Comsol Optical Wave Simulation

This textbook offers the first unified treatment of wave propagation in electronic and electromagnetic systems and introduces readers to the essentials of the transfer matrix method, a powerful analytical tool that can be used to model and study an array of problems pertaining to wave propagation in electrons and photons. It is aimed at graduate and advanced undergraduate students in physics, materials science, electrical and computer engineering, and mathematics, and is ideal for researchers in photonic crystals, negative index materials, left-handed materials, plasmonics, nonlinear effects, and optics. Peter Markos and Costas Soukoulis begin by establishing the analogy between wave propagation in electronic systems and electromagnetic media and then show how the transfer matrix can be easily applied to any type of wave propagation, such as electromagnetic, acoustic, and elastic waves. The transfer matrix approach of the tight-binding model allows readers to understand its implementation quickly and all the concepts of solid-state physics are clearly introduced. Markos and Soukoulis then build the discussion of such topics as random systems and localized and delocalized modes around the transfer matrix, bringing remarkable clarity to the subject. Total internal reflection, Brewster angles, evanescent waves, surface waves, and resonant tunneling in left-handed materials are introduced and treated in detail, as are important new developments like photonic crystals, negative index materials, and surface plasmons. Problem sets aid students working through the subject for the first time.
This proceedings volume presents selected and peer reviewed 50 reports of the 2015 International Conference on "Physics and Mechanics of New Materials and Their Applications" (Azov, Russia, 19-22 May, 2015), devoted to 100th Anniversary of the Southern Federal University, Russia. The book presents processing techniques, physics, mechanics, and applications of advanced materials. The book is concentrated on some nanostructures, ferroelectric crystals, materials and composites and other materials with specific properties. In this book are presented nanotechnology approaches, modern piezoelectric techniques, physical and mechanical studies of the structure-sensitive properties of the materials. A wide spectrum of mathematical and numerical methods is applied to the solution of different technological, mechanical and physical problems for applications. Great attention is devoted to novel devices with high accuracy, longevity and extended possibilities to work in a large scale of temperatures and pressure ranges, aggressive media, etc. The characteristics of materials and composites with improved properties is shown, and new possibilities in studying of various physico-mechanical processes and phenomena are demonstrated.
Suitable for advanced undergraduate and graduate students of engineering, physics, and mathematics and scientific researchers of all types, this is the first authoritative text on invisibility and the science behind it. More than 100 full-color illustrations, plus exercises with solutions. 2010 edition.
Devised at the beginning of the 20th century by french physicists Charles Fabry and Alfred Perot, the Fabry-Perot optical cavity is perhaps the most deceptively simple setup in optics, and today a key resource in many areas of science and technology. This thesis delves deeply into the applications of optical cavities in a variety of contexts: from LIGO's 4-km-long interferometer arms that are allowing us to observe the universe in a new way by measuring gravitational waves, to the atomic clocks used to realise time with unprecedented accuracy which will soon lead to a redefinition of the second, and the matterwave interferometers that are enabling us to test and measure gravity in a new scale. The work presented accounts for the elegance and versatility of this setup, which today underpins much of the progress in the frontier of atomic and gravitational experimental physics.
Infrared Fiber Optics
A First Principles Approach
An Introduction to Fiber Optics
Advances in Optical Fiber Technology
Fundamental Optical Design
Progress in Optomechatronic Technologies

Local electromagnetic field fluctuations and related enhancement of nonlinear phenomena in metal-dielectric composi near the percolation threshold (percolation composites) have recently become an area of active study, because of t many fundamental problems involved and the high potential for various applications. It has been recognized recently local field fluctuations can be especially large in the optical and infrared spectral ranges due to the surface plasmon resonance in metallic granules and their clusters. The strong fluctuations of the local electric and magnetic fields re the enhancement of various optical effects: anomalous absorption, Rayleigh and Raman scattering, generation of the higher harmonic, Kerr nonlinearity, etc. Nonlinear percolation composites are potentially of great practical importanc media with intensity-dependent dielectric functions and, in particular, as nonlinear filters and optical bistable elemen The optical response of nonlinear composites can be tuned, for example, by controlling the volume fraction and

morphology of constituents. This book presents a new theory of electromagnetic field distribution and nonlinear op processes in metal-dielectric composites. The new approach is based on a percolation theory and the fact that the problem of optical excitations in percolation composites mathematically maps the Anderson transition problem in quantum mechanics. The theory predicts localization of the excitations (surface plasmons) in percolation composite describes in detail the localization pattern that allows one to obtain relatively simple expressions for the enhancem linear and nonlinear optical responses. Thistheory is supported by recent near-field experiments where the surface plasmon localization has been directly observed in the percolating composites in optical and microwave bands.

This book is the culmination of twenty-five years of teaching Geometrical Optics. The volume is organised such tha single spherical refracting surface is the basic optical element. Spherical mirrors are treated as special cases of refraction, with the same applicable equations. Thin lens equations follow as combinations of spherical refracting surfaces while the cardinal points of the thick lens make it equivalent to a thin lens. Ultimately, one set of vergenc equations are applicable to all these elements.The chapters are devoted to in-depth treatments of stops, pupils and magnifiers, microscopes, telescopes, and camera lenses; ophthalmic instruments; resolving power and MTF; trigonometric ray tracing; and chromatic and monochromatic aberrations. There are over 100 worked examples, 40 homework problems and 400 illustrations.First published in 1994 by Penumbra Publishing Co.

"Coverage of each topic includes examples and problems, all of which are original and derived from realistic applicat such as optical configuration for automatic inspection in industry, surveying systems, robot navigation, X-ray imagi computerized radiography, microscopy vision and measurements, laser Doppler technique and flow study, non-conta measurement of temperature, acousto-optical scanners, spectral analysis, and more."--BOOK JACKET.

For decades, the surface-plasmon-polariton wave guided by the interface of simple isotropic materials dominated t scene. However, in recent times research on electromagnetic surface waves guided by planar interfaces has expand into new and exciting areas. In the 1990's research focused on advancing knowledge of the newly discovered Dyak wave. More recently, much of the surface wave research is motivated by the proliferation of nanotechnology and t growing number of materials available with novel properties. This book leads the reader from the relatively simple s plasmon-polariton wave with isotropic materials to the latest research on various types of electromagnetic surface guided by the interfaces of complex materials enabled by recent developments in nanotechnology. This includes: Dyakonov waves guided by interfaces formed with columnar thin films, Dyakonov-Tamm waves guided by interfaces formed with sculptured thin films, and multiple modes of surface-plasmon-polariton waves guided by the interface metal and a periodically varying dielectric material. Gathers research from the past 5 years in a single comprehensiv view of electromagnetic surface waves. Written by the foremost experts and researchers in the field. Layered presentation explains topics with an introductory overview level up to a highly technical level.

Fundamental Optical Phenomena and Applications
Optical And Microwave Technologies
A Modern Perspective
A Graphical Instructional Guide
Electromagnetic Surface Waves
Biomedical Optical Sensors

Reviews the fundamental concepts behind the theory and computation of electromagnetic fields The book is divided in two parts. The first part covers both fundamental theories (such as vector analysis, Maxwell's equations, boundary condition, and transmission line theory) and advanced topics (such as wave transformation, addition theorems, and fields in layered media) in order to benefit students at all levels. The second part of the book covers the major computational methods for numerical analysis of electromagnetic fields for engineering applications. These methods include the three fundamental approaches for numerical analysis of electromagnetic fields: the finite difference method (the finite difference time-domain method in particular), the finite element method, and the integral equation-based moment method. The second part also examines fast algorithms for solving integral equations and hybrid techniques that combine different numerical methods to seek more efficient solutions of complicated electromagnetic problems. Theory and Computation of Electromagnetic Fields, Second Edition: Provides the foundation necessary for graduate students to learn and understand more advanced topics Discusses electromagnetic analysis in rectangular, cylindrical and spherical coordinates Covers computational electromagnetics in both frequency and time domains Includes new and updated homework problems and examples Theory and Computation of Electromagnetic Fields, Second Edition is written for advanced undergraduate and graduate level electrical engineering students. This book can also be used as a reference for professional engineers interested in learning about analysis and computation skills.

The optical filter is resonator based. The required passband shape of ring resonator-filters can be custom designed by the use of configurations of various ring coupled resonators. This book describes the current state-of-the-art on these devices. It provides an in-depth knowledge of the simulation, fabrication and characterization of ring resonators for use as example filters, lasers, sensors.

Nonlinear Optical Crystals contains the most complete and up-to-date reference material

on properties of nonlinear optical crystals including: Traditional and specific applications The mathematical formulas necessary for the calculation of the frequency conversion process A survey of 63 nonlinear optical crystals containing more than 1500 different references with full titles Recent applications of common and novel nonlinear materials, including quasi-phase matching Special consideration for periodically-poled and self-frequency-doubling materials Significant amount of crystallophysical, thermophysical, spectroscopic, electro-optic and magneto-optic information

This book gathers a collection of papers by international experts presented at the International Conference on NextGen Electronic Technologies (ICNETS2-2016). ICNETS2 encompasses six symposia covering all aspects of the electronics and communications domains, including relevant nano/micro materials and devices. Highlighting the latest research on Optical And Microwave Technologies, the book will benefit all researchers, professionals, and students working in the core areas of electronics and their applications, especially in signal processing, embedded systems, and networking.

Theory and Computation of Electromagnetic Fields

From Electrons to Photonic Crystals and Left-Handed Materials

Advanced Materials

Select Proceedings of ICNETS2, Volume IV

Multiphysics Modeling Using COMSOL?

Optical Waveguides and Devices Modeling and Visualization Using COMSOL Multiphysics Volume 1

This book gathers high-quality papers presented at the International Symposium on Optomechatronic Technology (ISOT 2018), which was organized by the International Society for Optomechatronics (ISOM) and Centro de Investigaciones en Óptica (CIO) in Cancun, Mexico on November 5–8, 2018. The respective papers address the evolution of optomechatronic devices and systems, and their implementation in problem-solving and various other applications. Moreover, they cover a broad range of topics at the interface of optical, mechanical and electrical technologies and methods.

Multiphysics Modeling Using COMSOL® rapidly introduces the senior level undergraduate, graduate or professional scientist or engineer to the art and science of computerized modeling for physical systems and devices. It offers a step-by-step modeling methodology through examples that are linked to the Fundamental Laws of Physics through a First Principles Analysis approach. The text explores a breadth of multiphysics models in coordinate systems that range from 1D to 3D and introduces the readers to the numerical analysis modeling techniques employed in the COMSOL® Multiphysics® software. After readers have built and run the examples, they will have a much firmer understanding of the concepts, skills, and benefits acquired from the use of computerized modeling techniques to solve their current technological problems and to explore new areas of application for their particular technological areas of interest.

Teaching Electromagnetics: Innovative Approaches and Pedagogical Strategies is a guide for educators addressing course content and pedagogical methods primarily at the undergraduate level in electromagnetic theory and its applications. Topics include teaching methods, lab experiences and hands-on learning, and course structures that help teachers respond effectively to trends in learning styles and evolving engineering curricula. The book grapples with issues related to the recent worldwide shift to remote teaching. Each chapter begins with a high-level consideration of the topic, reviews previous work and publications, and gives the reader a broad picture of the topic before delving into details. Chapters include specific guidance for those who want to implement the methods and assessment results and evaluation of the effectiveness of the methods. Respecting the limited time available to the average teacher to try new methods, the chapters focus on why an instructor should adopt the methods proposed in it. Topics include virtual laboratories, computer-assisted learning, and MATLAB® tools. The authors also review flipped classrooms and online teaching methods that support remote teaching and learning. The end result should be an impact on the reader represented by improvements to his or her practical teaching methods and curricular approach to electromagnetics education. The book is intended for electrical engineering professors, students, lab instructors, and practicing engineers with an interest in teaching and learning. In summary, this book: Surveys methods and tools for teaching the foundations of wireless communications and electromagnetic theory Presents practical experience and best practices for topical coverage, course sequencing, and content Covers virtual laboratories, computer-assisted learning, and MATLAB tools Reviews flipped classroom and online teaching methods that support remote teaching and learning Helps instructors in RF systems, field theory, and wireless communications bring their teaching practice up to date Dr. Krishnasamy T. Selvan is Professor in the Department of Electronics & Communication Engineering, SSN College of Engineering, since June 2012. Dr. Karl F. Warnick is Professor in the Department of Electrical and Computer Engineering at BYU.

In the past 10 years, there have been many developments in the field of infrared transmitting fiber optics. This is highlighted by the many different fiber compositions that have been studied around the world for numerous practical applications. This book reviews different fiber systems, describing material properties, techniques used to prepare the fibers and fiber properties with particular emphasis on optical properties. These fibers possess unique optical, mechanical, and physical properties, enabling many technologies. Examples of applications are described within given chapters, allowing an engineer or scientist to choose the most appropriate fiber for a desired application. The introduction gives the reader an overview of transmission theory so that the basic concepts are clearly understood by someone new to the field. The next several chapters describe the different types of infrared transmitting fibers, including glass fibers such as those based on silica, fluoride, and chalcogenide glasses; the crystalline fibers based on single or polycrystalline materials; and hollow waveguides. The commercial chemical sensing applications of some of these new fibers are described. The final chapter summarizes the properties of the fibers and highlights future prospects.

Hyperspectral Imaging for Food Quality Analysis and Control

The Science of Invisibility

Applied and Computational Complex Analysis, Volume 3

Proceedings of International Symposium on Optomechatronic (2018)

Molding the Flow of Light - Second Edition

The contributions in this volume were presented at a NATO Advanced Study Institute held in Erice, Italy, 4-19 July 2013. Many aspects of important research into nanophotonics, plasmonics, semiconductor materials and devices, instrumentation for bio sensing to name just a few, are covered in depth in this volume. The growing connection between optics and electronics, due to the increasing important role plaid by semiconductor materials and devices, find their expression in the term photonics, which also reflects the importance of the photon aspect of light in the description of the performance of several optical systems. Nano-structures have unique capabilities that allow the enhanced performance of processes of interest in optical and photonic devices. In particular these structures permit the nanoscale manipulation of photons, electrons and atoms; they represent a very hot topic of research and are relevant to many devices and applications. The various subjects bridge over the disciplines of physics, biology and chemistry, making this volume of interest to people working in these fields. The emphasis is on the principles behind each technique and on examining the full potential of each technique.

This pictorial manuscript is a step-by-step graphical illustrations for waveguides and devices modeling and computational physics simulation using COMSOL Multiphysics with Ray Optics, Wave Optics and AC/DC Electrostatics modules. All the example models investigated and visualized with the help of Finite Element Analysis are referenced from the standard USA undergraduate text on Optical Guided Waves and Devices by Richard Syms and John Cozens. The simulations include the use of geometrical ray tracings for point source and full electromagnetic waves source employing the Maxwell's wave equations for plane wave input. Both 2D and 3D simulation results will help in visualize the electromagnetic field propagating inside the waveguides and devices. Readers without fundamental handle on optics modeling are suggested to read the Optics Modeling and Visualization with COMSOL Multiphysics: A step by step graphical instruction manuscripts for detailed discussion. These models may be expanded to post-graduate research and industrial photonics waveguides and devices development. There are 46 chapters of different 2D and 3D optical waveguides & devices structures modeled and simulated in Volume 1 and 2. Volume 1 models include 3D single mode optical fiber, planar waveguide, channel waveguide, longitudinal and transverse phase modulator, surface plasmon, optical square waveguide, tapered waveguide, FTIR beamsplitter in ray tracing and electromagnetic wave solvers, full prism coupler, halved prism coupler, plano convex overlay lens, overlay Luneburg lens, geodesic lens with control setup for resulted electric field comparison, corrugated gratings, transmission and reflection gratings, chirped grating lens, beam expander grating, grating coupler, chirped grating coupler, buried channel waveguide. Volume 2 models continue with the ridge channel waveguide, strip loaded channel waveguide, GaAs GaAlAs planar waveguide, GaAs GaAlAs heterostructure waveguide, radiation leaks at fiber bend, radiation leaks at waveguide bend, c-axis Calcite polarizer waveguide, integrated optic normal reflector, horn channel waveguide, Y-Junction waveguide, optical phase modulator, cut off modulator, electro optic Mach-Zehnder interferometer waveguide, parallel coupling waveguide, electro optic directional coupler, single polished fiber directional coupler, double polished fiber directional coupler, tunable-coupling strength of polished double fiber coupler, cross sectional coaxial fiber coupler, 2D directional coupler with tapered coupling, corrugated reflection gratings, optical fiber grating on half polished fiber coupler, and track-changing reflector with grating assisted-coupling fiber.

From the beginning Integrated Photonics introduces numerical techniques for studying non-analytic structures. Most chapters have numerical problems designed for solution using a computational program such as Matlab or Mathematica. An entire chapter is devoted to one of the numeric simulation techniques being used in optoelectronic design (the Beam Propagation Method), and provides opportunity for students to explore some novel optical structures without too much effort. Small pieces of code are supplied where appropriate to get the reader started on the numeric work. Integrated Photonics is designed for the senior/first year graduate student, and requires a basic familiarity with electromagnetic waves, and the ability to solve differential equations with boundary conditions.

This book provides the reader with a solid understanding of the fundamental modeling of photovoltaic devices. After the material independent limit of photovoltaic conversion, the readers are introduced to the most well-known theory of "classical" silicon modeling. Based on this, for each of the most important PV materials, their performance under different conditions is modeled. This book also covers different modeling approaches, from very fundamental theoretic investigations to applied numeric simulations based on experimental values. The book concludes wth a chapter on the influence of spectral variations. The information is supported by providing the names of simulation software and basic literature to the field. The information in the book gives the user specific application with a solid background in hand, to judge which materials could be appropriate as well as realistic expectations of the performance the devices could achieve.

Photonic Waveguides
Electrodynamics of Metamaterials
Manufacturing, Physics, Mechanics and Applications
The Finite Element Method in Electromagnetics
Optical Strategies for Enhancing Sensing, Imaging, Communication and Energy Conversion
Photovoltaic Modeling Handbook

Textbook on the physical principles of optical fibers - for advanced undergraduates and graduates in physics or electrical engineering.
A comprehensive manual on the efficient modeling and analysis of photonic devices through building numerical codes, this book provides graduate

students and researchers with the theoretical background and MATLAB programs necessary for them to start their own numerical experiments. Beginning by summarizing topics in optics and electromagnetism, the book discusses optical planar waveguides, linear optical fiber, the propagation of linear pulses, laser diodes, optical amplifiers, optical receivers, finite-difference time-domain method, beam propagation method and some wavelength division devices, solitons, solar cells and metamaterials. Assuming only a basic knowledge of physics and numerical methods, the book is ideal for engineers, physicists and practising scientists. It concentrates on the operating principles of optical devices, as well as the models and numerical methods used to describe them. This book introduces fundamental principles as well as applications of metasurfaces, i.e. electromagnetically thin structures manipulating EM wave propagation. The authors describe the precursors and history of metasurfaces before moving on to explore the physical insights that can be gained from the material parameters of the metasurface. They also present how to compute the fields scattered by a metasurface, with known material parameters, being illuminated by an arbitrary incident field, as well as how to realize a practical metasurface and relate it its material parameters to physical structures.The book finishes with a discussion of the future of the field.
A new edition of the leading textbook on the finite element method, incorporating major advancements and further applications in the field of electromagnetics The finite element method (FEM) is a powerful simulation technique used to solve boundary-value problems in a variety of engineering circumstances. It has been widely used for analysis of electromagnetic fields in antennas, radar scattering, RF and microwave engineering, high-speed/high-frequency circuits, wireless communication, electromagnetic compatibility, photonics, remote sensing, biomedical engineering, and space exploration. The Finite Element Method in Electromagnetics, Third Edition explains the method's processes and techniques in careful, meticulous prose and covers not only essential finite element method theory, but also its latest developments and applications—giving engineers a methodical way to quickly master this very powerful numerical technique for solving practical, often complicated, electromagnetic problems. Featuring over thirty percent new material, the third edition of this essential and comprehensive text now includes: A wider range of applications, including antennas, phased arrays, electric machines, high-frequency circuits, and crystal photonics The finite element analysis of wave propagation, scattering, and radiation in periodic structures The time-domain finite element method for analysis of wideband antennas and transient electromagnetic phenomena Novel domain decomposition techniques for parallel computation and efficient simulation of large-scale problems, such as phased-array antennas and photonic crystals Along with a great many examples, The Finite Element Method in Electromagnetics is an ideal book for engineering students as well as for professionals in the field.
Practical Optics
Nonlinear Optical Crystals: A Complete Survey
Wave Propagation
Teaching Electromagnetics
A Step by Step Graphical Instruction Manuscripts
Schott Guide to Glass

With contributed papers from the 2011 Materials Science & Technology symposia, this is a useful one-stop resource for understanding the most important issues in the advances and applications of electroceramics. Logically organized and carefully selected, the articles cover the themes of the symposia: Magnetoelectric Multiferroic Thin Films and Multilayers; Dielectric Ceramic Materials and Electronic Devices; and Multifunctional Oxide. An essential reference for government labs and academics in mechanical and chemical engineering, materials and or ceramics, and chemistry.

This book is a compilation of works presenting recent developments and practical applications in optical fiber technology. It contains 13 chapters from various institutions that represent global research in various topics such as scattering, dispersion, polarization interference, fuse phenomena and optical manipulation, optical fiber laser and sensor applications, passive optical network (PON) and plastic optical fiber (POF) technology. It provides the reader with a broad overview and sampling of the innovative research on optical fiber technologies.

Recently, the rapid development of radiofrequency (RF)/microwave and photonic/optical waveguide technologies has had a significant impact on the current electronic industrial, medical and information and communication technology (ICT) fields. This book is a self-contained collection of valuable scholarly papers related to waveguide design, modeling, and applications. This book contains 20 chapters that cover three main subtopics of waveguide technologies, namely RF and microwave waveguide, photonic and optical waveguide and waveguide analytical solutions. Hence, this book is particularly useful to the academics, scientists, practicing researchers and postgraduate students whose work relates to the latest waveguide technologies.

Presents applications as well as the basic theory of analytic functions of one or several complex variables. The first volume discusses applications and basic theory of conformal mapping and the solution of algebraic and transcendental equations. Volume Two covers topics broadly connected with ordinary differential equations: special functions, integral transforms, asymptotics and continued fractions. Volume Three details discrete fourier analysis, cauchy integrals, construction of conformal maps, univalent functions, potential theory in the plane and polynomial expansions.

The Compendium
Specialty Optical Fibers Handbook
Discrete Fourier Analysis, Cauchy Integrals, Construction of Conformal Maps, Univalent Functions
Gratings: Theory and Numeric Applications
Computational Photonics
Optical Modeling and Simulation of Thin-Film Photovoltaic Devices

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 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 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 solid-state physics and quantum theory. They then investigate the unique phenomena that take place within photonic crystals at defect sites and surfaces, from one to three dimensions. This new edition includes entirely new chapters describing

important hybrid structures that use band gaps or periodicity only in some directions: periodic waveguides, photonic-crystal slabs, and photonic-crystal fibers. The authors demonstrate how the capabilities of photonic crystals to localize light can be put to work in devices such as filters and splitters. A new appendix provides an overview of computational methods for electromagnetism. Existing chapters have been considerably updated and expanded to include many new three-dimensional photonic crystals, an extensive tutorial on device design using temporal coupled-mode theory, discussions of diffraction and refraction at crystal interfaces, and more. Richly illustrated and accessibly written, Photonic Crystals is an indispensable resource for students and researchers. Extensively revised and expanded Features improved graphics throughout Includes new chapters on photonic-crystal fibers and combined index-and band-gap-guiding Provides an introduction to coupled-mode theory as a powerful tool for device design Covers many new topics, including omnidirectional reflection, anomalous refraction and diffraction, computational photonics, and much more.

This manuscript is a step-by-step graphical instructions for COMSOL Multiphysics with Ray Optics Module and Wave Optics module modeling and computational physics simulation. All the example models investigated and visualized with the help of Finite Element Analysis are referenced from the standard USA undergraduate text on Optics by E. Hecht. The simulations include the use of geometrical ray tracings for point source, hemispherical, and conic rays as well as full electromagnetic waves source employing the Maxwell's wave equations for Gaussian waves input. Both 2D and 3D computational physics approach will be discussed with the introduction of the trick-of-the-trades meshings, and modeling skill besides setup options that are skillfully hidden in the simulation software from plain sight.The geometrical model covers 2D and 3D electromagnetic waves propagation in user defined refractive index domain; Laws of Refraction for 2D converging and diverging lens; Laws of Reflection for specular mirrors, 3D Prism, 3D Prism mirror equivalent system; Polarizations for 3D linear polarizers, 3D circular polarizer, 3D linear wave retarder such as half wave plate, quarter wave plate; the Theory of Superposition for the 2D Young's double slits Wavefront-splitting interference experiment, 3D thin film uniform thickness Amplitude-splitting interference experiment, 2D Michelson interferometer Mirrored-interference setup with the 1D interference fringes line graph; Fermat's principle for 2D single slits diffraction, 3D circular aperture diffraction experiment, 3D rectangular slit diffraction experiment, 3D diffraction gratings experiment with Fresnel near field and Fraunhofer far field diffraction pattern, diffraction pattern: Sinc() function observation discussions, the Limitation of ray tracing physics vs. full electromagnetic waves simulations in the physics of optics, the Babinet's principle of transparent openings or opaque obstacles diffraction slit; and finally the Modern optics of 2D and 3D LASER cavity multiphysics models with the application of multiple release time of rays for Stimulated Emission lasing. One of the most important and crucial component of the computational physics subject, the user customizable library of material properties that governs the realisticality of the final modeled results, is highlighted in the appendix section.

Metamaterials—artificially structured materials with engineered electromagnetic properties—have enabled unprecedented flexibility in manipulating electromagnetic waves and producing new functionalities. This book details recent advances in the study of optical metamaterials, ranging from fundamental aspects to up-to-date implementations, in one unified treatment. Important recent developments and applications such as superlens and cloaking devices are also treated in detail and made understandable. The planned monograph can serve as a very timely book for both newcomers and advanced researchers in this extremely rapid evolving field.

Optical Waveguides and Devices Modeling and Visualization Using COMSOL Multiphysics Volume 1A
Graphical Instructional GuideCreatespace Independent Publishing Platform
Innovative Approaches and Pedagogical Strategies
Advances and Applications in Electroceramics II
Differentiators for Winning Technologies
Photonic Crystals
An Introduction with MATLAB
Optical Waveguides and Devices Modeling and Visualization Using COMSOL Multiphysics Volume 2

Accessible and generously illustrated in full colour, this reference spans the history of glass, the raw materials and the manufacturing process, as well as its many products. Informative and compact, this convenient guide is appropriate for anyone interested in glass. Revised throughout for this new edition.

*This book is a comprehensive contributed volume that aims to describe and explain the design, fabrication, operating characteristics, and specific applications of the most popular and useful types of specialty optical fibers. These "specialty fibers include any kind of optical fiber that has been architecturally manipulated to diverge from a conventional structure. For instance, metal-coated fibers can be utilized for bandwidth improvement, and hollow core fibers offer more controllable dispersion for sensitive medical procedures. Applications for these specialty fibers abound in the biomedical, sensors, and industrial fields, as well as in more traditional communications capacities. This book will act as a specialty fiber "guided tour, hosted by the top names in the discipline. The globally renowned editors, Drs. Mendez and Morse, have extensive experience in research, academia, and industry. *Completely covers biomedical and industrial sensor technology with emphasis on real world applications *Comparative studies of pros and cons of all fiber types with relation to test and measurement, mechanical properties and strength, and reliability *Easy to access essential facts and details at the begining of each chapter*

This book provides all the essential and best elements of Kidger's many courses taught worldwide on lens and optical design. It is written in a direct style that is compact, logical, and to the point--a tutorial in the best sense of the word. "I read my copy late last

year and read it straight through, cover to cover. In fact, I read it no less than three times. Its elegant expositions, valuable insights, and up-front espousal of pre-design theory make it an outstanding work. It's in the same league with Conrady and Kingslake." Warren Smith.

This book provides wide-ranging coverage of current developments in biomedical sensing based on photonic techniques. Biomedical sensing is a dynamic topic that promises to deliver much in the future evolution of medical diagnostics, delivering advanced tools for fundamental research in biology at the micrometre and nanometre scales. The book explores a variety of alternative physical and biological methodologies that have become available for application, such as plasmonic sensors and photonic crystal biosensors. At the same time, it addresses issues that potentially limit the capability of biomedical optical sensing techniques, while reviewing the state-of-the-art in biomedical optical sensing for the future work that will lead to near-universal applications of such techniques. Edited and written by leading experts in this domain, this book is ideal as a comprehensive manual for researchers and graduate students.

Theory and Applications
Optics Modeling and Visualization with COMSOL Multiphysics
Optical Cavities for Optical Atomic Clocks, Atom Interferometry and Gravitational-Wave Detection
Emerging Waveguide Technology
Integrated Photonics
Introduction to Geometrical Optics

Based on the integration of computer vision and spectrscopy techniques, hyperspectral imaging is a novel technology for obtaining both spatial and spectral information on a product. Used for nearly 20 years in the aerospace and military industries, more recently hyperspectral imaging has emerged and matured into one of the most powerful and rapidly growing methods of non-destructive food quality analysis and control. Hyperspectral Imaging for Food Quality Analysis and Control provides the core information about how this proven science can be practically applied for food quality assessment, including information on the equipment available and selection of the most appropriate of those instruments. Additionally, real-world food-industry-based examples are included, giving the reader important insights into the actual application of the science in evaluating food products. Presentation of principles and instruments provides core understanding of how this science performs, as well as guideline on selecting the most appropriate equipment for implementation Includes real-world, practical application to demonstrate the viability and challenges of working with this technology Provides necessary information for making correct determination on use of hyperspectral imaging

This book presents the principles of non-linear integrated optics.The first objective is to provide the reader with a thoroughunderstanding of integrated optics so that they may be able todevelop the theoretical and experimental tools to study and controlthe linear and non-linear optical properties of waveguides. The potential use of these structures can then be determined inorder to realize integrated optical components for light modulationand generation. The theoretical models are accompanied byexperimental tools and their setting in order to characterize thestudied phenomenon. The passage from theory to practice makes thecomprehension of the physical phenomena simple and didactic. The book also gives a presentation of the industrial applicationsof the integrated optical components. The studied topics range fromthe theory of waveguides and the linear and non-linear opticalcharacterization techniques to photonic crystals. This last fieldconstitutes a major challenge of photonic technologies of the 21stcentury.

In wafer-based and thin-film photovoltaic (PV) devices, the management of light is a crucial aspect of optimization since trapping sunlight in active parts of PV devices is essential for efficient energy conversions. Optical modeling and simulation enable efficient analysis and optimization of the optical situation in optoelectronic and PV devices. Optical Modeling and Simulation of Thin-Film Photovoltaic Devices provides readers with a thorough guide to performing optical modeling and simulations of thin-film solar cells and PV modules. It offers insight on examples of existing optical models, demonstrates the applicability of optical modeling, and presents concrete directions and solutions for improving the devices. Along with giving practical hints, the book highlights significant research, development, and production in the field. It covers numerous approaches of one-, two-, and three-dimensional optical modeling, including one-dimensional semi-coherent modeling and two-dimensional modeling based on the finite element method (FEM). Many practical examples illustrate the use of simulations with the developed models, helping readers better understand and develop their own models as well as appreciate innovative concepts in light management in thin-film PV devices.

Optical Metamaterials
Nano-Structures for Optics and Photonics
Integrated Ring Resonators
Geometry and Light
Fundamentals and Applications
Electromagnetic Metasurfaces