

Series in Optics and Photonics – Vol. 9

Fundamentals of Laser Optoelectronics

Second Edition

See Leang Chin
Huailiang Xu
Shuai Yuan



World Scientific

Fundamentals Of Laser Optoelectronics

Charles Blain



Fundamentals Of Laser Optoelectronics:

Fundamentals Of Laser Optoelectronics (Second Edition) See Leang Chin, Huailiang Xu, Shuai Yuan, 2022-08-18 This textbook is based on a course given by the first named author to third and fourth year undergraduate students from physics engineering physics and electrical engineering The purpose is to introduce and explain some of the fundamental principles underlying laser beam control in optoelectronics especially those in relation to optical anisotropy which is at the heart of many optical devices The book attempts to give the reader the background knowledge needed to work in a laser optoelectronic or photonic environment and to manage and handle laser beam equipment with ease In this edition recent research results on modern technologies and instruments relevant to laser optoelectronics have been added to each chapter New material include chirped pulse amplification for petawatt lasers optical anisotropy physical explanations for group velocity dispersion group delay dispersion and third order dispersion an introduction of different types of laser systems and both optical isotropy and anisotropy in different types of harmonic generation Theories based upon mode locking and chirped pulse amplifications have become increasingly more important It is thus necessary that students learn all these in a course devoted to laser optoelectronics As such Chapter 12 is now devoted to mode locking and carrier envelope phase locking A new chapter Chapter 13 which focuses on chirped pulse amplification has also been added

Fundamentals Of Laser Optoelectronics See Leang Chin, 1989-11-01 This book is based on a course given by the author to third and fourth year undergraduate students from physics engineering physics and electrical engineering The purpose is to introduce and explain some of the fundamental principles underlying laser beam control in optoelectronics especially those in relation to optical anisotropy which is at the heart of many optical devices The contents of the book are scattered in many sources and there seems to be no single source available at the undergraduate level That is why the present book is written The book attempts to give the reader a good background needed for working in a laser optoelectronic or photonic laboratory so that the use of equipment and the control of laser beams can be mastered without difficulty

Fundamentals of Laser Optoelectronics S. L. Chin, 1989 This book is based on a course given by the author to third and fourth year undergraduate students from physics engineering physics and electrical engineering The purpose is to introduce and explain some of the fundamental principles underlying laser beam control in optoelectronics especially those in relation to optical anisotropy which is at the heart of many optical devices The contents of the book are scattered in many sources and there seems to be no single source available at the undergraduate level That is why the present book is written The book attempts to give the reader a good background needed for working in a laser optoelectronic or photonic laboratory so that the use of equipment and the control of laser beams can be mastered without difficulty

Lasers and Optoelectronics Anil K. Maini, 2013-08-05 With emphasis on the physical and engineering principles this book provides a comprehensive and highly accessible treatment of modern lasers and optoelectronics Divided into four parts it explains laser fundamentals types of lasers laser electronics

optoelectronics and laser applications covering each of the topics in their entirety from basic fundamentals to advanced concepts. Key features include exploration of technological and application related aspects of lasers and optoelectronics detailing both existing and emerging applications in industry, medical diagnostics and therapeutics, scientific studies and Defence. Simple explanation of the concepts and essential information on electronics and circuitry related to laser systems, illustration of numerous solved and unsolved problems, practical examples, chapter summaries, self evaluation exercises and a comprehensive list of references for further reading. This volume is a valuable design guide for R D engineers and scientists engaged in design and development of lasers and optoelectronics systems and technicians in their operation and maintenance. The tutorial approach serves as a useful reference for under graduate and graduate students of lasers and optoelectronics also PhD students in electronics, optoelectronics and physics.

Lasers and Electro-optics Christopher C. Davis, 2014-03-20. Covering a broad range of topics in modern optical physics and engineering, this textbook is invaluable for undergraduate students studying laser physics, optoelectronics, photonics, applied optics and optical engineering. This new edition has been re organized and now covers many new topics such as the optics of stratified media, quantum well lasers and modulators, free electron lasers, diode pumped solid state and gas lasers, imaging and non imaging optical systems, squeezed light, periodic poling in nonlinear media, very short pulse lasers and new applications of lasers. The textbook gives a detailed introduction to the basic physics and engineering of lasers as well as covering the design and operational principles of a wide range of optical systems and electro optic devices. It features full details of important derivations and results and provides many practical examples of the design, construction and performance characteristics of different types of lasers and electro optic devices.

Semiconductor-Laser Fundamentals Weng W. Chow, Stephan W. Koch, 2013-03-09. Since Fall of 1993 when we completed the manuscript of our book *Semiconductor Laser Physics*, W W Chow, S W Koch and M Sargent III, Springer, Berlin Heidelberg, 1994, many new and exciting developments have taken place in the world of semiconductor lasers. Novel laser and amplifier structures were developed and others, for example the VCSEL (vertical cavity surface emitting laser) and monolithic MOPA (master oscillator power amplifier), made the transition from research and development to production. When investigating some of these systems we discovered instances when device performance and thus design depend critically on details of the gain medium properties, e.g. spectral shape and carrier density dependence of the gain and refractive index. New material systems were also introduced with optical emission wavelengths spanning from the mid infrared to the ultraviolet. Particularly noteworthy are laser and light emitting diodes based on the wide bandgap group III nitride and II-VI compounds. These devices emit in the visible to ultra violet wavelength range which is important for the wide variety of optoelectronic applications. While these novel semiconductor laser materials show many similarities with the more conventional near infrared systems, they also possess rather different material parameter combinations. These differences appear as band structure modifications and as increased importance of Coulomb effects such that, e.g. excitonic signatures

resulting from the attractive electron hole interaction are generally significantly more prominent in the wide bandgap systems

Laser Spectroscopy Wolfgang Demtröder, 2013-06-29 Keeping abreast of the latest techniques and applications this new edition of the standard reference and graduate text on laser spectroscopy has been completely revised and expanded While the general concept is unchanged the new edition features a broad array of new material e g frequency doubling in external cavities reliable cw parametric oscillators tunable narrow band UV sources more sensitive detection techniques tunable femtosecond and sub femtosecond lasers X ray region and the attosecond range control of atomic and molecular excitations frequency combs able to synchronize independent femtosecond lasers coherent matter waves and still more applications in chemical analysis medical diagnostics and engineering

Optoelectronics for Low-Intensity Conflicts and Homeland Security Anil Maini, 2018-11-30 This authoritative new resource provides an overview of the deployment of various devices in systems in actual field conditions and efficacy established in warfare The book covers laser and optronic technologies that have evolved over the years to build practical devices and systems for use in Homeland Security and low intensity conflict scenarios Readers will be able to assess combat and battle worthiness of various available devices and systems This book covers state of the art and emerging trends in various optoelectronics technologies having applications in Homeland Security It provides information on operational aspects deployment scenarios and actual usage of laser and optoelectronics based technologies for low intensity conflicts offering insight into the utility of each technology device for a given operational requirement This book evaluates the merits of various laser and optoelectronic sensor based technologies intended for low intensity conflict operations including counter insurgency and anti terrorist operations It is a useful reference for those specializing in defense electronics and optronics and professionals in the defence industry involved in operation and maintenance of laser based security equipment Packed with tables photographs and a comprehensive list of references in every chapter this is the only book that covers all topics related to Laser and Optoelectronics devices intended for low intensity conflict operations in a single volume

Semiconductor Laser Fundamentals Toshiaki Suhara, 2004-03-16 Ranging from fundamental theoretical concepts to advanced device technologies this reference text explores the engineering characteristics and performance of specific semiconductor lasers It defines key principles in electromagnetics optoelectronics and laser implementation for novel applications in optical communications storage processing measurement and sensing This text prepares students for advanced experimental and theoretical research in semiconductor laser technology and provides the only comprehensive systematic and concise description of semiconductor lasers available for an understanding of the physics and parameters of laser operation and function

Military Laser Technology and Systems David H. Titterton, 2015-03-01 This new resource provides an insight into the physical principles of the device technology that underpins many laser based military systems in one form or another From this knowledge a deeper understanding of the fundamental requirements and the potential performance as well as limitations of such systems may be assessed given the

appropriate operational parameters Engineers and students are provided with practical advice on how to evaluate laser devices and systems operate them safely and train with them

An Introduction to Optoelectronic Sensors Giancarlo C. Righini, 2009 Preface Part I Optoelectronic Sensors Technologies 1 Fiber and Integrated Optics Sensors Fundamentals and Applications G C Righini A G Mignani I Cacciari and M Brenci 1 Introduction 2 Fiber and Integrated Optics Fundamentals of Waveguiding 3 Waveguide Sensors Basic Working Principle 4 Fiber Optic Sensors 5 Long Period Optical Fiber Grating Sensors 6 Micro structured Fiber Sensors 7 Integrated Optic Sensors 8 Conclusions References 2 Fiber Bragg Grating Sensors Industrial Applications C Ambrosino A Iadicicco S Campopiano A Cutolo M Giordano and A Cusano 1 Introduction 2 Fiber Bragg Gratings History 3 Fiber Bragg Gratings as Sensors 4 Civil Applications 5 Aerospace Applications 6 Energy Applications 7 Oil and Gas Applications 8 Transport Applications 9 Underwater Applications 10 Perspective and Challenges References 3 Distributed Optical Fiber Sensors R Bernini A Minardo and L Zeni 1 Introduction 2 Linear Backscattering Systems 3 Non Linear Backscattering Systems 4 Non Linear Forward Scattering Systems 5 Conclusions References 4 Lightwave Technologies for Interrogation Systems of Fiber Bragg Gratings Sensors D Donisi R Beccherelli and A d Alessandro 1 Introduction 2 Operating Principle of the Fiber Bragg Grating Sensor 3 FBG Interrogation Techniques 4 An Integrated Tunable Filter using Composite Holographic Grating 5 POLICRYPS Filterbased FBG Sensors Interrogation 6 Conclusions Acknowledgments References 5 Surface Plasmon Resonance Applications in Sensors and Biosensors R Rella and M G Manera 1 Introduction 2 SPR Theory 3 Optical Sensors based on Surface Plasmon Resonance 4 Application of SPR in Chemical Sensors and Biosensors 5 SPR Instrumentation From Traditional SPR Instrument to SPR Imaging 6 Future Capabilities References 6 Microresonators for Sensing Applications S Berneschi G Nunzi Conti S Pelli and S Soria 1 Introduction 2 Whispering Gallery Modes in a Microsphere 3 WGM Resonators Applications in Sensing Acknowledgments References 7 Photonic Crystals Towards a Novel Generation of Integrated Optical Devices for Chemical and Biological Detection A Ricciardi C Ciminelli M Pisco S Campopiano C E Campanella E Scivittaro M N Armenise A Cutolo and A Cusano 1 Introduction 2 Photonic Crystals 190 Fundamental Principles 3 Functional Photonic Band Gap Components and Devices 4 Photonic Crystals for Chemical and Biological Sensing 5 Photonic Crystal Fibers Sensors 6 Perspectives and Challenges References 8 Micromachining Technologies for Sensor Applications P M Sarro A Irace and P J French 1 Introduction 2 Bulk Micromachining 3 Surface Micromachining 4 Characterization of Thin Film Membranes 5 Conclusions and Outlook References 9 Spectroscopic Techniques for Sensors S Pelli A Chiasera M Ferrari and G C Righini 1 Introduction 2 Absorption Reflectance and Transmission Measurements 3 Luminescence Measurements 4 Raman and Brillouin Measurements 5 Conclusions References 10 Laser Doppler Vibrometry P Castellini G M Revel OCLC

Basics of Laser Physics Karl F. Renk, 2012-02-09 Basics of Laser Physics provides an introductory presentation of the field of all types of lasers It contains a general description of the laser a theoretical treatment and a characterization of its operation as it deals with gas solid state

free electron and semiconductor lasers and furthermore with a few laser related topics The different subjects are connected to each other by the central principle of the laser namely that it is a self oscillating system Special emphasis is put on a uniform treatment of gas and solid state lasers on the one hand and semiconductor lasers on the other hand The discussions and the treatment of equations are presented in a way that a reader can immediately follow The book addresses undergraduate and graduate students of science and engineering Not only should it enable instructors to prepare their lectures but it can be helpful to students for preparing for an examination

Fundamentals of Laser Optics Ken'ichi Iga, Richard Bryant Miles, 1994 Developed from a lecture series for graduate and advanced undergraduate students in information processing and applied electronics sets out the fundamental principles and optical behavior of lasers that need to be understood for industrial laser use Annotation copyright Book News Inc Portland Or

Lasers Charles Blain, 2002 Developments in lasers continue to enable progress in many areas such as eye surgery the recording industry and dozens of others This book presents citations from the book literature for the last 25 years and groups them for ease of access which is also provided by subject author and titles indexes

Reliability of Semiconductor Lasers and Optoelectronic Devices Robert Herrick, Osamu Ueda, 2021-03-06 Reliability of Semiconductor Lasers and Optoelectronic Devices simplifies complex concepts of optoelectronics reliability with approachable introductory chapters and a focus on real world applications This book provides a brief look at the fundamentals of laser diodes introduces reliability qualification and then presents real world case studies discussing the principles of reliability and what occurs when these rules are broken Then this book comprehensively looks at optoelectronics devices and the defects that cause premature failure in them and how to control those defects Key materials and devices are reviewed including silicon photonics vertical cavity surface emitting lasers VCSELs InGaN LEDs and lasers and AlGaIn LEDs covering the majority of optoelectronic devices that we use in our everyday lives powering the Internet telecommunication solid state lighting illuminators and many other applications This book features contributions from experts in industry and academia working in these areas and includes numerous practical examples and case studies This book is suitable for new entrants to the field of optoelectronics working in R D Includes case studies and numerous examples showing best practices and common mistakes affecting optoelectronics reliability written by experts working in the industry Features the first wide ranging and comprehensive overview of fiber optics reliability engineering covering all elements of the practice from building a reliability laboratory qualifying new products to improving reliability on mature products Provides a look at the reliability issues and failure mechanisms for silicon photonics VCSELs InGaN LEDs and lasers AlGaIn LEDs and more

Photonic Networks, Components And Applications - Proceedings Of The Montebello Workshop J Terry, Jacek Chrostowski, 1991-03-07 This Workshop gathered engineers and scientists to discuss their recent research and issues related to photonic networks and their topologies the enabling devices and applications these networks support Optical communication neural sensor and computer networks were considered Another part of the workshop was

devoted to network components based on optical fibre semiconductor and organic materials such as lasers amplifiers and detectors integrated optic and optoelectronic circuits Applications in communications optical sensing and signal processing were addressed with particular emphasis on avionics submarine space as well as office residential medical and specialized captive services **Laser Spectroscopy 2** Wolfgang Demtröder,2015-01-07 Keeping abreast of the latest techniques and applications this new edition of the standard reference and graduate text on laser spectroscopy has been completely revised and expanded While the general concept is unchanged the new edition features a broad array of new material e g ultrafast lasers atto and femto second lasers coherent matter waves Doppler free Fourier spectroscopy interference spectroscopy quantum optics and gravitational waves and still more applications in chemical analysis medical diagnostics and engineering

Semiconductor Lasers II Eli Kapon,1999-01-14 Judging from the impact it has on our everyday lives the semiconductor laser has emerged as perhaps the most important laser device currently in use This volume presents information on recent advances in materials and structures **Diode Lasers** D. Sands,2004-10-30 The compact size reliability and low cost of diode lasers lead to applications throughout modern technology most importantly in modern optical telecommunication systems This book presents a comprehensive introduction to the principles and operation of diode lasers It begins with a review of semiconductor physics and laser fundamentals before describing the most basic homojunction laser Later chapters describe more advanced laser types and their applications including the most recently developed and exotic laser designs The author s intuitive style coupled with an extensive set of worked examples and sample problems make this an outstanding introduction to the subject **Multiphoton Processes - Proceedings Of The Sixth International Conference** See Leang Chin,D K Evans,1994-08-31 This volume of important papers by one the world s leading astrophysicists provides a sweeping survey of the incisive and exciting applications of nuclear and particle physics to a wide range of problems in astrophysics and cosmology The prime focus of the book is on Big Bang cosmology and the role of primordial nucleosynthesis in establishing the modern consensus on the Big Bang This leads into the connection of cosmology to particle physics and the constraints put on various elementary particles by astrophysical arguments Big Bang Nucleosynthesis has also led to the argument for nonbaryonic dark matter and is thus related to the major problem in physical cosmology today namely structure formation The nuclear particle interface with astrophysics also extends to the other topics of major interest such as the age of the universe cosmic rays supernovae and solar neutrinos each of which will be discussed in some detail Each section contains historical papers current papers and frequently a popular article on the subject which provides an overview of the topic This volume is testimony to the success of the integration of nuclear and particle physics with astrophysics and cosmology and to the ingenuity of the work in this area which has earned the author numerous prestigious awards The book which is accessible to beginning graduate students should be of particular interest to researchers and students in astronomy astrophysics cosmology and gravitation and also in high energy and nuclear physics

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