



ELEMENTS OF PHOTONICS

VOLUME I

IN FREE SPACE AND
SPECIAL MEDIA



KEIGO IIZUKA

Wiley Series in Pure and Applied Optics
Robert E. A. Saleh, Editor

Elements Of Photonics In Free Space And Special Media

Jia-ming Liu



Elements Of Photonics In Free Space And Special Media:

Elements of Photonics, Volume I Keigo Iizuka, 2002-06-06 Deals with photonics in free space and special media such as anisotropic crystals Covers all important topics from Fourier optics such as the properties of lenses optical image processing and holography to the Gaussian beam light propagation in anisotropic media external field effects polarization of light and its major applications The book is self contained and is suitable as a textbook for a two semester course Provides a particularly good discussion of the electromagnetics of light in bounded media Only book that treats the two complementary topics fiber and integrated optics Careful and thorough presentation of the topics that makes it well suited for courses and self study Includes numerous figures problems and worked out solutions Heavily illustrated with over 400 figures specially formatted to aid in comprehension

Elements of Photonics: In free space and special media Keigo Iizuka, 2002 *Photonic Devices* Jia-ming Liu, 2009-06-11 Photonic devices lie at the heart of the communications revolution and have become a large and important part of the electronic engineering field so much so that many colleges now treat this as a subject in its own right With this in mind the author has put together a unique textbook covering every major photonic device and striking a careful balance between theoretical and practical concepts The book assumes a basic knowledge of optics semiconductors and electromagnetic waves Many of the key background concepts are reviewed in the first chapter Devices covered include optical fibers couplers electro optic devices magneto optic devices lasers and photodetectors Problems are included at the end of each chapter and a solutions set is available The book is ideal for senior undergraduate and graduate courses but being device driven it is also an excellent engineers reference

Free Space Optical Systems Engineering Larry B. Stotts, 2017-03-21 Gets you quickly up to speed with the theoretical and practical aspects of free space optical systems engineering design and analysis One of today's fastest growing system design and analysis disciplines is free space optical systems engineering for communications and remote sensing applications It is concerned with creating a light signal with certain characteristics how this signal is affected and changed by the medium it traverses how these effects can be mitigated both pre and post detection and if after detection it can be differentiated from noise under a certain standard e.g receiver operating characteristic Free space optical systems engineering is a complex process to design against and analyze While there are several good introductory texts devoted to key aspects of optics such as lens design lasers detectors fiber and free space optical communications and remote sensing until now there were none offering comprehensive coverage of the basics needed for optical systems engineering If you're an upper division undergraduate or first year graduate student looking to acquire a practical understanding of electro optical engineering basics this book is intended for you Topics and tools are covered that will prepare you for graduate research and engineering in either an academic or commercial environment If you are an engineer or scientist considering making the move into the opportunity rich field of optics this all in one guide brings you up to speed with everything you need to know to hit the ground running leveraging your experience and expertise

acquired previously in alternate fields Following an overview of the mathematical fundamentals this book provides a concise yet thorough coverage of among other crucial topics Maxwell Equations Geometrical Optics Fourier Optics Partial Coherence theory Linear algebra Basic probability theory Statistics Detection and Estimation theory Replacement Model detection theory LADAR LIDAR detection theory optical communications theory Critical aspects of atmospheric propagation in real environments including commonly used models for characterizing beam and spherical and plane wave propagation through free space turbulent and particulate channels Lasers blackbodies graybodies sources and photodetectors e g PIN ADP PMT and their inherent internal noise sources The book provides clear detailed discussions of the basics for free space optical systems design and analysis along with a wealth of worked examples and practice problems found throughout the book and on a companion website Their intent is to help you test and hone your skill set and assess your comprehension of this important area Free Space Optical Systems Engineering is an indispensable introduction for students and professionals alike

Physics of Photonic Devices Shun Lien Chuang, 2012-11-07 The most up to date book available on the physics of photonic devices This new edition of Physics of Photonic Devices incorporates significant advancements in the field of photonics that have occurred since publication of the first edition Physics of Optoelectronic Devices New topics covered include a brief history of the invention of semiconductor lasers the Lorentz dipole method and metal plasmas matrix optics surface plasma waveguides optical ring resonators integrated electroabsorption modulator lasers and solar cells It also introduces exciting new fields of research such as surface plasmonics and micro ring resonators the theory of optical gain and absorption in quantum dots and quantum wires and their applications in semiconductor lasers and novel microcavity and photonic crystal lasers quantum cascade lasers and GaN blue green lasers within the context of advanced semiconductor lasers Physics of Photonic Devices Second Edition presents novel information that is not yet available in book form elsewhere Many problem sets have been updated the answers to which are available in an all new Solutions Manual for instructors Comprehensive timely and practical Physics of Photonic Devices is an invaluable textbook for advanced undergraduate and graduate courses in photonics and an indispensable tool for researchers working in this rapidly growing field **Principles**

of Photonics Jia-Ming Liu, 2016-08-19 A comprehensive and self contained introductory text covering all the fundamental concepts and major principles of photonics **Optics of Liquid Crystal Displays** Pochi Yeh, Claire Gu, 2009-11-02 NOW UPDATED THE HIGHLY PRACTICAL GUIDE TO ANALYZING LIQUID CRYSTAL DISPLAYS The subject of liquid crystal displays has vigorously evolved into an exciting interdisciplinary field of research and development involving optics materials and electronics Updated to reflect recent advances the Second Edition of Optics of Liquid Crystal Displays now offers a broader more comprehensive discussion on the fundamentals of display systems and teaches readers how to analyze and design new components and subsystems for LCDs New features of this edition include Discussion of the dynamics of molecular reorientation Expanded information of the method of Poincar sphere in various optical components including

achromatic wave plates and compensators Neutral and negative Biaxial thin films for compensators Circular polarizers and anti reflection coatings The introduction of wide field of view wave plates and filters Comprehensive coverage of VA LCD and IPS LCD Additional numerical examples This updated edition is intended as a textbook for students in electrical engineering and applied physics as well as a reference book for engineers and scientists working in the area of research and development of display technologies

Photonic Crystals, Theory, Applications and Fabrication Dennis W Prather,Ahmed Sharkawy,Shouyuan Shi,Janusz Murakowski,Garrett Schneider,2009-05-26 The Only Source You Need for Understanding the Design and Applications of Photonic Crystal Based Devices This book presents in detail the fundamental theoretical background necessary to understand the unique optical phenomena arising from the crystalline nature of photonic crystal structures and their application across a range of disciplines Organized to take readers from basic concepts to more advanced topics the book covers Preliminary concepts of electromagnetic waves and periodic media Numerical methods for analyzing photonic crystal structures Devices and applications based on photonic bandgaps Engineering photonic crystal dispersion properties Fabrication of two and three dimensional photonic crystals The authors assume an elementary knowledge of electromagnetism vector calculus Fourier analysis and complex number analysis Therefore the book is appropriate for advanced undergraduate students in physics applied physics optics electronics and chemical and electrical engineering as well as graduate students and researchers in these fields

Information Photonics Asit Kumar Datta,Soumika Munshi,2016-11-25 The main aim of this book is to introduce the concept of photonic information processing technologies to the graduate and post graduate students researchers engineers and scientists It is expected to give the readers an insight into the concepts of photonic techniques of processing as a system the photonic devices as required components which are applied in the areas of communication computation and intelligent pattern recognition

Elements of Photonics, Volume I Keigo Iizuka,2002-06-06 Deals with photonics in free space and special media such as anisotropic crystals Covers all important topics from Fourier optics such as the properties of lenses optical image processing and holography to the Gaussian beam light propagation in anisotropic media external field effects polarization of light and its major applications The book is self contained and is suitable as a textbook for a two semester course Provides a particularly good discussion of the electromagnetics of light in bounded media Only book that treats the two complementary topics fiber and integrated optics Careful and thorough presentation of the topics that makes it well suited for courses and self study Includes numerous figures problems and worked out solutions Heavily illustrated with over 400 figures specially formatted to aid in comprehension

Optomechanical Systems Engineering Keith J. Kasunic,2015-04-27 Covers the fundamental principles behind optomechanical design This book emphasizes a practical systems level overview of optomechanical engineering showing throughout how the requirements on the optical system flow down to those on the optomechanical design The author begins with an overview of optical engineering including optical fundamentals as well as the fabrication

and alignment of optical components such as lenses and mirrors The concepts of optomechanical engineering are then applied to the design of optical systems including the structural design of mechanical and optical components structural dynamics thermal design and kinematic design Optomechanical Systems Engineering Reviews the fundamental concepts of optical engineering as they apply to optomechanical design Illustrates the fabrication and alignment requirements typically found in an optical system Examines the elements of structural design from a mechanical optical and vibrational viewpoint Develops the thermal management principles of temperature and distortion control Describes the optomechanical requirements for kinematic and semi kinematic mounts Uses examples and case studies to illustrate the concepts and equations presented in the book Provides supplemental materials on a companion website Focusing on fundamental concepts and first order estimates of optomechanical system performance Optomechanical Systems Engineering is accessible to engineers scientists and managers who want to quickly master the principles of optomechanical engineering

Statistical Optics Joseph W. Goodman, 2015-05-06 This book discusses statistical methods that are useful for treating problems in modern optics and the application of these methods to solving a variety of such problems This book covers a variety of statistical problems in optics including both theory and applications The text covers the necessary background in statistics statistical properties of light waves of various types the theory of partial coherence and its applications imaging with partially coherent light atmospheric degradations of images and noise limitations in the detection of light New topics have been introduced in the second edition including Analysis of the Vander Pol oscillator model of laser light Coverage on coherence tomography and coherence multiplexing of fiber sensors An expansion of the chapter on imaging with partially coherent light including several new examples An expanded section on speckle and its properties New sections on the cross spectrum and bispectrum techniques for obtaining images free from atmospheric distortions A new section on imaging through atmospheric turbulence using coherent light The addition of the effects of read noise to the discussions of limitations encountered in detecting very weak optical signals A number of new problems and many new references have been added Statistical Optics Second Edition is written for researchers and engineering students interested in optics physicists and chemists as well as graduate level courses in a University Engineering or Physics Department

Foundations of Image Science Harrison H. Barrett, Kyle J. Myers, 2013-06-13 Winner of the 2006 Joseph W Goodman Book Writing Award A comprehensive treatment of the principles mathematics and statistics of image science In today's visually oriented society images play an important role in conveying messages From seismic imaging to satellite images to medical images our modern society would be lost without images to enhance our understanding of our health our culture and our world Foundations of Image Science presents a comprehensive treatment of the principles mathematics and statistics needed to understand and evaluate imaging systems The book is the first to provide a thorough treatment of the continuous to discrete or CD model of digital imaging Foundations of Image Science emphasizes the need for meaningful objective assessment of

image quality and presents the necessary tools for this purpose Approaching the subject within a well defined theoretical and physical context this landmark text presents the mathematical underpinnings of image science at a level that is accessible to graduate students and practitioners working with imaging systems as well as well motivated undergraduate students Destined to become a standard text in the field Foundations of Image Science covers Mathematical Foundations Examines the essential mathematical foundations of image science Image Formation Models and Mechanisms Presents a comprehensive and unified treatment of the mathematical and statistical principles of imaging with an emphasis on digital imaging systems and the use of SVD methods Image Quality Provides a systematic exposition of the methodology for objective or task based assessment of image quality Applications Presents detailed case studies of specific direct and indirect imaging systems and provides examples of how to apply the various mathematical tools covered in the book Appendices Covers the prerequisite material necessary for understanding the material in the main text including matrix algebra complex variables and the basics of probability theory

Speckle Phenomena in Optics Joseph W. Goodman, 2007 Speckle Phenomena in Optics provides a comprehensive discussion of the statistical properties of speckle as well as detailed coverage of its role in applications Some of the applications discussed include speckle in astronomy speckle in the eye speckle in projection displays speckle in coherence tomography speckle in lithography speckle in waveguides modal noise speckle in optical radar detection and speckle in metrology This book is aimed at graduate students and professionals working in a wide variety of fields

Wavelength Division Multiplexing Klaus Grobe, Michael Eiselt, 2013-09-12 In this book Optical Wavelength Division Multiplexing WDM is approached from a strictly practical and application oriented point of view Based on the characteristics and constraints of modern fiber optic components transport systems and fibers the text provides relevant rules of thumb and practical hints for technology selection WDM system and link dimensioning and also for network related aspects such as wavelength assignment and resilience mechanisms Actual 10 40 Gb/s WDM systems are considered and a preview of the upcoming 100 Gb/s systems and technologies for even higher bit rates is given as well Key features Considers WDM from ULH backbone big picture view down to PON access micro view Includes all major telecom and datacom applications Provides the relevant background for state of the art and next gen systems Offers practical guidelines for system link engineering

Fundamentals of Infrared and Visible Detector Operation and Testing John David Vincent, Steve Hodges, John Vampola, Mark Stegall, Greg Pierce, 2015-10-26 Presents a comprehensive introduction to the selection operation and testing of infrared devices including a description of modern detector assemblies and their operation This book discusses how to use and test infrared and visible detectors The book provides a convenient reference for those entering the field of IR detector design test or use those who work in the peripheral areas and those who teach and train others in the field Chapter 1 contains introductory material Radiometry is covered in Chapter 2 The author examines Thermal detectors in Chapter 3 the Classical photon detectors simple photoconductors and photovoltaics in Chapter 4 and

Modern Photon Detectors in Chapter 5 Chapters 6 through 8 consider respectively individual elements and small arrays of elements the readouts ROICs used with large imaging arrays and Electronics for FPA Operation and Testing The Test Set and The Testing Process are analyzed in Chapters 9 and 10 with emphasis on uncertainty and trouble shooting Chapters 11 through 15 discuss related skills such as Uncertainty Cryogenics Vacuum Optics and the use of Fourier Transforms in the detector business Some highlights of this new edition are that it Discusses radiometric nomenclature and calculations detector mechanisms the associated electronics how these devices are tested and real life effects and problems Examines new tools in Infrared detector operations specifically selection and use of ROICs electronics for FPA operation operation of single element and very small FPAs microbolometers and multi color FPAs Contains five chapters with frequently sought after information on related subjects such as uncertainty optics cryogenics vacuum and the use of Fourier mathematics for detector analyses Fundamentals of Infrared and Visible Detector Operation and Testing Second Edition provides the background and vocabulary necessary to help readers understand the selection operation and testing of modern infrared devices

Nonlinear Optics George I. Stegeman, Robert A. Stegeman, 2012-06-29 Clear integrated coverage of all aspects of nonlinear optics phenomena materials and devices Coauthored by George Stegeman one of the most highly respected pioneers of nonlinear optics with contributions on applications from Robert Stegeman this book covers nonlinear optics from a combined physics optics materials science and devices perspective It offers a thoroughly balanced treatment of concepts nonlinear materials practical aspects of nonlinear devices and current application areas Beginning with the presentation of a simple electron on a spring model to help readers make the leap from concepts to applications Nonlinear Optics gives comprehensive explanations of second order phenomena derivation of nonlinear susceptibilities third order nonlinear effects multi wave mixing scattering and more Coverage includes Nonlinear response of materials at the molecular level Second order nonlinear devices their optimization and limitations The physical origins of second and third order nonlinearities Typical frequency dispersion of nonlinearities explained in terms of simple two and three level models Ultrafast and ultrahigh intensity processes Practice problems demonstrating the design of such nonlinear devices as frequency doublers and optical oscillators Based on more than twenty years of lectures at the College of Optics and Photonics CREOL at the University of Central Florida Nonlinear Optics introduces all topics from the ground up making the material easily accessible not only for physicists but also for chemists and materials scientists as well as professionals in diverse areas of optics from laser physics to electrical engineering

Diffraction, Fourier Optics and Imaging Okan K. Ersoy, 2006-12-13 This book presents current theories of diffraction imaging and related topics based on Fourier analysis and synthesis techniques which are essential for understanding analyzing and synthesizing modern imaging optical communications and networking as well as micro nano systems Applications covered include tomography magnetic resonance imaging synthetic aperture radar SAR and interferometric SAR optical communications and networking devices computer generated holograms and analog holograms

and wireless systems using EM waves

Computational Lithography Xu Ma, Gonzalo R. Arce, 2011-01-06 A Unified Summary of the Models and Optimization Methods Used in Computational Lithography Optical lithography is one of the most challenging areas of current integrated circuit manufacturing technology The semiconductor industry is relying more on resolution enhancement techniques RETs since their implementation does not require significant changes in fabrication infrastructure Computational Lithography is the first book to address the computational optimization of RETs in optical lithography providing an in depth discussion of optimal optical proximity correction OPC phase shifting mask PSM and off axis illumination OAI RET tools that use model based mathematical optimization approaches The book starts with an introduction to optical lithography systems electric magnetic field principles and the fundamentals of optimization from a mathematical point of view It goes on to describe in detail different types of optimization algorithms to implement RETs Most of the algorithms developed are based on the application of the OPC PSM and OAI approaches and their combinations Algorithms for coherent illumination as well as partially coherent illumination systems are described and numerous simulations are offered to illustrate the effectiveness of the algorithms In addition mathematical derivations of all optimization frameworks are presented The accompanying MATLAB software files for all the RET methods described in the book make it easy for readers to run and investigate the codes in order to understand and apply the optimization algorithms as well as to design a set of optimal lithography masks The codes may also be used by readers for their research and development activities in their academic or industrial organizations An accompanying MATLAB software guide is also included An accompanying MATLAB software guide is included and readers can download the software to use with the guide at ftp://ftp.wiley.com/public/sci_tech_med/computational_lithography Tailored for both entry level and experienced readers Computational Lithography is meant for faculty graduate students and researchers as well as scientists and engineers in industrial organizations whose research or career field is semiconductor IC fabrication optical lithography and RETs Computational lithography draws from the rich theory of inverse problems optics optimization and computational imaging as such the book is also directed to researchers and practitioners in these fields

Understanding Earth Observation

Domenico Solimini, 2016-04-19 This volume addresses the physical foundation of remote sensing The basic grounds are presented in close association with the kinds of environmental targets to monitor and with the observing techniques The book aims at plugging the quite large gap between the thorough and quantitative description of electromagnetic waves interacting with the Earth s environment and the user applications of Earth observation It is intended for scientifically literate students and professionals who plan to gain a first understanding of remote sensing data and of their information content

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