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Handbook Of Photonics

# **The Handbook Of Photonics**

The development of integrated silicon photonic circuits has recently been driven by the

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Internet and the push for high bandwidth as well as the need to reduce power dissipation induced by high data-rate signal transmission. To reach these goals, efficient passive and active silicon photonic

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devices, including waveguide, modulators, photodetectors, Biomedical optics holds tremendous promise to deliver effective, safe, non- or minimally invasive diagnostics and targeted, customizable

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therapeutics. Handbook of Biomedical Optics provides an in-depth treatment of the field, including coverage of applications for biomedical research, diagnosis, and therapy. It introduces the

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theory and fundamental  
This tutorial explains the human eye, its function, and performance limits from the perspective of an experienced optical engineer and lens designer. It is concise and

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readable, with examples and data, and is intended for students, practicing engineers, and technology users.

Deals with the fundamental properties of photon and light beams, both experimentally and

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theoretically. It covers the essentials of linear interactions and most of the nonlinear interactions between light and matter in both the transparent and absorbing cases. About 4000 references open access to

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original literature.

A wide variety of biomedical photonic technologies have been developed recently for clinical monitoring of early disease states; molecular diagnostics and imaging of



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physiological parameters; molecular and genetic biomarkers; and detection of the presence of pathological organisms or biochemical species of clinical importance. However, available information

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on this rapidly growing field is fragmented among a variety of journals and specialized books. Now researchers and medical practitioners have an authoritative and comprehensive source for the

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latest research and applications in biomedical photonics. Over 150 leading scientists, engineers, and physicians discuss state-of-the-art instrumentation, methods, and protocols in the Biomedical

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Photonics Handbook. Editor-in-Chief Tuan Vo-Dinh and an advisory board of distinguished scientists and medical experts ensure that each of the 65 chapters represents the latest and most accurate information

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currently available.

Examining classic theories, experimental methods, and practical formulas for exploration of the core topics in nonlinear optics, the second edition of this acclaimed text

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was extensively revised to reflect recent advances in the analysis and modification of material properties for application in frequency conversion, optical switching and limiting,

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The importance of photonics in science and engineering is widely recognized and will continue to increase through the foreseeable future. In particular, applications in telecommunications, medicine,

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astronomy, industrial sensing, optical computing and signal processing continue to become more diverse. Essentials of Photonics, Second Edition describes the entire range of photonic principles and



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techniques in detail. Previously named Essentials of Optoelectronics, this newly named second edition of a bestseller reflects changes that have occurred in this field. The book presents a new approach

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that concentrates on the physical principles, demonstrating their interdependence, and developing them to explain more complex phenomena. It gives insight into the

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underlying physical processes in a way that is readable and easy to follow, as well as entirely self-contained. Written by an author with many years of experience in teaching and research, this book includes a

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detailed treatment of lasers, waveguides (including optical fibres), modulators, detectors, non-linear optics and optical signal processing. This new edition is brought up-to-date with additional sections on

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photonic crystal fibres, distributed optical-fibre sensing, and the latest developments in optical-fibre communications.

This book sets out to build bridges between the domains of

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photonic device physics and neural networks, providing a comprehensive overview of the emerging field of "neuromorphic photonics." It includes a thorough discussion of evolution of neuromorphic

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photonics from the advent of fiber-optic neurons to today's state-of-the-art integrated laser neurons, which are a current focus of international research. Neuromorphic Photonics explores candidate

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interconnection architectures and devices for integrated neuromorphic networks, along with key functionality such as learning. It is written at a level accessible to graduate students, while also intending to serve as



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frequency tunable. Among the many different types of frequency tunable lasers are: dye lasers, excimer lasers, and semiconductor lasers. This book gives active researchers and engineers the practical

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information they need to choose an appropriate tunable laser for their particular applications. Presents a unified and integrated perspective on tunable lasers Includes sources spanning the

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electromagnetic spectrum  
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Contains 182 figures and 68  
tables Provides coverage of  
optical parametric  
oscillators and tunable gas,  
liquid, solid state, and  
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The combination of laser and optoelectronics with optical fiber technology can enhance the seamless activities of fiber-optic communications and fiber-sensor arena. This book discusses foundations of laser technology, non-

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linear optics, laser and fiber-optic applications in telecommunication and sensing fields including fundamentals and recent developments in photonics technology. Accumulated chapters cover constituent



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materials, techniques of measurement of non-linear optical properties of nanomaterials, photonic crystals and pertinent applications in medical, high voltage engineering and, in optical computations

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and designing logic gates. In the 1990s, optical technology and photonics industry developed fast, but further progress became difficult due to a fundamental limit of light known as the diffraction

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limit. This limit could be overcome using the novel technology of nano-optics or nanophotonics in which the size of the electromagnetic field is decreased down to the nanoscale and is used as a carrier for signal

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transmission, processing, and fabrication. Such a decrease beyond the diffraction limit is possible by using optical near-fields. The true nature of nano-optics and nanophotonics involves not

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only their abilities to meet the above requirements but also their abilities to realize qualitative innovations in photonic devices, fabrication techniques, energy conversion and information

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processing systems. The objective of this work is to review the innovations of optical science and technology by nano-optics and nanophotonics. While in conventional optical science and technology, light and

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matter are discussed separately, in nano-optics and nanophotonics, light and matter have to be regarded as being coupled to each other, and the energy flow between nanoparticles is bidirectional. This means

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that nano-optics and nanophotonics have to be regarded as a technology fusing optical fields and matter. This unique work reviews and covers the most recent topics of nano-optics, applications to



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device operations,  
fabrication techniques,  
energy conversion,  
information processing,  
architectures and  
algorithms. Each chapter is  
written by the leading  
scientists in the relevant

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field. Thus, this work will provide high-quality scientific and technical information to scientists, engineers, and graduate students who are and will be engaged in R&D of nano-optics and nanophotonics.

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Especially, the topics to be covered by this work will be popularly used by the engineers in the rapidly growing market of the optical energy conversion.

Shaped by Quantum Theory, Technology, and the Genomics

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RevolutionThe integration of photonics, electronics, biomaterials, and nanotechnology holds great promise for the future of medicine. This topic has recently experienced an explosive growth due to the

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noninvasive or minimally invasive nature and the cost-effectiveness of photonic modalities in

Handbook of Optoelectronics offers a self-contained reference from the basic science and light sources to

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devices and modern applications across the entire spectrum of disciplines utilizing optoelectronic technologies. This second edition gives a complete update of the original work with a focus

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on systems and applications. Volume I covers the details of optoelectronic devices and techniques including semiconductor lasers, optical detectors and receivers, optical fiber devices, modulators,

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amplifiers, integrated optics, LEDs, and engineered optical materials with brand new chapters on silicon photonics, nanophotonics, and graphene optoelectronics. Volume II addresses the underlying



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system technologies enabling state-of-the-art communications, imaging, displays, sensing, data processing, energy conversion, and actuation. Volume III is brand new to this edition, focusing on

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applications in infrastructure, transport, security, surveillance, environmental monitoring, military, industrial, oil and gas, energy generation and distribution, medicine, and free space. No other

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resource in the field comes close to its breadth and depth, with contributions from leading industrial and academic institutions around the world. Whether used as a reference, research tool, or broad-based introduction to

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the field, the Handbook offers everything you need to get started. John P. Dakin, PhD, is professor (emeritus) at the Optoelectronics Research Centre, University of Southampton, UK. Robert G.

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W. Brown, PhD, is chief executive officer of the American Institute of Physics and an adjunct full professor in the Beckman Laser Institute and Medical Clinic at the University of California, Irvine.

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For years scientists turned to the CRC Handbook of Laser Science & Technology for reliable data on optical materials. Out of print for several years, that standard-setting work now has a successor: the Handbook of

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Optical Materials. This new handbook is an authoritative compilation of the physical properties of materials used in all types of lasers and optical systems. In it, scientist, author, and editor Dr. Marvin J. Weber

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provides extensive data tabulations and references for the most important optical materials, including crystals, glasses, polymers, metals, liquids, and gases. The properties detailed include both linear and



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nonlinear optical properties, mechanical properties, thermal properties together with many additional special properties, such as electro-, magneto-, and elasto-optic properties.

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particular applications. Appendices furnish a wealth of other useful information, including lists of the many abbreviations and acronyms that proliferate in this field. The Handbook of Optical Materials is simply

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the most complete one-stop source available for materials data essential to lasers and optical systems. The Handbook of Neurophotonics provides a dedicated overview of neurophotonics, covering the

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use of advanced optical technologies to record, stimulate, and control the activity of the brain, yielding new insight and advantages over conventional tools due to the adaptability and non-

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invasive nature of light. Including 32 colour figures, this book addresses functional studies of neurovascular signaling, metabolism, electrical excitation, and hemodynamics, as well as

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clinical applications for imaging and manipulating brain structure and function. The unifying theme throughout is not only to highlight the technology, but to show how these novel methods are becoming

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critical to breakthroughs that will lead to advances in our ability to manage and treat human diseases of the brain. Key Features: Provides the first dedicated book on state-of-the-art optical techniques for



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sensing and imaging across at the cellular, molecular, network, and whole brain levels. Highlights how the methods are used for measurement, control, and tracking of molecular events in live neuronal cells, both

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in basic research and clinical practice. Covers the entire spectrum of approaches, from optogenetics to functional methods, photostimulation, optical dissection, multiscale imaging,

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microscopy, and structural imaging. Includes chapters that show use of voltage-sensitive dye imaging, hemodynamic imaging, multiphoton imaging, temporal multiplexing, multiplane microscopy,

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optoacoustic imaging, near-infrared spectroscopy, and miniature neuroimaging devices to track cortical brain activity.

Optoelectronic devices are now ubiquitous in our daily lives, from light emitting

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diodes (LEDs) in many household appliances to solar cells for energy. This handbook shows how we can probe the underlying and highly complex physical processes using modern mathematical models and

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numerical simulation for optoelectronic device design, analysis, and performance optimization. It reflects the wide availability of powerful computers and advanced commercial software, which

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have opened the door for non-specialists to perform sophisticated modeling and simulation tasks. The chapters comprise the know-how of more than a hundred experts from all over the world. The handbook is an

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from local to global scales, using a uniquely visual approach to take students on a journey from the top layers of the Earth's atmosphere to the rocks underlying the ocean basins to the forests of the farthest continents. As students explore the

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critical topics of physical geography, their study of the climate, surface features, and habitats around the world uses basic concepts of ecology, geology, chemistry, environmental science, biology, and physics and many

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and interpret what they see in a meaningful, accurate and exciting way. The content, design and layout of the text takes advantage of the full capacity in which students process information □ visual as well as verbal. Visualizing

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continues to offer ongoing study tips and psychological techniques for mastering the material. Most importantly students are provided with numerous opportunities to immediately access their understanding.

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Microwave photonics and information optics provide high bandwidth and precision along with ultrafast speed at a low cost. In order to reduce noise at the communication trans-receivers, scattering in the devices needs to

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be decreased, which can be achieved by replacing optoelectronic devices with photonic devices because in the latter only photons propagate electromagnetic waves.

Contemporary Developments in

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metamaterials, optoelectronic devices, and plasmonics, this book is excellent for students, researchers, engineers, and professionals.

Optofluidics is an emerging field that involves the use of fluids to

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modify optical properties and the use of optical devices to detect flowing media. Ultimately, its value is highly dependent on the successful integration of photonic integrated circuits with microfluidic or nanofluidic systems. Handbook

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of Optofluidics provides a snapshot of the s

An optical cavity confines light within its structure and constitutes an integral part of a laser device.

Unlike traditional gas lasers, semiconductor lasers are invariably

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much smaller in dimensions, making optical confinement more critical than ever. In this book, modern methods that control and manipulate light at the micrometer and nanometer scales by using a variety of cavity geometries and



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demonstrate optical resonance from ultra-violet (UV) to infra-red (IR) bands across multiple material platforms are explored. The book has a comprehensive collection of chapters that cover a wide range of topics pertaining to resonance in

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optical cavities and are contributed by leading researchers in the field. The topics include theory, design, simulation, fabrication, and characterization of micrometer- and nanometer-scale structures and devices that support cavity

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resonance via various mechanisms such as Fabry-Pérot, whispering gallery, photonic bandgap, and plasmonic modes. The chapters discuss optical cavities that resonate from UV to IR wavelengths and are based on

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This handbook--a sequel to the widely used Handbook of Optical Constants of Solids--contains critical reviews and tabulated

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values of indexes of refraction ( $n$ ) and extinction coefficients ( $k$ ) for almost 50 materials that were not covered in the original handbook. For each material, the best known  $n$  and  $k$  values have been carefully tabulated, from the x-ray to

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millimeter-wave region of the spectrum by expert optical scientists. In addition, the handbook features thirteen introductory chapters that discuss the determination of  $n$  and  $k$  by various techniques. \* Contributors have

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decided the best values for  $n$  and  $k$

- \* References in each critique allow the reader to go back to the original data to examine and understand where the values have come from \*
- Allows the reader to determine if any data in a spectral region needs

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to be filled in \* Gives a wide and detailed view of experimental techniques for measuring the optical constants  $n$  and  $k$  \* Incorporates and describes crystal structure, space-group symmetry, unit-cell dimensions, number of



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optic and acoustic modes, frequencies of optic modes, the irreducible representation, band gap, plasma frequency, and static dielectric constant

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achievements in diffractive optics, focusing on the creation of new nanophotonic components and devices, as well as instrumentation and available information technology. The author describes methods of calculation of diffractive

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optical elements to solve actual problems of nanophotonics. Coverage includes mathematical methods for calculation of diffraction gratings, calculation of modes of inhomogeneous waveguides, integral methods of

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calculation of electromagnetic field near the focus, and methods of calculation of diffractive optical elements generating vortex laser beams.

Reflecting changes in the field in the ten years since the publication

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their combined knowledge and the continued contributions of world-class researchers. New in the Second Edition: Information on optical fiber technology and the economic impact of photonics  
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in nanotechnology Sections on optical amplifiers, and polymeric optical materials The book covers photonics materials, devices, and systems, respectively. An introductory chapter, new to this edition, provides an overview of

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research and training in this field, making it the reference of first resort.

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and nanotechnology holds great promise for the future of medicine. This topic has recently experienced an explosive growth due to the noninvasive or minimally invasive nature and the cost-effectiveness of photonic modalities in medical

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diagnostics and therapy. The second edition of the Biomedical Photonics Handbook presents recent fundamental developments as well as important applications of biomedical photonics of interest to scientists, engineers,

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variety of photonic biochemical sensing technologies has already been developed for clinical monitoring of physiological parameters, such as blood pressure, blood chemistry, pH, temperature, and the presence of

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pathological organisms or biochemical species of clinical importance. Advanced photonic detection technologies integrating the latest knowledge of genomics, proteomics, and metabolomics allow sensing of early disease



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states, thus revolutionizing the medicine of the future.

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Biophotonics, this second edition contains eight sections, and provides introductory material in each chapter. It also includes an overview of the topic, an extensive collection of spectroscopic data, and lists of references for further

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In recent years, photonics has found increasing applications in such areas as communications, signal processing, computing, sensing, display, printing, and energy transport. Now,

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Fundamentals of Photonics is the first self-contained introductory-level textbook to offer a thorough survey of this rapidly expanding area of engineering and applied physics. Featuring a logical

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blend of theory and applications, coverage includes detailed accounts of the primary theories of light, including ray optics, wave optics, electromagnetic optics, and photon optics, as well as

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the interaction of light with matter, and the theory of semiconductor materials and their optical properties. Presented at increasing levels of complexity, these sections serve as building blocks for the

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treatment of more advanced topics, such as Fourier optics and holography, guidedwave and fiber optics, photon sources and detectors, electro-optic and acousto-optic devices, nonlinear optical

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devices, fiber-optic communications, and photonic switching and computing. Included are such vital topics as: Generation of coherent light by lasers, and incoherent light by luminescence sources

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such as light-emitting diodes  
Transmission of light through  
optical components (lenses,  
apertures, and imaging  
systems), waveguides, and  
fibers Modulation, switching,  
and scanning of light through

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the use of electrically, acoustically, and optically controlled devices

Amplification and frequency conversion of light by the use of wave interactions in nonlinear materials Detection



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of light by means of semiconductor photodetectors. Each chapter contains summaries, highlighted equations, problem sets and exercises, and selected reading lists. Examples of real systems

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are included to emphasize the concepts governing applications of current interest, and appendices summarize the properties of one- and two-dimensional Fourier transforms, linear-systems

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includes practical applications used as examples, details of experimental techniques, useful tables that summarize equations, and, most importantly, properties of various materials, as well as an

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extensive glossary. Along with significant updates to the content and the references, the second edition includes a number of new chapters such as those covering novel materials and selected



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applications. This handbook is a valuable resource for graduate students, researchers and practicing professionals working in the area of electronic, optoelectronic and photonic materials.

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relationships, and most promising applications of organic materials. This new release includes new content on emerging organic materials, expanded content on the basic physics behind electronic

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conversion efficiencies have made dramatic advances since the first edition, this latest release presents a necessary understanding of the underlying physics that enabled novel material design

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devices New content to reflect latest advances in our understanding of underlying physics to enable material design and device fabrication Nanophotonics has emerged rapidly into technological



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mainstream with the advent and maturity of nanotechnology available in photonics and enabled many new exciting applications in the area of biomedical science and engineering that were

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unimagined even a few years ago with conventional photonic engineering techniques.

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information on nanophotonics that can inspire readers by detailing emerging and established possibilities of nanophotonics in biomedical science and engineering applications. This

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comprehensive reference presents not only the basics of nanophotonics but also explores recent experimental and clinical methods used in biomedical and bioengineering research. Each peer-reviewed

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chapter of this book discusses fundamental aspects and materials/fabrication issues of nanophotonics, as well as applications in interfaces, cell, tissue, animal studies, and clinical engineering. The

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engineering, and medical and healthcare industry will find this essential reference book highly useful.

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everything they need to begin creating foundry-ready designs.

In recent decades, there has been a phenomenal growth in the field of photonic crystal research and has emerged as



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an interdisciplinary area. Photonic crystals are usually nanostructured electromagnetic media consisting of periodic variation of dielectric constant, which prohibit certain

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electromagnetic wave frequency ranges called photonic bandgaps to propagate through them. Photonic crystals elicited numerous interesting features by unprecedented control of

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light and their exploitation is a promising tool in nanophotonics and designing optical components. The book 'Advances in Photonic Crystals and Devices' is designed with 15 chapters with introductory

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as well as research and application based contents. It covers the following highlighted features: Basics of photonic crystals and photonic crystal fibers Different theoretical as well as

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experimental approaches  
Current research advances  
from around the globe  
Nonlinear optics and super-  
continuum generation in  
photonic crystal fibers  
Magnetized cold plasma

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photonic crystals Liquid crystal defect embedded with graphene layers Biophysics and biomedical applications as optical sensors Two-dimensional photonic crystal demultiplexer Optical logic

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gates using photonic crystals A large number of references The goal of this book is to draw the background in understanding, fabrication and characterization of photonic crystals using a variety of

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materials and their applications in design of several optical devices. Though the book is useful as a reference for the researchers working in the area of photonics, optical computing and fabrication of



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nanophotonic devices, it is intended for the beginners like students pursuing their masters' degree in photonics. Photonics, a volume in the Interface Transmission Tutorial Book series, describes the

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science of photonic transmission properties of the interfaces of composite materials systems and devices. The book's authors review the general analysis methods of interface transmission, give

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many examples, and apply these methods to photonic applications. Applications discussed include photonic crystals, materials, devices and circuits. Offers a unique approach on photonics from

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the interfacial transmission point-of-view Reviews the interface transmission properties of composite materials for photonics applications Authored by world-leading experts on interface

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transmission

Since the first edition of this book was published in 1997, the photonics landscape has evolved considerably and so has the role of distributed feedback (DFB) laser diodes.

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Although tunable laser diodes continue to be introduced in advanced optical communication systems, DFB laser diodes are still widely applied in many deployed systems. This also includes

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wavelength tunable DFB laser diodes and DFB laser diode arrays, usually integrated with intensity or phase modulators and semiconductor optical amplifiers. This valuable resource gives professionals a

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comprehensive description of the different effects that determine the behavior of a DFB laser diode. Special attention is given to two new chapters on wavelength tunable DFB laser diodes and



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bistable and unstable DFB laser diodes. Among many other updates throughout the reference, semi-conductor and electromagnetic professionals are also provided two new appendices. This book fully

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covers the underlying theory, commercial applications, necessary design criteria, and future direction of this technology.

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communications systems. One of the prime candidates to provide satisfactory performance at low cost in the photonic circuit is silicon. Whilst silicon photonics is less well developed as compared to

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some other material technologies, it is poised to make a serious impact on the telecommunications industry, as well as in many other applications, as other technologies fail to meet the yield/performance/cost

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trade-offs. Following a sympathetic tutorial approach, this first book on silicon photonics provides a comprehensive overview of the technology. Silicon Photonics explains the concepts of the technology,



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communications and semiconductor industries. This book is also an invaluable reference and a potential main text to senior undergraduates and postgraduate students studying fibre optics,

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integrated optics, or optical network technology. The self-assembled nanostructured materials described in this book offer a number of advantages over conventional material technologies in a wide range

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of sectors. World leaders in the field of self-organisation of nanostructures review the current status of research and development in the field, and give an account of the formation,

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properties, and self-organisation of semiconductor nanostructures. Chapters on structural, electronic and optical properties, and devices based on self-organised nanostructures are

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will provide an excellent starting point for workers entering the field and a useful reference to the nanostructured materials research community. It will be useful to any scientist who is involved in

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nanotechnology and those wishing to gain a view of what is possible with modern fabrication technology.

Mohamed Henini is a Professor of Applied Physics at the University of Nottingham. He has authored

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and co-authored over 750 papers in international journals and conference proceedings and is the founder of two international conferences. He is the Editor-in-Chief of Microelectronics Journal and

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on the interaction of coherent, polarized, and acoustically modulated radiation with tissues and cells. It covers modalities of nonlinear spectroscopic microscopies, photonic technologies for therapy and

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modeling of semiconductor nanostructures in the optical regime, with a focus on nonlinear effects. The visible range as well as near and far infrared spectral region will be considered with a view to

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nanophotonics, including fabrication, characterization and modeling of semiconductor nanostructures in the optical regime, with a focus on nonlinear effects • Describes the research



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thorough and complete overview of the current state of the art in the field of semiconductor nonlinear nanophotonics

Costantino De Angelis has been full professor of electromagnetic fields at

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the University of Brescia since 1998. He is an OSA Fellow and has been responsible for several university research contracts in the last 20 years within Europe, the United States, and Italy.

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His technical interests are in optical antennas and nanophotonics. He is the author of over 150 peer-reviewed scientific journal articles. Giuseppe Leo has been a full professor in physics at Paris Diderot

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University since 2004, and in charge of the nonlinear devices group of MPQ Laboratory since 2006. His research areas include nonlinear optics, micro- and nano-photonics, and optoelectronics, with a

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focus on AlGaAs platform. He has coordinated several research programs and coauthored 100 peer-reviewed journal articles, 200 conference papers, 10 book chapters and also has four patents. Dragomir Neshev is

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a professor in physics and the leader of the experimental photonics group in the Nonlinear Physics Centre at Australian National University (ANU). His activities span over several branches of optics,



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including nonlinear periodic structures, singular optics, plasmonics, and photonic metamaterials. He has coauthored 200 publications in international peer-reviewed scientific journals.

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Since it was first published in 1995, Photonic Crystals has remained the definitive text for both undergraduates and researchers on photonic band-gap materials and their use in controlling the propagation of light. This

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newly expanded and revised edition covers the latest developments in the field, providing the most up-to-date, concise, and comprehensive book available on these novel materials and their applications. Starting

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from Maxwell's equations and Fourier analysis, the authors develop the theoretical tools of photonics using principles of linear algebra and symmetry, emphasizing analogies with traditional

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