneling microscopy. Example problems at the end of chapters and other features clarify and improve understanding of the material. Written by an author team with extensive experience in both industry and academe, this reference and text provides a well-rounded introduction to the field for students, as well as a means for professional chemists, engineers, and technicians to expand and sharpen their skills in using the technology.

The awaited revision of Semiconductor Devices: Physics and Technology offers more than 50% new or revised material that reflects a multitude of important discoveries and advances in device physics and integrated circuit processing. Offering a basic introduction to physical principles of modern semiconductor devices and their advanced fabrication technology, the third edition presents students with theoretical and practical aspects of every step in device characterizations and fabrication, with an emphasis on integrated circuits. Divided into three parts, this text covers the basic properties of semiconductor materials, emphasizing silicon and gallium arsenide; the physics and characteristics of semiconductor devices bipolar, unipolar special microwave and photonic devices; and the latest processing technologies, from crystal growth to lithographic pattern transfer.

The second edition examines in detail three of the most basic members of the field device family to introduce the reader to relevant terms, concepts, models, and analytical procedures.

CIRCUIT ANALYSIS: THEORY AND PRACTICE, 5E, International Edition provides a thorough, engaging introduction to the theory, design, and analysis of electrical circuits. Comprehensive without being overwhelming, this reader-friendly book combines a detailed exploration of key electrical principles with an innovative, practical approach to the tools and techniques of modern circuit analysis. Coverage includes topics such as direct and alternating current, capacitance, inductance, magnetism, simple transients, transformers, Fourier series, methods of analysis, and more. Conceptual material is supported by abundant illustrations and diagrams throughout the book, as well as hundreds of step-by-step examples, thought-provoking exercises, and hands-on activities, making it easy to master and apply even complex material. Now thoroughly updated with new and revised content, illustrations, examples, and activities, the Fifth Edition also features powerful new interactive learning resources. Nearly 200 files for use in MultiSim 11 allow you to learn in a full-featured virtual workshop, complete with switches, multimeters, oscilloscopes, signal generators, and more. Designed to provide the knowledge, skills, critical thinking ability, and hands-on experience you need to confidently analyze and optimize circuits, this proven book provides ideal preparation for career success in electricity, electronics, or engineering fields.

Quantum mechanics is widely recognized as the basic law which governs all of nature, including all materials and devices. It has always been essential to the understanding of material properties, and as devices become smaller it is also essential for studying their behavior. Nevertheless, only a small fraction of graduate engineers and materials scientists take a course giving a systematic presentation of the subject. The courses for physics students tend to focus on the fundamentals and formal background, rather than on application, and do not fill the need. This invaluable text has been designed to fill the very apparent gap. The book covers those parts of quantum theory which may be necessary for a modern engineer. It focuses on the approximations and concepts which allow estimates of the entire range of properties of nuclei, atoms, molecules, and solids, as well as the behavior of lasers and other quantum-optic devices. It may well prove useful also to graduate students in physics, whose courses on quantum theory tend not to include any of these applications. The material has been the basis of a course taught to graduate engineering students for the past four years at Stanford University. Topics Discussed: Foundations; Simple Systems; Hamiltonian Mechanics; Atoms and Nuclei; Molecules; Crystals; Transitions; Tunneling; Transition Rates; Statistical Mechanics; Transport; Noise; Energy Bands; Electron Dynamics in Solids; Vibrations in Solids; Creation and Annihilation Operators; Phonons; Photons and Lasers; Coherent States; Coulomb Effects; Cooperative Phenomena; Magnetism; Shake-off Excitations; Exercise Problems.

Fundamentals of Modern Manufacturing is a balanced and qualitative examination of the materials, methods, and procedures of both traditional and recently-developed manufacturing principles and practices. This comprehensive textbook explores a broad range of essential points of learning, from long-established manufacturing processes and materials to contemporary electronics manufacturing technologies. An emphasis on the use of mathematical models and equations in manufacturing science presents readers with quantitative coverage of key topics, while plentiful tables, graphs, illustrations, and practice problems strengthen student comprehension and retention. Now in its seventh edition, this leading textbook provides junior or senior-level engineering students in manufacturing courses with an inclusive and up-to-date treatment of the basic building blocks of modern manufacturing science. Coverage of core subject areas helps students understand the physical and mechanical properties of numerous manufacturing materials, the fundamentals of common manufacturing processes, the economic and quality control issues surrounding various processes, and recently developed and emerging manufacturing technologies. Thorough investigation of topics such as metal-casting and welding, material shaping processes, machining and cutting technology, and manufacturing systems and support helps students gain solid foundational knowledge of modern manufacturing.

This text builds a firm foundation in PN junction theory from a conceptual and mathematical viewpoint. The second edition adds a large number of end-of-chapter problems, solved exercises, and a new chapter on metal-semiconductor contacts.

Analog circuit and system design today is more essential than ever before. With the growth of digital systems, wireless communications, complex industrial and automotive systems, designers are challenged to develop sophisticated analog solutions. This comprehensive source book of circuit design solutions will aid systems designers with elegant and practical design techniques that focus on common circuit design challenges. The book's in-depth application examples provide insight into circuit design and application solutions that you can apply in today's demanding designs. Covers the fundamentals of linear/analog circuit and system design to guide engineers with their design challenges Based on the Application Notes of Linear Technology, the foremost designer of high performance analog products, readers will gain practical insights into design techniques and practice Broad range of topics, including power management tutorials, switching regulator design, linear regulator design, data conversion, signal conditioning, and high frequency/RF design Contributors include the leading lights in analog design, Robert Dobkin, Jim Williams and Carl Nelson, among others

The expanded fourth edition of the book that offers an essential introduction to laser technology and the newest developments in the field The revised and updated fourth edition of Understanding Lasers offers an essential guide and introduction that explores how lasers work, what they do, and how they are applied in the real world. The author—a Fellow of The Optical Society—reviews the key concepts of physics and optics that are essential for understanding lasers and explains how lasers operate. The book also contains information on the optical accessories used with lasers. Written in non-technical terms, the book gives an overview of the wide-variety laser types and configurations. Understanding Lasers covers fiber, solid-state, excimer, helium-neon, carbon dioxide, free-electron lasers, and more. In addition, the book also explains concepts such as the difference between laser oscillation and amplification, the importance of laser gain, and tunable lasers. The updated fourth edition highlights the most recent research and development in the field. This important resource: Includes a new chapter on fiber lasers and amplifiers Reviews new topics on physics of optical fibers and fiber lasers, disk lasers, and Ytterbium lasers Contains new sections on Laser Geometry and Implications, Diode Laser Structures, Optimal Parametric Sources, and 3D Printing and Additive Manufacturing Puts the focus on research and emerging developments in areas such as spectroscopy, slow light, laser cooling, and extremely precise measurements Contains appendices, glossary, and index that help make this book a useful reference Written for engineering and physics students, engineers, scientists, and technicians, the fourth edition of Understanding Lasers contains the basic concepts of lasers and the most recent advances in the technology.

This Solution Manual, a companion volume of the book, Fundamentals of Solid-State Electronics, provides the solutions to selected problems listed in the book. Most of the solutions are for the selected problems that had been assigned to the engineering undergraduate students who were taking an introductory device core course using this book. This Solution Manual also contains an extensive appendix which illustrates the application of the fundamentals to solutions of state-of-the-art transistor reliability problems which have been taught to advanced undergraduate and graduate students. This book is also available as a set with Fundamentals of Solid-State Electronics and Fundamentals of Solid-State Electronics — Study Guide.

Praise for the First Edition ". . . outstandingly appealing with regard to its style, contents, considerations of requirements of practice, choice of examples, and exercises." —Zentrablatt Math ". . . carefully structured with many detailed worked examples . . ." —The Mathematical Gazette ". . . an up-to-date and user-friendly account . . ." —Mathematika

An Introduction to Numerical Methods and Analysis addresses the mathematics underlying approximation and scientific computing and successfully explains where approximation methods come from, why they sometimes work (or don't work), and when to use one of the many techniques that are available. Written in a style that emphasizes readability and usefulness for the numerical methods novice, the book begins with basic, elementary material and gradually builds up to more advanced topics. A selection of concepts required for the study of computational mathematics is introduced, and simple approximations using Taylor's Theorem are also treated in some depth. The text includes exercises that run the gamut from simple hand computations, to challenging derivations and minor proofs, to programming exercises. A greater emphasis on applied exercises as well as the cause and effect associated with numerical mathematics is featured throughout the book. An Introduction to Numerical Methods and Analysis is the ideal text for students in advanced undergraduate mathematics and engineering courses who are interested in gaining an understanding of numerical methods and numerical analysis.

Focus on silicon-based semiconductors—a real-world, market-dominating issue that will appeal to people looking to apply what they are learning. Comprehensive coverage includes treatment of basic semiconductor properties, elements of Quantum Mechanics, energy band theory, equilibrium carrier statistics, recombination-generation processes, and drift/diffusion carrier transport. Practicing engineers and scientists will find this volume helpful, whether it be self-study, reference, or review.

Excellent bridge between general solid-state physics textbook and research articles packed with providing detailed explanations of the electronic, vibrational, transport, and optical properties of semiconductors "The most striking feature of the book is its modern outlook ... provides a wonderful foundation. The most wonderful feature is its efficient style of exposition ... an excellent book." Physics Today "Presents the theoretical derivations carefully and in detail and gives thorough discussions of the experimental results it

presents. This makes it an excellent textbook both for learners and for more experienced researchers wishing to check facts. I have enjoyed reading it and strongly recommend it as a text for anyone working with semiconductors ... I know of no better text ... I am sure most semiconductor physicists will find this book useful and I recommend it to them."

Contemporary Physics Offers much new material: an extensive appendix about the important and by now well-established, deep center known as the DX center, additional problems and the solutions to over fifty of the problems at the end of the various chapters.

This book provides a comprehensive introduction into photonics, from the electrodynamic and quantum mechanic fundamentals to the level of photonic components and building blocks such as lasers, amplifiers, modulators, waveguides, and detectors. The book will serve both as textbook and as a reference work for the advanced student or scientist.

Theoretical results are derived from basic principles with convenient, yet state-of-the-art mathematical tools, providing not only deeper understanding but also familiarization with formalisms used in the relevant technical literature and research articles. Among the subject matters treated are polarization optics, pulse and beam propagation, waveguides, light-matter interaction, stationary and transient behavior of lasers, semiconductor optics and lasers (including low-dimensional systems such as quantum wells), detector technology, photometry, and colorimetry. Nonlinear optics are elaborated comprehensively. The book is intended for both students of physics and electronics and scientists and engineers in fields such as laser technology, optical communications, laser materials processing, and medical laser applications who wish to gain an in-depth understanding of photonics.

Nanoscale devices differ from larger microscale devices because they depend on the physical phenomena and effects that are central to their operation. This textbook illuminates the behavior of nanoscale devices by connecting them to the electronic, as well as magnetic, optical and mechanical properties, which fundamentally affect nanoscale devices in fascinating ways. Their small size means that an understanding of the phenomena measured is even more important, as their effects are so dominant and the changes in scale of underlying energetics and response are significant. Examples of these include classical effects such as single electron effects, quantum effects such as the states accessible as well as their properties; ensemble effects ranging from consequences of the laws of numbers to changes in properties arising from different magnitudes of the interactions, and others. These interactions, with the limits on size, make their physical behavior interesting, important and useful.

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