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Optical Waveguide Analysis

MASANORI KOSHIBA

Optical Waveguide Analysis

Amal Banerjee



Optical Waveguide Analysis:

Optical Waveguide Analysis Masanori Koshiba, 1992 A solutions oriented introduction for electronic engineers and researchers to the computational tools used in the modeling and simulation of optical waveguides a critical technology in fiber optics communication and integrated optical electronics No index First published in Japanese in 1990 Annotation copyrighted by Book News Inc Portland OR

Optical Waveguides Analysis and Design Amal Banerjee, 2022-03-09 This book offers readers a comprehensive detailed analysis and treatment of optical waveguides fiber slab an essential component of ultra high bandwidth long medium and short haul telecommunication The author describes an analysis scheme for optical waveguides that combines both geometric ray optics and Maxwell s equations based classical electrodynamics This unique approach enables readers to develop an intuitive understanding of this topic starting with macro properties e g V parameter of an optical fiber and progressively refining the analysis to individual modes of propagation through an optical waveguide An exhaustive set of diagrams highlight the key features of an optical waveguide property such as acceptance angle meridional and skew rays in an optical fiber or signal attenuation and dispersion in an optical waveguide The author also provides a set of ready to use ANSI C executables for both Linux and Windows that enable the reader to e g determine the allowed propagation modes even odd TE TM of a graded step index optical fiber and a slab waveguide Offers readers a single source reference to the analysis and design of optical waveguides Begins with macro level analysis of the properties of optical waveguides and dives deeply into details in a step by step manner enabling readers to develop an intuitive understanding Includes C language executables along with optical waveguide analysis and design examples to demonstrate their use in context

Introduction to Optical Waveguide Analysis Kenji Kawano, Tsutomu Kitoh, 2001-08-03 A complete survey of modern design and analysis techniques for optical waveguides This volume thoroughly details modern and widely accepted methods for designing the optical waveguides used in telecommunications systems It offers a straightforward presentation of the sophisticated techniques used in waveguide analysis and enables a quick grasp of modern numerical methods with easy mathematics The book is intended to guide the reader to a comprehensive understanding of optical waveguide analysis through self study This comprehensive presentation includes An extensive and exhaustive list of mathematical manipulations Detailed explanations of common design methods finite element method FEM finite difference method FDM beam propagation method BPM and finite difference time domain method FD TDM Explanations for numerical solutions of optical waveguide problems with sophisticated techniques used in modern computer aided design CAD software Solutions to Maxwell s equations and the Schrodinger equation The authors provide excellent self study material for practitioners researchers and students while also presenting detailed mathematical manipulations that can be easily understood by readers who are unfamiliar with them *Introduction to Optical Waveguide Analysis* presents modern design methods in a comprehensive and easy to understand format

Microwave and Optical Waveguide Analysis by the

Finite Element Method F. Aníbal Fernández, Yilong Lu, 1996 Optical Waveguide Analysis Naoki Matsuda, 2005

Propagating Beam Analysis of Optical Waveguides Junji Yamauchi, 2003 This book is for graduate students and scientists interested in the numerical analysis of dielectric waveguides Engineers in industries should be interested since optical waveguide analysis is becoming popular and indispensable in designing various optical devices at a small cost of time and labour This text is a comprehensive introduction to a beam propagation analysis of optical waveguides and is the summary of the research investigations made at Hosei University Japan The subject described in the book includes the finite difference beam propagation method BPM in Cartesian cylindrical and oblique coordinates For the Cartesian coordinates based BPM semivectorial and fullvectorial BPMs are presented with some applications Improved finite difference formulas are introduced to accurately analyze graded index and step index waveguides The alternating direction implicit method is employed to efficiently treat three dimensional structures To deal with a reflection problem a time domain BPM scalar FD TD method and vectorial FD TD method are provided A hybrid technique that combines the BPM and the FD TD method is also described

Optical Fibre Waveguide Analysis Charles Tsao, 1992 A comprehensive but practical analysis methodology for treating optical fibre waveguides is presented in this book It is designed for both college students and practicing scientists and engineers The book presents a framework which treats the light waveguide as a continuum of polarizing devices to which a multitude of analysis techniques are applied A more rigorous but easy to grasp mathematical arrangement is developed in Parts II and III for analyzing an all dielectric or metallic 1D or 2D optical stratum This basic technique is extended in Part IV to cover a general 2D or 3D curved optical fibre waveguide for which both the propagative and radiative far field distributions together with a set of characteristic equations and their solutions are established Similar to these simplified straight or curvilinear guidance structures an elliptic waveguide or a fibre with the D shaped cladding may be characterized analytically but approximately as demonstrated in Part V Also included in Part V is the so called finite element analysis as a distinctive alternative numerical computation method for analysing a more arbitrary fibre waveguide exhibiting an obvious irregularity or anisotropy

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 Optical Waveguide Theory by the Finite Element Method Masanori Koshiba,2012-11-07 Recent advances in the field of guided wave optics such as fiber optics and integrated optics have included the introduction of arbitrarily shaped optical waveguides which in many cases also happened to be arbitrarily inhomogeneous dissipative anisotropic and or nonlinear Most of such cases of waveguide arbitrariness do not lend themselves to analytical solutions hence computational tools for modeling and simulation are essential for successful design optimization and realization of the optical waveguides For this purpose various numerical techniques have been developed In particular the finite element method FEM is a powerful and efficient tool for the most general i e arbitrarily shaped inhomogeneous dissipative anisotropic and nonlinear optical waveguide problem Its use in industry and research is extensive and indeed it could be said that without it many optical waveguide problems would be incapable of solution This book is intended for students engineers designers and technical managers interested in a detailed description of the FEM for optical waveguide analysis Starting from a brief review of electromagnetic theory the first chapter provides the concepts of the FEM and its fundamentals In addition to conventional elements i e line elements triangular elements tetrahedral elements ring elements and triangular ring elements which are utilized for one dimensional two dimensional three dimensional axisymmetric two dimensional and axisymmetric three dimensional problems respectively special purpose elements such as isoparametric elements edge elements infinite elements and boundary elements are also introduced Fundamentals of Optical Waveguides Katsunari Okamoto,2010-08-04 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 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 **Optical Waveguide Theory** Yury Shestopalov,Yury Smirnov,Eugene Smolkin,2022 This book addresses the most advanced to date mathematical

approach and numerical methods in electromagnetic field theory and wave propagation. It presents the application of developed methods and techniques to the analysis of waves in various guiding structures: shielded and open metal dielectric waveguides of arbitrary cross section, planar and circular waveguides filled with inhomogeneous dielectrics, metamaterials, chiral media, anisotropic media, and layered media with absorption. It also looks into spectral properties of wave propagation for the waveguide families being considered and the relevant mathematical techniques such as spectral theory of non self adjoint operator valued functions are described including rigorous proofs of the existence of various types of waves. Further numerical methods constructed on the basis of the presented mathematical approach and the results of numerical modeling for various structures are also described in depth. The book is beneficial to a broad spectrum of readers ranging from pure and applied mathematicians in electromagnetic field theory to researchers and engineers who are familiar with mathematics. Further, it is also useful as a supplementary text for upper level undergraduate students interested in learning more advanced topics of mathematical methods in electromagnetics.

Integrated Optics Robert G. Hunsperger, 2009-04-29 Integrated Optics explains the subject of optoelectronic devices and their use in integrated optics and fiber optic systems. The approach taken is to emphasize the physics of how devices work and how they can be and have been used in various applications as the field of optoelectronics has progressed from microphotonics to nanophotonics. Illustrations and references from technical journals have been used to demonstrate the relevance of the theory to currently important topics in industry. By reading this book, scientists, engineers, students, and engineering managers can obtain an overall view of the theory and the most recent technology in Integrated Optics.

Optical Waveguide Analysis Using Transmission Lines Xin Qian, 2005 **Optical Waveguide Theory by the Finite Element Method** Masanori Koshiba, 2014-01-14 Recent advances in the field of guided wave optics such as fiber optics and integrated optics have included the introduction of arbitrarily shaped optical waveguides which in many cases also happened to be arbitrarily inhomogeneous, dissipative, anisotropic, and/or nonlinear. Most of such cases of waveguide arbitrariness do not lend themselves to analytical solutions; hence computational tools for modeling and simulation are essential for successful design, optimization, and realization of the optical waveguides. For this purpose, various numerical techniques have been developed. In particular, the finite element method (FEM) is a powerful and efficient tool for the most general, i.e., arbitrarily shaped, inhomogeneous, dissipative, anisotropic, and nonlinear optical waveguide problem. Its use in industry and research is extensive, and indeed it could be said that without it, many optical waveguide problems would be incapable of solution. This book is intended for students, engineers, designers, and technical managers interested in a detailed description of the FEM for optical waveguide analysis. Starting from a brief review of electromagnetic theory, the first chapter provides the concepts of the FEM and its fundamentals. In addition to conventional elements, i.e., line elements, triangular elements, tetrahedral elements, ring elements, and triangular ring elements, which are utilized for one-dimensional, two-dimensional, three-dimensional, axisymmetric two-dimensional, and axisymmetric three-dimensional problems, respectively.

special purpose elements such as isoparametric elements edge elements infinite elements and boundary elements are also introduced

Waveguide Optoelectronics J.H. Marsh, Richard M. de la Rue, 2012-12-06 The NATO Advanced Study on Waveguide Optoelectronics was held at the Kelvin Conference Centre in Glasgow Scotland between 30 July and 10 August 1990 In aliSO students and 15 lecturers attended the ASI The success of the meeting was due not only to the high quality of the presentations but also to the enthusiasm of all the participants and their willingness to take part in the discussion and poster sessions 1990 was also the year in which Glasgow was the European City of Culture This resulted in interesting diversions during the middle weekend of the school and also made the meeting probably the first NATO ASI to share accommodation with the Bolshoi Opera and Ballet who gave memorable performances as part of the City's celebrations This volume is however intended to be more than merely a record of presentations at the NATO meeting The authors have written their material so as to be approachable by a first degree graduate with some background in optoelectronics The principal materials considered are the III V semiconductors lithium niobate and silica Recent developments towards optoelectronic integration in semiconductors developments in devices fabricated in doped silica and doped lithium niobate and developments in all optical switching networks are highlighted The role of reduced dimensional structures is examined in some detail

Analysis of Electromagnetic Fields and Waves Reinhold Pregla, 2008-04-30 The Method of Lines MOL is a versatile approach to obtaining numerical solutions to partial differential equations PDEs as they appear in dynamic and static problems This method popular in science and engineering essentially reduces PDEs to a set of ordinary differential equations that can be integrated using standard numerical integration methods Its significant advantage is that the analysis algorithms follow the physical wave propagation and are therefore efficient This is because the fields on the discretisation lines are described by generalised transmission line GTL equations With this formulation we have a connection to the well known transmission line theory and resulting in an easy understanding The method of lines is a very accurate and powerful way to analyze electromagnetic waves enabling a full wave solution without the computational burden of pure finite element or finite difference methods With Analysis of Electromagnetic Fields and Waves Reinhold Pregla describes an important and powerful method for analyzing electromagnetic waves This book Describes the general analysis principles for electromagnetic fields Includes applications in microwave millimetre wave and optical frequency regions Unifies the analysis by introducing generalised transmission line GTL equations for all orthogonal coordinate systems and with materials of arbitrary anisotropy as a common start point Demonstrates a unique analysis principle with the numerical stable impedance admittance transformation and a physical adapted field transformation concept that is also useful for other modelling algorithms Includes chapters on Eigenmode calculations for various waveguides concatenations and junctions of arbitrary number of different waveguide sections in complex devices periodic structures e g Bragg gratings meander lines clystron resonators photonic crystals antennas e g circular and conformal Enables the reader to solve partial differential equations in

other physical areas by using the described principles Features an accompanying website with program codes in Matlab for special problems Analysis of Electromagnetic Fields and Waves will appeal to electromagnetic field practitioners in primary and applied research as well as postgraduate students in the areas of photonics micro and millimetre waves general electromagnetics e g microwave integrated circuits antennas integrated and fibre optics optoelectronics nanophotonics microstructures artificial materials Fundamentals of Guided-Wave Optoelectronic Devices William S. C. Chang,2010 Uniquely combines both the optical and electrical properties of guided wave optoelectronic devices providing key concepts and practical analytical techniques Microwave And Optical Waveguide Analysis By The Finite Element Method F.A. Fernandez, **Analysis of Optical Waveguide-ridge Waveguide** Mohamad Fadli Yusop,2009 **Optical Waveguide Theory** A.W. Snyder,J. Love,1983-11-30 This is a comprehensive treatment of optical waveguide theory

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