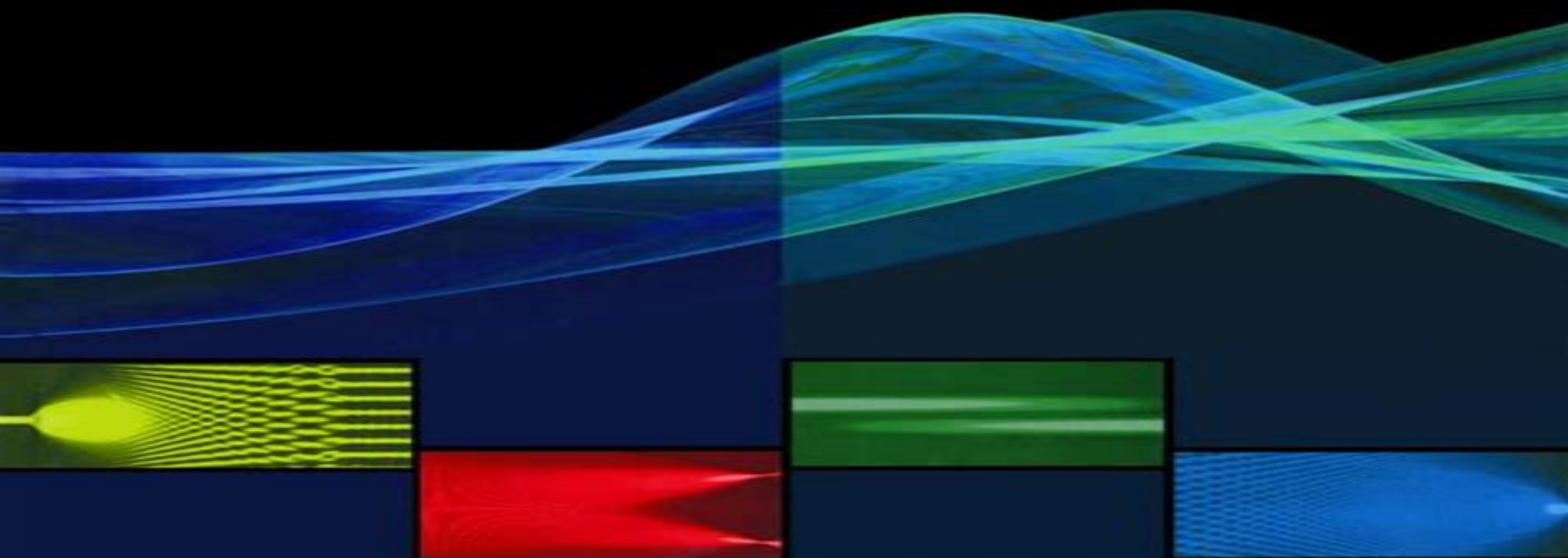


Fundamentals of Optical Waveguides

SECOND EDITION



Katsunari Okamoto

Fundamentals Of Optical Waveguides Optics And Photonics

Rachel S Tattersall



Fundamentals Of Optical Waveguides Optics And Photonics:

Fundamentals of Optical Waveguides Katsunari Okamoto, 2006 Fundamentals of Optical Waveguides is an essential resource for any researcher professional or student involved in optics and communications engineering Any reader interested in designing or actively working with optical devices must have a firm grasp of the principles of lightwave propagation Katsunari Okamoto has presented this difficult technology clearly and concisely with several illustrations and equations Optical theory encompassed in this reference includes coupled mode theory nonlinear optical effects finite element method beam propagation method staircase concatenation method along with several central theorems and formulas Since the publication of the well received first edition of this book planar lightwave circuits and photonic crystal fibers have fully matured With this second edition the advances of these fibers along with other improvements on existing optical technologies are completely detailed This comprehensive volume enables readers to fully analyze design and simulate optical atmospheres Features Exceptional new chapter on Arrayed Waveguide Grating AWG In depth discussion of Photonic Crystal Fibers PCFs Thorough explanation of Multimode Interference Devices MMI Full coverage of polarization Mode Dispersion PMD About the Author Katsunari Okamoto was born in Hiroshima Japan on October 19 1949 He received the B S M S and Ph D in electronic engineering from Tokyo University Japan in 1972 1974 and 1977 respectively He has engaged in research on the transmission characteristics of various fibers including PANDA fibers as well as fiber optic components and proposed the idea of dispersion flattened fibers DFF on which he has also experimented Dr Okamoto has worked for the Optical Fiber Group in Southampton England and the NTT Photonics Laboratories at the Ibaraki R D Center where he developed various AWGs and integrated optic add drop multiplexers He is a fellow of IEEE and a research fellow of NTT Science and Core Technology Laboratory Group In 2003 he started Okamoto Laboratory Ltd Okamoto Laboratory is an R D consulting company that deals with the custom design of optical fibers and functional planar lightwave circuits Fundamentals of Optical Waveguides Katsunari Okamoto, 2021-11-12 Now in its Third Edition Fundamentals of Optical Waveguides continues to be an essential resource for any researcher professional or student involved in optics and communications engineering Any reader interested in designing or actively working with optical devices must have a firm grasp of the principles of lightwave propagation Katsunari Okamoto continues to present this difficult technology clearly and concisely with several illustrations and equations Optical theory encompassed in this reference includes coupled mode theory nonlinear optical effects finite element method beam propagation method staircase concatenation method along with several central theorems and formulas Silicon photonics devices such as coupled resonator optical waveguides CROW lattice form filters and AWGs are also fully described This new edition gives readers not only a thorough understanding the silicon photonics devices for on chip photonic network but also the capability to design various kinds of devices Features recent advances in PLC and silicon photonic devices Provides an understanding of silicon photonics and how to apply this knowledge to system design Describes

numerical analysis methods such as BPM and FEM *Fundamentals of Optical Waveguides* Katsunari Okamoto, 2006

Fundamentals of Photonics Bahaa E. A. Saleh, Malvin Carl Teich, 2020-03-04 *Fundamentals of Photonics* A complete thoroughly updated full color third edition *Fundamentals of Photonics Third Edition* is a self contained and up to date introductory level textbook that thoroughly surveys this rapidly expanding area of engineering and applied physics Featuring a 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 the interaction of light and matter Presented at increasing levels of complexity preliminary sections build toward more advanced topics such as Fourier optics and holography photonic crystal optics guided wave and fiber optics LEDs and lasers acousto optic and electro optic devices nonlinear optical devices ultrafast optics optical interconnects and switches and optical fiber communications The third edition features an entirely new chapter on the optics of metals and plasmonic devices Each chapter contains highlighted equations exercises problems summaries and selected reading lists Examples of real systems are included to emphasize the concepts governing applications of current interest Each of the twenty four chapters of the second edition has been thoroughly updated

Optical Waveguides María L. Calvo, Vasudevan Lakshminarayanan, 2018-10-03 Although the theory and principles of optical waveguides have been established for more than a century the technologies have only been realized in recent decades *Optical Waveguides From Theory to Applied Technologies* combines the most relevant aspects of waveguide theory with the study of current detailed waveguiding technologies in particular photonic devices telecommunication applications and biomedical optics With self contained chapters written by well known specialists the book features both fundamentals and applications The first three chapters examine the theoretical foundations and bases of planar optical waveguides as well as critical optical properties such as birefringence and nonlinear optical phenomena The next several chapters focus on contemporary waveguiding technologies that include photonic devices and telecommunications The book concludes with discussions on additional technological applications including biomedical optical waveguides and the potential of neutron waveguides As optical waveguides play an increasing part in modern technology photonics will become to the 21st century what electronics were to the 20th century Offering both novel insights for experienced professionals and introductory material for novices this book facilitates a better understanding of the new information era the photonics century

Non-diffracting Waves Hugo E. Hernández-Figueroa, Michel Zamboni-Rached, Erasmo Recami, 2013-09-25 This continuation and extension of the successful book *Localized Waves* by the same editors brings together leading researchers in non diffractive waves to cover the most important results in their field and as such is the first to present the current state The well balanced presentation of theory and experiments guides readers through the background of different types of non diffractive waves their generation propagation and possible applications The authors include a historical account of the development of the field and cover different types of non diffractive waves including Airy waves and realistic finite energy

solutions suitable for experimental realization Apart from basic research the concepts explained here have promising applications in a wide range of technologies from wireless communication to acoustics and bio medical imaging Guided Wave Photonics Le Nguyen Binh,2011 A comprehensive presentation of the theory and simulation of optical waveguides and wave propagations in a guided environment Guided Wave Photonics Fundamentals and Applications with MATLAB supplies fundamental and advanced understanding of integrated optical devices that are currently employed in modern optical fiber communications systems and photonic signal processing systems While there are many texts available in this area none provide the breadth and depth of coverage and computational rigor found in this one **Localized Waves** Hugo E. Hernández-Figueroa, Michel Zamboni-Rached, Erasmo Recami,2007-10-26 The first book on Localized Waves a subject of phenomenal worldwide research with important applications from secure communications to medicine Localized waves also known as non diffractive waves are beams and pulses capable of resisting diffraction and dispersion over long distances even in non guiding media Predicted to exist in the early 1970s and obtained theoretically and experimentally as solutions to the wave equations starting in 1992 localized waves now garner intense worldwide research with applications in all fields where a role is played by a wave equation from electromagnetism to acoustics and quantum physics In the electromagnetics areas they are paving the way for instance to ubiquitous secure communications in the range of millimeter waves terahertz frequencies and optics At last the localized waves with an envelope at rest are expected to have important applications especially in medicine Localized Waves brings together the world s most productive researchers in the field to offer a well balanced presentation of theory and experiments in this new and exciting subject Composed of thirteen chapters this dynamic volume Presents a thorough review of the theoretical foundation and historical aspects of localized waves Explores the interconnections of the subject with other technologies and scientific areas Analyzes the effect of arbitrary anisotropies on both continuous wave and pulsed non diffracting fields Describes the physical nature and experimental implementation of localized waves Provides a general overview of wave localization for example in photonic crystals which have received increasing attention in recent years Localized Waves is the first book to cover this emerging topic making it an indispensable resource in particular for researchers in electromagnetics acoustics fundamental physics and free space communications while also serving as a requisite text for graduate students *Photonics* Abdul Al-Azzawi,2017-12-19 Since the invention of the laser our fascination with the photon has led to one of the most dynamic and rapidly growing fields of technology An explosion of new materials devices and applications makes it more important than ever to stay current with the latest advances Surveying the field from fundamental concepts to state of the art developments Photonics Principles and Practices builds a comprehensive understanding of the theoretical and practical aspects of photonics from the basics of light waves to fiber optics and lasers Providing self contained coverage and using a consistent approach the author leads you step by step through each topic Each skillfully crafted chapter first explores the theoretical concepts of each topic and then demonstrates

how these principles apply to real world applications by guiding you through experimental cases illuminated with numerous illustrations Coverage is divided into six broad sections systematically working through light optics waves and diffraction optical fibers fiber optics testing and laboratory safety A complete glossary useful appendices and a thorough list of references round out the presentation The text also includes a 16 page insert containing 28 full color illustrations Containing several topics presented for the first time in book form Photonics Principles and Practices is simply the most modern comprehensive and hands on text in the field

Beam Propagation Method for Design of Optical Waveguide Devices

Ginés Lifante Pedrola, 2015-12-21 The basic of the BPM technique in the frequency domain relies on treating the slowly varying envelope of the monochromatic electromagnetic field under paraxial propagation thus allowing efficient numerical computation in terms of speed and allocated memory In addition the BPM based on finite differences is an easy way to implement robust and efficient computer codes This book presents several approaches for treating the light wide angle scalar approach semivectorial treatment and full vectorial treatment of the electromagnetic fields Also special topics in BPM cover the simulation of light propagation in anisotropic media non linear materials electro optic materials and media with gain losses and describe how BPM can deal with strong index discontinuities or waveguide gratings by introducing the bidirectional BPM BPM in the time domain is also described and the book includes the powerful technique of finite difference time domain method which fills the gap when the standard BPM is no longer applicable Once the description of these numerical techniques have been detailed the last chapter includes examples of passive active and functional integrated photonic devices such as waveguide reflectors demultiplexers polarization converters electro optic modulators lasers or frequency converters The book will help readers to understand several BPM approaches to build their own codes or to properly use the existing commercial software based on these numerical techniques

Undersea Fiber Communication Systems

José Chesnoy, 2002-10-21 Description This book provides a detailed overview of the evolution of undersea communications systems with emphasis on the most recent breakthroughs of optical submarine cable technologies based upon Wavelength Division Multiplexing optical amplification new generation optical fibers and high speed digital electronics The role played by submarine communication systems in the development of high speed networks and associated market demands for multiplying Internet and broadband services is also covered Importance of This Topic This book will fill the gap between highly specialized papers from large international conferences and broad audience technology review updates The book provides a full overview of the evolution in the field and conveys the dimension of the large undersea projects In addition the book uncovers the myths surrounding marine operations and installations in that domain which have remained known so far to only very few specialists

Optical Waveguide Technology and Applications

Ki Young Kim, 2024-09-11 Optical Waveguide Technology and Applications encompasses both fundamental theory and engineering applications appealing to a wide range of interests from classical approaches to emerging modern research topics in related

fields This book is a collection of contemporary research and developments in optical waveguide technology and applications It features seven carefully selected chapters organized into two sections Optical Sensing and Waveguiding Media Chapters address such topics as fiber optical sensing techniques and their underlying theory and applications integrated optical waveguide structures and performances waveguides in magnetism and spintronics graphene based surface plasmonics optical waveguides in quantum computations and optical waveguide fabrication processes *VLSI Micro- and Nanophotonics* El-Hang Lee, Louay Eldada, Manijeh Razeghi, Chennupati Jagadish, 2018-09-03 Addressing the growing demand for larger capacity in information technology VLSI Micro and Nanophotonics Science Technology and Applications explores issues of science and technology of micro nano scale photonics and integration for broad scale and chip scale Very Large Scale Integration photonics This book is a game changer in the sense that it is quite possibly the first to focus on VLSI Photonics Very little effort has been made to develop integration technologies for micro nanoscale photonic devices and applications so this reference is an important and necessary early stage perspective on this field New demand for VLSI photonics brings into play various technological and scientific issues as well as evolutionary and revolutionary challenges all of which are discussed in this book These include topics such as miniaturization interconnection and integration of photonic devices at micron submicron and nanometer scales With its disruptive creativity and unparalleled coverage of the photonics revolution in information technology this book should greatly impact the future of micro nano photonics and IT as a whole It offers a comprehensive overview of the science and engineering of micro nanophotonics and photonic integration Many books on micro nanophotonics focus on understanding the properties of individual devices and their related characteristics However this book offers a full perspective from the point of view of integration covering all aspects of benefits and advantages of VLSI scale photonic integration the key technical concept in developing a platform to make individual devices and components useful and practical for various applications **Handbook of Optoelectronics (Two-Volume Set)** John P. Dakin, Robert G. W. Brown, 2010-12-12 A field as diverse as optoelectronics needs a reference that is equally versatile From basic physics and light sources to devices and state of the art applications the Handbook of Optoelectronics provides comprehensive self contained coverage of fundamental concepts and practical applications across the entire spectrum of disciplines encompassed by optoelectronics The handbook unifies a broad array of current research areas with a forward looking focus on systems and applications Beginning with an introduction to the relevant principles of physics materials science engineering and optics the book explores the details of optoelectronic devices and techniques including semiconductor lasers optical detectors and receivers optical fiber devices modulators amplifiers integrated optics LEDs and engineered optical materials Applications and systems then become the focus with sections devoted to industrial medical and commercial applications communications imaging and displays sensing and data processing spectroscopic analysis the art of practical optoelectronics and future prospects This extensive resource comprises the efforts of more than 70 world renowned

experts from leading industrial and academic institutions around the world and includes many references to contemporary works Whether used as a field reference as a research tool or as a broad and self contained introduction to the field the Handbook of Optoelectronics places everything you need in a unified conveniently organized format

Photonic Microresonator Research and Applications Ioannis Chremmos,Otto Schwelb,Nikolaos Uzunoglu,2010-06-09 The technology surrounding the design and fabrication of optical microresonators has matured to a point where there is a need for commercialization Consequently there is a need for device research involving more advanced architectures and more esoteric operating principles Photonic Microresonator Research and Applications explores advances in the fabrication process that enable nanometer waveguide separations exceptionally smooth surfaces essential to reach Q factors in the order of 10^6 10^8 and high index contrast materials

Handbook of Silicon Based MEMS Materials and Technologies Markku Tilli,Mervi Paulasto-Kröckel,Teruaki Motooka,Veikko Lindroos,2015-09-02 The Handbook of Silicon Based MEMS Materials and Technologies Second Edition is a comprehensive guide to MEMS materials technologies and manufacturing that examines the state of the art with a particular emphasis on silicon as the most important starting material used in MEMS The book explains the fundamentals properties mechanical electrostatic optical etc materials selection preparation manufacturing processing system integration measurement and materials characterization techniques sensors and multi scale modeling methods of MEMS structures silicon crystals and wafers also covering micromachining technologies in MEMS and encapsulation of MEMS components Furthermore it provides vital packaging technologies and process knowledge for silicon direct bonding anodic bonding glass frit bonding and related techniques shows how to protect devices from the environment and provides tactics to decrease package size for a dramatic reduction in costs Provides vital packaging technologies and process knowledge for silicon direct bonding anodic bonding glass frit bonding and related techniques Shows how to protect devices from the environment and decrease package size for a dramatic reduction in packaging costs Discusses properties preparation and growth of silicon crystals and wafers Explains the many properties mechanical electrostatic optical etc manufacturing processing measuring including focused beam techniques and multiscale modeling methods of MEMS structures Geared towards practical applications rather than theory

Photonic Waveguides Azzedine Boudrioua,2013-03-01 This book presents the principles of non linear integrated optics The first objective is to provide the reader with a thorough understanding of integrated optics so that they may be able to develop the theoretical and experimental tools to study and control the linear and non linear optical properties of waveguides The potential use of these structures can then be determined in order to realize integrated optical components for light modulation and generation The theoretical models are accompanied by experimental tools and their setting in order to characterize the studied phenomenon The passage from theory to practice makes the comprehension of the physical phenomena simple and didactic The book also gives a presentation of the industrial applications of the integrated optical components The studied topics range from the

theory of waveguides and the linear and non linear optical characterization techniques to photonic crystals This last field constitutes a major challenge of photonic technologies of the 21st century *Guided Wave Photonics* Le Nguyen Binh,2016-04-19 A comprehensive presentation of the theory and simulation of optical waveguides and wave propagations in a guided environment *Guided Wave Photonics Fundamentals and Applications with MATLAB* supplies fundamental and advanced understanding of integrated optical devices that are currently employed in modern optical fiber communications systems and p **Erbium-Doped Fiber Amplifiers** Philippe M. Becker,Anders A. Olsson,Jay R. Simpson,1999-03-15 *Erbium Fiber Amplifiers* is a comprehensive introduction to the increasingly important topic of optical amplification Written by three Bell Labs pioneers the book stresses the importance of the interrelation of materials properties optical properties and systems aspects of optical fiber amplifiers All disc based content for this title is now available on the Web Key Features Explains the theory of noise in optically amplified systems in an intuitive way The book contains a discussion of components used in amplifier fabrication and of the attendant technologies used in real systems The book provides basic tools for amplifier design as well as systems engineering including the latest developments in WDM and soliton systems The book discusses the fundamentals of rare earth ions for the reader desiring more depth in the topic The book is for either the novice or experienced reader The chapter have links between them to allow the reader to understand the relationship between the amplifier characteristics noise and systems applications The book contains extensive references **Graphene Science Handbook, Six-Volume Set** Mahmood Aliofkhaezrai,Nasar Ali,William I. Milne,Cengiz S. Ozkan,Stanislaw Mitura,Juana L. Gervasoni,2016-04-26 Graphene is the strongest material ever studied and can be an efficient substitute for silicon This six volume handbook focuses on fabrication methods nanostructure and atomic arrangement electrical and optical properties mechanical and chemical properties size dependent properties and applications and industrialization There is no other major reference work of this scope on the topic of graphene which is one of the most researched materials of the twenty first century The set includes contributions from top researchers in the field and a foreword written by two Nobel laureates in physics

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