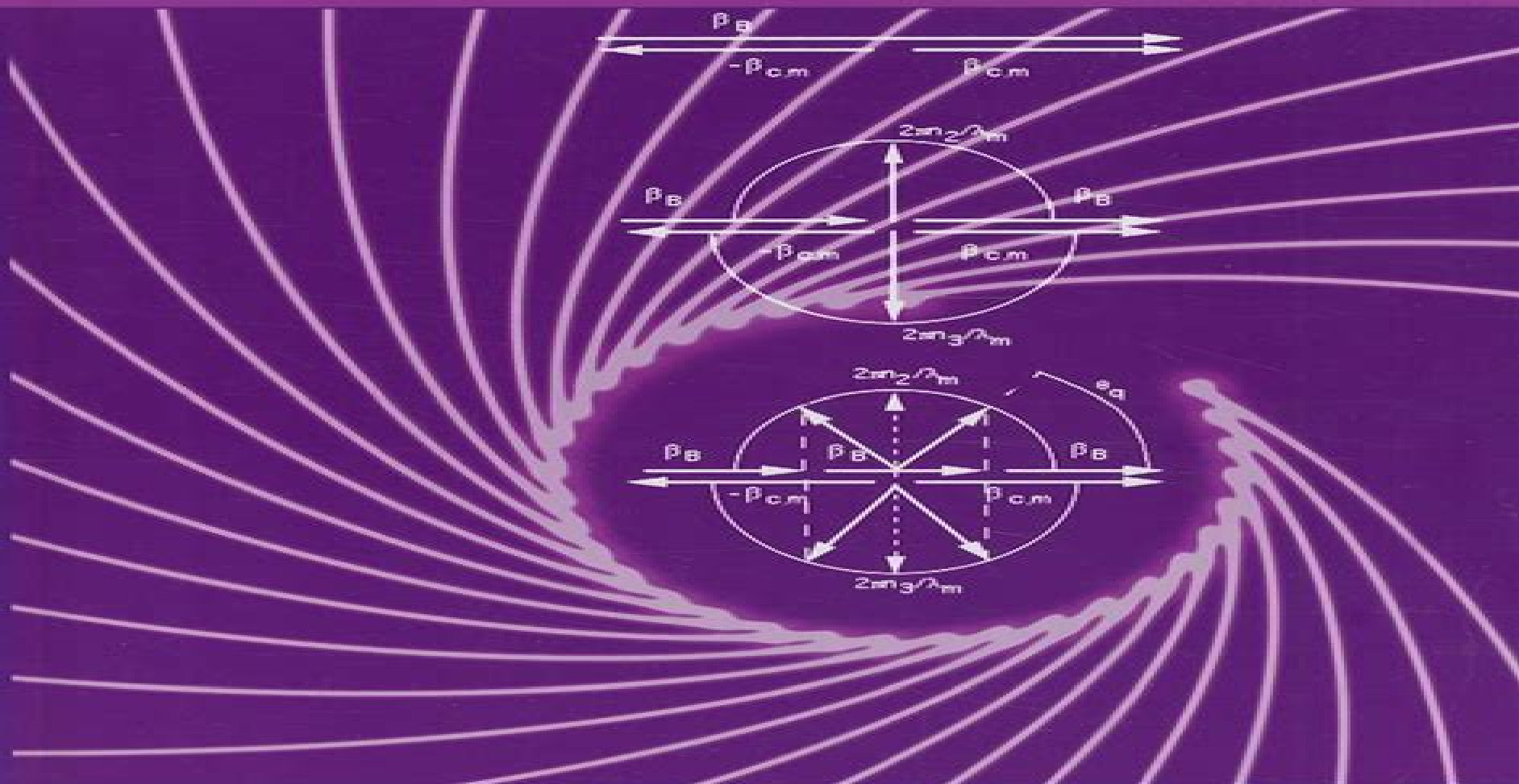


# HANDBOOK OF Distributed Feedback Laser Diodes

SECOND EDITION



GEERT MORTHIER • PATRICK VANKWIKELBERGE

# Handbook Of Distributed Feedback Laser Diodes

**William S. C. Chang**



## **Handbook Of Distributed Feedback Laser Diodes:**

Handbook of Distributed Feedback Laser Diodes, Second Edition Geert Morthier, Patrick Vankwikelberge, 2013-09-01 Since the first edition of this book was published in 1997 the photonics landscape has evolved considerably and so has the role of distributed feedback DFB laser diodes. Although tunable laser diodes continue to be introduced in advanced optical communication systems, DFB laser diodes are still widely applied in many deployed systems. This also includes wavelength tunable DFB laser diodes and DFB laser diode arrays usually integrated with intensity or phase modulators and semiconductor optical amplifiers. This valuable resource gives professionals a comprehensive description of the different effects that determine the behavior of a DFB laser diode. Special attention is given to two new chapters on wavelength tunable DFB laser diodes and bistable and unstable DFB laser diodes. Among many other updates throughout the reference, semiconductor and electromagnetic professionals are also provided two new appendices. This book fully covers the underlying theory, commercial applications, necessary design criteria, and future direction of this technology. Distributed Feedback Laser Diodes and Optical Tunable Filters Dr. H. Ghafouri-Shiraz, 2004-02-06 Advances in optical fibre based communications systems have played a crucial role in the development of the information highway. By offering a single mode oscillation and narrow spectral output, distributed feedback DFB semiconductor laser diodes offer excellent optical light sources as well as optical filters for fibre based communications and dense wavelength division multiplexing DWDM systems. This comprehensive text focuses on the basic working principles of DFB laser diodes and optical filters and details the development of a new technique for enhanced system performance. Considers the optical waveguiding characteristics and properties of semiconductor materials and the physics of DFB semiconductor lasers. Presents a powerful modelling technique based on the transfer matrix method which can be used to improve the design of laser diodes, optical fibres, and amplifiers. Examines the effect of the various corrugation shapes on the coupling coefficients and lasing characteristics of DFB laser diodes. Technical advice to improve immunity against the spatial hole burning effect. Extensive referencing throughout and a comprehensive glossary of symbols and abbreviations. Suitable for both introductory and advanced levels. This is an indispensable textbook for undergraduate and postgraduate students of electrical and electronic engineering and physics as it consolidates their knowledge in this rapidly growing field. As a technical guide for the structural design of DFB laser diodes and optical filters, the book will serve as an invaluable reference for researchers in optoelectronics and semiconductor device physics. **Distributed Feedback Laser Diodes** Dr. H. Ghafouri-Shiraz, B. S. K. Lo, 1996-08-06 Distributed Feedback Laser Diodes: Principles and Physical Modelling H. Ghafouri-Shiraz, B. S. K. Lo, University of Birmingham, UK. Advances in optical fibre based communications systems have played a crucial role in the development of the information highway. By offering a single mode oscillation and narrow spectral output, distributed feedback DFB semiconductor laser diodes offer an excellent optical light source for fibre based communication systems. This comprehensive text focuses on the basic working principles

of DFB laser diodes and details the development of a new technique for enhanced system performance Considers the optical waveguiding characteristics and properties of semiconductor materials and the physics of DFB semiconductor lasers Presents a powerful modelling technique based on the transfer matrix method which can be used to improve the design of laser diodes optical filters and amplifiers Examines the effect of the various corrugation shapes on the coupling coefficients and lasing characteristics of DFB laser diodes Technical advice to improve immunity against the spatial hole burning effect Extensive referencing throughout and a comprehensive glossary of symbols and abbreviations Distributed Feedback Laser Diodes is an indispensable text for senior students of electrical and electronic engineering and physics and will consolidate their knowledge in this rapidly growing field As a technical guide for the structural design of DFB laser diodes it will serve as an invaluable reference for researchers in optoelectronics and semiconductor and device physics **RF Photonic**

**Technology in Optical Fiber Links** William S. C. Chang, 2007-05-14 In many applications radio frequency RF signals need to be transmitted and processed without being digitalized Optical fiber provides a transmission medium in which RF modulated optical carriers can be transmitted and distributed with very low loss making it more efficient and less costly than conventional electronic systems This volume presents a review of RF photonic components transmission systems and signal processing examples in optical fibers from leading academic government and industry scientists working in this field It also introduces the reader to various related technologies such as direct modulation of laser sources external modulation techniques and detectors The text is aimed at engineers and scientists engaged in the research and development of optical fibers and analog RF applications With an emphasis on design performance and practical application this book will be of particular interest to those developing systems based on this technology *Distributed Feedback Semiconductor Lasers*

John E. Carroll, James Whiteaway, Dick Plumb, 1998 Concentrating on presenting a thorough analysis of DFB lasers from a level suitable for research students this book emphasises and gives extensive coverage of computer aided modeling techniques **A Practical Guide to Handling Laser Diode Beams** Haiyin Sun, 2015-02-20 This book offers the reader a practical guide to the control and characterization of laser diode beams Laser diodes are the most widely used lasers accounting for 50% of the global laser market Correct handling of laser diode beams is the key to the successful use of laser diodes and this requires an in depth understanding of their unique properties Following a short introduction to the working principles of laser diodes the book describes the basics of laser diode beams and beam propagation including Zemax modeling of a Gaussian beam propagating through a lens The core of the book is concerned with laser diode beam manipulations collimating and focusing circularization and astigmatism correction coupling into a single mode optical fiber diffractive optics and beam shaping and manipulation of multi transverse mode beams The final chapter of the book covers beam characterization methods describing the measurement of spatial and spectral properties including wavelength and linewidth measurement techniques The book is a significantly revised and expanded version of the title Laser Diode Beam

Basics Manipulations and Characterizations by the same author New topics introduced in this volume include laser diode types and working principles non paraxial Gaussian beam Zemax modeling numerical analysis of a laser diode beam spectral property characterization methods and power and energy characterization techniques The book approaches the subject in a practical way with mathematical content kept to the minimum level required making the book a convenient reference for laser diode users     Advanced Functional Materials Yafang Han,2018-04-19 This proceedings volume gathers selected papers presented at the Chinese Materials Conference 2017 CMC2017 held in Yinchuan City Ningxia China on July 06 12 2017 This book covers a wide range of metamaterials and multifunctional composites multiferroic materials amorphous and high entropy alloys advanced glass materials and devices advanced optoelectronic and microelectronic materials biomaterials deformation behavior and flow units in metastable materials advanced fibers and nano composites polymer materials and nanoporous metal materials The Chinese Materials Conference CMC is the most important serial conference of the Chinese Materials Research Society C MRS and has been held each year since the early 1990s The 2017 installment included 37 Symposia covering four fields Advances in energy and environmental materials High performance structural materials Fundamental research on materials and Advanced functional materials More than 5500 participants attended the congress and the organizers received more than 700 technical papers Based on the recommendations of symposium organizers and after peer reviewing 490 papers have been included in the present proceedings which showcase the latest original research results in the field of materials achieved by more than 300 research groups at various universities and research institutes

**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     **Quantum Dot Lasers on Silicon** Bozhang Dong,2023-02-04 This book provides guidelines and design rules for developing high performance low cost and energy efficient quantum dot QD lasers for silicon photonic integrated circuits PIC optical

frequency comb generation and quantum information systems To this end the nonlinear properties and dynamics of QD lasers on silicon are investigated in depth by both theoretical analysis and experiment This book aims at addressing four issues encountered in developing silicon PIC 1 The instability of laser emission caused by the chip scale back reflection During photonic integration the chip scale back reflection is usually responsible for the generation of severe instability i e coherence collapse from the on chip source As a consequence the transmission performance of the chip could be largely degraded To overcome this issue we investigate the nonlinear properties and dynamics of QD laser on Si in this book to understand how can it be applied to isolator free photonic integration in which the expensive optical isolator can be avoided Results show that the QD laser exhibits a high degree of tolerance for chip scale back reflections in absence of any instability which is a promising solution for isolator free applications 2 The degradation of laser performance at a high operating temperature In this era of Internet of Thing IoT about 40% of energy is consumed for cooling in the data center In this context it is important to develop a high temperature continuous wave CW emitted laser source In this book we introduce a single mode distributed feedback DFB QD laser with a design of optical wavelength detuning OWD By taking advantage of the OWD technique and the high performance QD with high thermal stability all the static and dynamical performances of the QD device are improved when the operating temperature is high This study paves the way for developing uncooled and isolator free PIC 3 The limited phase noise level and optical bandwidth of the laser are the bottlenecks for further increasing the transmission capacity To improve the transmission capacity and meet the requirement of the next generation of high speed optical communication we introduce the QD based optical frequency comb OFC laser in this book Benefiting from the gain broadening effect and the low noise properties of QD the OFC laser is realized with high optical bandwidth and low phase noise We also provide approaches to further improve the laser performance including the external optical feedback and the optical injection 4 Platform with rich optical nonlinearities is highly desired by future integrated quantum technologies In this book we investigate the nonlinear properties and four wave mixing FWM of QD laser on Si This study reveals that the FWM efficiency of QD laser is more than ten times higher than that of quantum well laser which gives insight into developing a QD based silicon platform for quantum states of light generation Based on the results in this book scientists researchers and engineers can come up with an informed judgment in utilizing the QD laser for applications ranging from classical silicon PIC to integrated quantum technologies

Handbook of Laser Technology and Applications Colin Webb, Julian D.C. Jones, 2020-09-29 The invention of the laser was one of the towering achievements of the twentieth century At the opening of the twenty first century we are witnessing the burgeoning of the myriad technical innovations to which that invention has led The Handbook of Laser Technology and Applications is a practical and long lasting reference source for scientists and engineers who work with lasers The Handbook provides a comprehensive guide to the current status of lasers and laser systems it is accessible to science or engineering graduates needing no more than standard undergraduate knowledge of

optics Whilst being a self contained reference work the Handbook provides extensive references to contemporary work and is a basis for studying the professional journal literature on the subject It covers applications through detailed case studies and is therefore well suited to readers who wish to use it to solve specific problems of their own The first of the three volumes comprises an introduction to the basic scientific principles of lasers laser beams and non linear optics The second volume describes the mechanisms and operating characteristics of specific types of laser including crystalline solid state lasers semiconductor diode lasers fibre lasers gas lasers chemical lasers dye lasers and many others as well as detailing the optical and electronic components which tailor the laser s performance and beam delivery systems The third volume is devoted to case studies of applications in a wide range of subjects including materials processing optical measurement techniques medicine telecommunications data storage spectroscopy earth sciences and astronomy and plasma fusion research This vast compendium of knowledge on laser science and technology is the work of over 130 international experts many of whom are recognised as the world leaders in their respective fields Whether the reader is engaged in the science technology industrial or medical applications of lasers or is researching the subject as a manager or investor in technical enterprises they cannot fail to be informed and enlightened by the wide range of information the Handbook supplies Handbook of Laser Technology and Applications: Laser design and laser systems Colin E. Webb, Julian D. C. Jones, 2004 **Handbook of Laser Technology and Applications (Three- Volume Set)** Colin Webb, Julian D. C. Jones, 2003-12-01 The invention of the laser was one of the towering achievements of the twentieth century At the opening of the twenty first century we are witnessing the burgeoning of the myriad technical innovations to which that invention has led The Handbook of Laser Technology and Applications is a practical and long lasting reference source for scientists a **Optical Fiber Telecommunications IV** Ivan P. Kaminow, Tingye Li, 2002 Volume IVA is devoted to progress in optical component research and development Topics include design of optical fiber for a variety of applications plus new materials for fiber amplifiers modulators optical switches light wave devices lasers and high bit rate electronics This volume is an excellent companion to Optical Fiber Telecommunications IVB Systems and Impairments March 2002 ISBN 0 12 3951739 Fourth in a respected and comprehensive series Authoritative authors from a range of organizations Suitable for active lightwave R D designers developers purchasers operators students and analysts Lightwave components reviewed in Volume A Lightwave systems and impairments reviewed in Volume B Up to the minute coverage **Fiber-Optic Communication Systems** Govind P. Agrawal, 2012-02-23 This book provides a comprehensive account of fiber optic communication systems The 3rd edition of this book is used worldwide as a textbook in many universities This 4th edition incorporates recent advances that have occurred in particular two new chapters One deals with the advanced modulation formats such as DPSK QPSK and QAM that are increasingly being used for improving spectral efficiency of WDM lightwave systems The second chapter focuses on new techniques such as all optical regeneration that are under development and likely to be used in future communication

systems All other chapters are updated as well     Optical Fiber Communications Systems Le Nguyen Binh,2011-06-08  
Carefully structured to provide practical knowledge on fundamental issues Optical Fiber Communications Systems Theory  
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communication systems With coverage ranging from fundamental to modern aspects the text presents optical communic

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super resolution microscopy and optical tomography The chapters detailing new options arising from the combination of  
classic TCSPC and fluorescence lifetime with methods based on intensity fluctuation represent a particularly unique highlight

*Engineering Electromagnetics* Rajeev Bansal,2018-10-08 Electromagnetics is too important in too many fields for  
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Optoelectronic Devices Joachim Piprek,2013-10-22 Optoelectronics has become an important part of our lives Wherever light  
is used to transmit information tiny semiconductor devices are needed to transfer electrical current into optical signals and  
vice versa Examples include light emitting diodes in radios and other appliances photodetectors in elevator doors and digital  
cameras and laser diodes that transmit phone calls through glass fibers Such optoelectronic devices take advantage of  
sophisticated interactions between electrons and light Nanometer scale semiconductor structures are often at the heart of  
modern optoelectronic devices Their shrinking size and increasing complexity make computer simulation an important tool to



design better devices that meet ever rising performance requirements The current need to apply advanced design software in optoelectronics follows the trend observed in the 1980 s with simulation software for silicon devices Today software for technology computer aided design TCAD and electronic design automation EDA represents a fundamental part of the silicon industry In optoelectronics advanced commercial device software has emerged recently and it is expected to play an increasingly important role in the near future This book will enable students device engineers and researchers to more effectively use advanced design software in optoelectronics Provides fundamental knowledge in semiconductor physics and in electromagnetics while helping to understand and use advanced device simulation software Demonstrates the combination of measurements and simulations in order to obtain realistic results and provides data on all required material parameters Gives deep insight into the physics of state of the art devices and helps to design and analyze of modern optoelectronic devices

*Handbook of Laser Technology and Applications* Chunlei Guo,2021-06-24 This comprehensive handbook gives a fully updated guide to lasers and laser systems including the complete range of their technical applications The first volume outlines the fundamental components of lasers their properties and working principles The second volume gives exhaustive coverage of all major categories of lasers from solid state and semiconductor diode to fiber waveguide gas chemical and dye lasers The third volume covers modern applications in engineering and technology including all new and updated case studies spanning telecommunications and data storage to medicine optical measurement defense and security nanomaterials processing and characterization

**Optical Fiber Communication Systems with MATLAB® and Simulink® Models, Second Edition** Le Nguyen Binh,2014-12-01 Carefully structured to instill practical knowledge of fundamental issues Optical Fiber Communication Systems with MATLAB and Simulink Models describes the modeling of optically amplified fiber communications systems using MATLAB and Simulink This lecture based book focuses on concepts and interpretation mathematical procedures and engineering applications shedding light on device behavior and dynamics through computer modeling Supplying a deeper understanding of the current and future state of optical systems and networks this Second Edition Reflects the latest developments in optical fiber communications technology Includes new and updated case studies examples end of chapter problems and MATLAB and Simulink models Emphasizes DSP based coherent reception techniques essential to advancement in short and long term optical transmission networks Optical Fiber Communication Systems with MATLAB and Simulink Models Second Edition is intended for use in university and professional training courses in the specialized field of optical communications This text should also appeal to students of engineering and science who have already taken courses in electromagnetic theory signal processing and digital communications as well as to optical engineers designers and practitioners in industry

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