Lasers

Basic Aspects of Medical and Dental Lasers provides tutorials for the non-laser-technical reader on the basic aspects of medical and dental lasers, laser delivery systems used in laser medicine and surgery, and how laser light interacts with biological tissue. Use of mathematics is kept to an absolute minimum, and the math is simple. These tutorials are recommended reading by the Academy of Laser Dentistry for dentists and hygienists preparing for their certification exams. This book should also be of interest to students at all levels (high school, college, medical/dental school), clinical and administrative medical professionals, and medical device marketing professionals wanting a basic introduction to medical and dental lasers and how they are used clinically. Jeffrey G. Manni is a laser engineer who helps clients develop laser-based products and applications. He specializes in lasers for biomedical and biotechnology instrumentation, laser microscopy, and laser-based displays.

Solid-state lasers which offer multiple desirable qualities, including enhanced reliability, robustness, efficiency and wavelength diversity, are absolutely indispensable for many applications. The Handbook of solid-state lasers reviews the key materials, processes and applications of solid-state lasers across a wide range of fields. Part one begins by reviewing solid-state laser materials. Fluoride laser crystals, oxide laser ceramics, crystals and fluoride laser ceramics doped by rare earth and transition metal ions are discussed alongside neodymium, erbium and ytterbium laser glasses, and nonlinear crystals for solid-state lasers. Part two then goes on to explore solid-state laser systems and their applications, beginning with a discussion of the principles, powering and operation regimes for solid-state lasers. The use of neodymium-doped materials is considered, followed by system sizing issues with diode-pumped quasi-three level materials, erbium glass lasers, and microchip, fiber, Raman and cryogenic lasers. Laser mid-infrared systems, laser induced breakdown spectroscope and the clinical applications of surgical solid-state lasers are also explored. The use of solid-state lasers in defense programs is then reviewed, before the book concludes by presenting some environmental applications of solid-state lasers. With its distinguished editors and international team of expert contributors, the Handbook of solid-state lasers is an authoritative guide for all those involved in the design and application of this technology, including laser and materials scientists and engineers, medical and military professionals, environmental researchers, and academics working in this field. Reviews the materials used in solid-state lasers Explores the principles of solid-state laser systems and their applications Considers defence and environmental applications

Lasers were developed out of Einstein's theories, but the first work ing device was not produced until 1960. Since then, they have found applications in many areas of medicine, and hold promise for many more. This book has been written to provide a basic found ation on lasers - what they are, how they work, and what they can do for the patient. It assumes only a basic scientific background in the reader, and has many simple and clear diagrams. It should be of interest to clinicians, surgeons, nurses, safety officers, patients and interested laymen. The book consists of six chapters, and following a glossary of technical terms, begins with a brief discussion of the physics behind laser action. This section is illustrated with clear diagrams, and is written in an easy-to-follow style. It describes how laser light originates, and how it differs fundamentally from ordinary light. The remainder of the book is concerned with the use of lasers in medicine. Chapter 2 deals with the various ways in which a laser beam can interact with tissue, and shows how this depends on the particular laser being used. The following chapter describes some properties of those lasers which are most usually used in current medical practice, but also discusses new and experimental develop ments. There are various methods of getting the laser beam to the target tissue, and these are described in Chapter 4.

This volume presents state-of-the-art information on several important material systems and device structures employed in modern semiconductor lasers. The first two chapters discuss several III-V, II-VI, and VI-VI compound semiconductor material systems employed in diode lasers whose emission spectra cover the range from the blue to the mid-infrared. Subsequent chapters describe the elaboration of special laser structures designed for achieving narrow spectral linewidths and wavelength tunability, as well as high power emission devices. The last chapter covers the development of surface emitting diode lasers, particularly vertical cavity structures. In all five chapters, the underlying device physics as well as the state-of-the-art and future trends are discussed. This book introduces the non-expert to the design and fabrication issues involved in the development of these important laser devices. In addition, it reviews the current status of the different material systems and cavity configurations for the benefit of readers engaged in research in this field. Useful background material related to the fundamentals of lasing in semiconductors can be found in the companion volume, Semiconductor Lasers I: Fundamentals. Covers important recent advances in materials, design, fabrication, and device structure of semiconductor lasers - aspects not covered in previously existing literature Introduces the non-expert to the subject Useful for professionals engaged in research and development Numerous schematic and data-containing illustrations Written by leading experts in the field

Solid-State Laser Engineering

Fundamentals and Engineering

An Introduction

Lasers in Cardiovascular Interventions

For Students of Science and Engineering

The only introductory text on the market today that explains the underlying physics and engineering applicable to all lasers Although lasers

are becoming increasingly important in our high-tech environment, many of the technicians and engineers who install, operate, and maintain them have had little, if any, formal training in the field of electro-optics. This can result in less efficient usage of these important tools. Introduction to Laser Technology, Fourth Edition provides readers with a good understanding of what a laser is and what it can and cannot do. The book explains what types of laser to use for different purposes and how a laser can be modified to improve its performance in a given application. With a unique combination of clarity and technical depth, the book explains the characteristics and important applications of commercial lasers worldwide and discusses light and optics, the fundamental elements of lasers, and laser modification.? In addition to new chapter-end problems, the Fourth Edition includes new and expanded chapter material on: Material and wavelength Diode Laser Arrays Quantum-cascade lasers Fiber lasers Thin-disk and slab lasers Ultrafast fiber lasers Raman lasers Quasi-phase matching Optically pumped semiconductor lasers Introduction to Laser Technology, Fourth Edition is an excellent book for students, technicians, engineers, and other professionals seeking a fuller, more formal introduction to the field of laser technology.

Accessible, illustrated introduction covers wave patterns and coherence, summarizes the development of lasers and the phenomenon of wave diffraction, and describes zone plates and properties of holograms. 1981 edition.

Since the introduction of laser devices to the medical sciences this technology has created great interest. Specifically, the laser’s unique physical properties and precise bio-tissue interactions render this versatile source of biologic energy an attractive tool for multiple therapeutic purposes in cardiovascular medicine. Over the course of the last 2 decades the utilization of laser technology has become an important component for the management of patients with complex cardiovascular diseases. During this time period, cutting edge laser technology including a variety of wave length generators, newly designed catheters, and a selection of advanced optic fibers have been introduced and applied in the cardiovascular circulation. Improved lasing techniques in the cardiac catheterization suites and operation rooms have been implemented for treatment of ischemic coronary syndromes, peripheral arterial occlusive disease and other atherosclerotic thrombotic conditions. Moreover, during this 20 year time frame, several multicenter and single center clinical studies have been published focusing on the role and utilization of lasers in coronary and peripheral revascularization. And within the rapidly expanding field of interventional cardiac electrophysiology, laser technology has recently revolutionized the management of fractured, abandoned and malfunctioning leads of cardiac pacemakers and automatic defibrillators. Consequently, replacing a notoriously cumbersome and high risk open heart surgery with safe and markedly efficient percutaneous laser based extraction. This textbook will provide the most authoritative, comprehensive and contemporary information covering technological progress, clinical experience and pertinent aspects of laser applications in cardiovascular medicine. It will be of interest to cardiologists, vascular surgeons and interventional radiologist as well as medical students, scientists, biomedical engineering students and graduates.

An introductory text on laser physics features an emphasis on basic laser principles and theory, without requiring a quantum mechanical background.

Lasers and Electro-optics

An Introductory Guide

Lasers in Medicine

Unifying Physics of Accelerators, Lasers and Plasma

Analysis and Design of Vertical Cavity Surface Emitting Lasers

An introduction to photonics and lasers that does not rely on complex mathematics This book evolved from a series of courses developed by the author and taught in the areas of lasers and photonics. This thoroughly classroom-tested work fills a unique need for students, instructors, and industry professionals in search of an introductory-level book that covers a wide range of topics in these areas. Comparable books tend to be aimed either too high or too low, or they cover only a portion of the topics that are needed for a comprehensive treatment. Photonics and Lasers is divided into four parts: * Propagation of Light * Generation and Detection of Light * Laser Light * Light-Based Communication The author has ensured that complex mathematics does not become an obstacle to understanding key physical concepts. Physical arguments and explanations are clearly set forth while, at the same time, sufficient mathematical detail is provided for a quantitative understanding. As an additional aid to readers who are learning to think symbolically, some equations are expressed in words as well as symbols. Problem sets are provided throughout the book for readers to test their knowledge and grasp of key concepts. A solutions manual is also available for instructors. Finally, the detailed bibliography leads readers to in-depth explorations of particular topics. The book's topics, lasers and photonics, are often treated separately in other texts; however, the author skillfully demonstrates their natural synergy. Because of the combined coverage, this text can be used for a two-semester course or a one-semester course emphasizing either lasers or photonics. This is a perfect introductory textbook for both undergraduate and graduate students, additionally serving as a practical reference for engineers in telecommunications, optics, and laser electronics.

An essential introduction to the principles of laser operation and design for graduates in physics and engineering.
The volume contains the proceedings of the 7th Course on Physics and Technology of Free Electron Lasers of the International School of Quantum Electronics, which was held in Erice (Italy) from 17 to 29 August 1980, under the auspices of the "Ettore Majorana" Centre for Scientific Culture. The level of this Course was much closer to a workshop than to a school, and "Advances in Free Electron Lasers" might have been an appropriate title. Many of the world's leading scientists in the field (among them, the inventor of FEL, J. M. J. Madey) were brought together to review the accomplishments of FEL experiments, as well various trends in FEL theory. In editing this material we did not modify the original manu scripts except to assist in uniformity of style. The papers. are presented without reference to the chronology of the Course but in the following topical arrangement: A. "Fundamentals of free electron lasers," a group of tutorial papers; B. "Free electron lasers operating in the Compton regime," where theories and experiments of FELs based on Compton scattering are reviewed; C. "Free electron lasers operating in the Raman regime," a dis cussion of FELs based on Raman scattering; D. "Optical klystrons," where the possibility of this class of FEL is discussed from a theoretical viewpoint; E.
The State of the Art in High-Power Laser Technology Filled with full-color images, High-Power Laser Handbook offers comprehensive details on the latest advances in high-power laser development and applications. Performance parameters for each major class of lasers are described. The book covers high-power gas, chemical, and free-electron lasers and then discusses semiconductor diode lasers, along with the associated technologies of packaging, reliability, and beam shaping and delivery. Current research and development in solid-state lasers is described as well as scaling approaches for high CW powers, high pulse energies, and high peak powers. This authoritative work also addresses the emergence of fiber lasers and concludes by reviewing various methods for beam combining. Coverage Includes: Carbon dioxide lasers Excimer lasers Chemical lasers High-power free-electron lasers Semiconductor laser diodes High-power diode laser arrays Introduction to high-power solid-state lasers Zig-zag slab lasers ThinZag high-power laser development Thin disk lasers Heat capacity lasers Ultrafast solid-state lasers Ultrafast lasers in the thin disk geometry The National Ignition Facility laser Optical fiber lasers Pulsed fiber lasers High-power ultrafast fiber laser systems High-power fiber lasers for industry and defense Beam combining
Handbook of Solid-state Lasers
Electromagnetic Waves and Lasers
Basics, Advances and Applications
A Practical Approach to High Power and Single Mode Devices
Fundamentals of Light Sources and Lasers
Lasers with a gaseous active medium offer high flexibility, wide tunability, and advantages in cost, beam quality, and power scalability. Gas lasers have tended to become overshadowed by the recent popularity and proliferation of semiconductor lasers. As a result of this shift in focus, details on modern developments in gas lasers are difficult to find. In addition, different types of gas lasers have unique properties that are not well-described in other references. Collecting expert contributions from authorities dealing with specific types of lasers, Gas Lasers examines the fundamentals, current research, and applications of this important class of laser. It is important to understand all types of lasers, from solid-state to gaseous, before making a decision for any application. This book fills in the gaps by discussing the definition and properties of gaseous media along with its fluid dynamics, electric excitation circuits, and optical resonators. From this foundation, the discussion launches into the basic physics, characteristics, applications, and current research efforts for specific types of gas lasers: CO lasers, CO2 lasers, HF/DF lasers, excimer lasers, iodine lasers, and metal vapor lasers. The final chapter discusses miscellaneous lasers not covered in the previous chapters. Collecting hard-to-find material into a single, convenient source, Gas Lasers offers an encyclopedic survey that helps you approach new applications with a more complete inventory of laser options.
Lasers and Nuclei describes the generation of high-energy-particle radiation with high-intensity lasers and its application to nuclear science. A basic introduction to laser--matter interaction at high fields is complemented by detailed presentations of state of the art laser particle acceleration and elementary laser nuclear experiments. The text also discusses future applications of lasers in nuclear science, for example in nuclear astrophysics, isotope generation, nuclear fuel physics and proton and neutron imaging.
Unifying Physics of Accelerators, Lasers and Plasma introduces the physics of accelerators, lasers and plasma in tandem with the industrial methodology of inventiveness, a technique that teaches that similar problems and solutions appear again and again in seemingly dissimilar disciplines. This unique approach builds bridges and enhances connection
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.
Lasers and Optical Instrumentation
Vascular - Pigmentation - Hair - Scars - Medical Applications
Gas Lasers
Introduction to Laser Technology
X-Ray Lasers 2018

From the reviews: "Takes the reader on a journey that covers all the basic science and engineering related to the topic of developing a solid-state laser for common materials processing problems. [...] Entrants to the field will certainly find it a book to keep for future reference." Optics & Photonic News

Lasers and Optical Instrumentation covers B.E., M.E., and M. Sc. (Electronics) degree courses. The text covers basic principles of lasers, types of lasers and their characteristics, laser applications in engineering and medicine. Further the book includes extensive coverage of optoelectronic devices, fibre optic communication and fibre optic sensors. The book includes many solved problems throughout the text to support the theoretical concepts and help in understanding of underlying principles. Review questions have been included at the end of each chapter to practise and self-study. Spread in Ten Chapters the book broadly covers: * Characteristics of lasers, mode locking, Q-switching, powerful lasers, frequency stabilisation * Overview of applications of lasers in science, engineering and medicine; reliability and safety aspects * Laser interferometer, laser strain gauges, laser Doppler velocimeter, laser ranging, mechanical cutting, welding, scribing, holography * Applications of Raman spectroscopy * Application of laser devices, optical fibers etc., in fiber optic communications * Integrated optics, radiation source, transmission link, detector * Fibre optical sensors, non-intrusively, displacements, pressure, temperature, high currents, angular velocity * Future perspectives — nanophotonics, quantum dots, photonic crystals

This newly revised title helps you incorporate the very latest in Lasers and Lights into your busy practice. Succinctly written and lavishly illustrated, this book focus on procedural how-to’s and offer step-by-step advice on proper techniques, pitfalls, and tricks of the trade-so you can refine and hone your skills...and expand your repertoire. Contains a wealth of color illustrations and photographs that depict cases as they appear in practice so you can visualize techniques clearly. Updates chapters throughout the book to keep you up to date on the latest uses of lasers and lights in this rapidly moving field. Includes guidance for getting the best results when performing hot techniques such as Thermage or the use of Radiofrequency lasers.

This reference book provides a fully integrated novel approach to the development of high-power, single-transverse mode, edge-emitting diode lasers by addressing the complementary topics of device engineering, reliability engineering and device diagnostics in the same book, and thus closes the gap in the current book literature. Diode laser fundamentals are discussed, followed by an elaborate discussion of problem-oriented design guidelines and techniques, and by a systematic treatment of the origins of laser degradation and a thorough exploration of the engineering means to enhance the optical strength of the laser. Stability criteria of critical laser characteristics and key laser robustness factors are discussed along with clear design considerations in the context of reliability engineering approaches and models, and typical programs for reliability tests and laser product qualifications. Novel, advanced diagnostic methods are reviewed to discuss, for the first time in detail in book literature, performance- and reliability-impacting factors such as temperature, stress and material instabilities. Further key features include: practical design guidelines that consider also reliability related effects, key laser robustness factors, basic laser fabrication and packaging issues; detailed discussion of diagnostic investigations of diode lasers, the fundamentals of the applied approaches and techniques, many of them pioneered by the author to be fit-for-purpose and novel in the application; systematic insight into laser degradation modes such as catastrophic optical damage, and a wide range of technologies to increase the optical strength of diode lasers; coverage of basic concepts and techniques of laser reliability engineering with details on a standard commercial high power laser reliability test program. Semiconductor Laser Engineering, Reliability and Diagnostics reflects the extensive expertise of the author in the diode laser field both as a top scientific researcher as well as a key developer of high-power highly reliable devices. With invaluable practical advice, this new reference book is suited to practising researchers in diode laser technologies, and to postgraduate engineering students. Dr. Peter W. Epperlein is Technology Consultant with his own semiconductor technology consulting business Pwe-PhotonicsElectronics-IssueResolution in the UK. He looks back at a thirty years career in cutting edge photonics and electronics industries with focus on emerging technologies, both in global and start-up companies, including IBM, Hewlett-Packard, Agilent Technologies, Philips/NXP, Essient Photonics and IBM/JDSU Laser Enterprise. He holds Pre-Dipl. (B.Sc.), Dipl. Phys. (M.Sc.) and Dr. rer. nat. (Ph.D.) degrees in physics, magna cum laude, from the University of Stuttgart, Germany. Dr. Epperlein is an internationally recognized expert in compound semiconductor and diode laser technologies. He has accomplished R&D in many device areas such as semiconductor lasers, LEDs, optical modulators, quantum well devices, resonant tunneling devices, FETs, and superconducting tunnel junctions and integrated circuits. His pioneering work on sophisticated diagnostic research has led to many world’s first reports and has been adopted by other researchers in academia and industry. He authored more than seventy peer-reviewed journal papers, published more than ten invention disclosures in the IBM Technical Disclosure Bulletin, has served as reviewer of numerous proposals for publication in technical journals, and has won five IBM Research Division Awards. His key achievements include the design and fabrication of high-power, highly reliable, single mode diode lasers. Book Reviews “Semiconductor Laser Engineering, Reliability and Diagnostics: A Practical Approach to High Power and Single Mode Devices”. By Peter W. Epperlein Prof. em. Dr. Heinz Jäckel, High Speed Electronics and Photonics, Swiss Federal Institute of Technology ETH Zürich, Switzerland The book “Semiconductor Laser Engineering, Reliability and Diagnostics” by Dr. P.W. Epperlein is a landmark in the recent literature on semiconductor lasers because it fills a longstanding gap between many excellent books on laser theory and the complex and challenging endeavor to fabricate these devices reproducibly and reliably in an industrial, real world environment. Having worked myself in the early research and development of high power semiconductor lasers, I appreciate the competent, complete and skillful presentation of these three highly interrelated topics, where small effects have dramatic consequences on the success of a final product, on the ultimate performance and on the stringent reliability requirements, which are the name of the game. As the title suggests the author addresses three tightly interwoven and critical topics of state-of-the-art power laser

research. The three parts are: device and mode stability engineering (chapter 1, 2), reliability mechanisms and reliability assessment strategies (chapter 3, 4, 5, 6) and finally material and device diagnostics (chapter 7, 8, 9) all treated with a strong focus on the implementation. This emphasis on the complex practical aspects for a large-scale power laser fabrication is a true highlight of the book. The subtle interplay between laser design, reliability strategies, advanced failure analysis and characterization techniques are elaborated in a very rigorous and scientific way using a very clear and easy to read representation of the complex interrelation of the three major topics. I will abstain from trying to provide a complete account of all the topics but mainly concentrate on the numerous highlights. The first part 1 “Laser Engineering” is divided in two chapters on basic electronic-optical, structural, material and resonator laser engineering on the one side, and on single mode control and stability at very high, still reliable power-levels with the trade-off between mirror damage, single mode stability on the other side. To round up the picture less well-known concepts and the state-of-the-art of large-area lasers, which can be forced into single-mode operation, are reviewed carefully. The subtle and complex interplay, which is challenging to optimize for a design for reliability and low stress as a major boundary condition is crucial for the design. The section gives a rather complete and well-referenced account of all relevant aspects, relations and trade-offs for understanding the rest of the book. The completeness of the presentation on power laser diode design based on basic physical and plausible arguments is mainly based on analytic mathematical relations as well as experiments providing a new and well-balanced addition for the power diode laser literature in particular. Modern 2D self-consistent electro-optical laser modeling including carrier hole burning and thermal effects – this is important because the weak optical guiding and gain-discrimination depend critically on rather small quantities and effects, which are difficult to optimize experimentally – is used in the book for simulation results, but is not treated separately. The novel and really original, “gap-filling” bulk of the book is elaborated by the author in a very clear way in the following four chapters in the part 2 “Laser Reliability” on laser degradation physics and mirror design and passivation at high power, followed then by two very application oriented chapters on reliability design engineering and practical reliability strategies and implementation procedures. This original combination of integral design and reliability aspects – which are mostly neglected in standard literature – is certainly a major plus of this book. I liked this second section as a whole, because it provides excellent insights in degradation physics on a high level and combines it in an interesting and skillful way with the less “glamorous” (unfortunately) but highly relevant reliability science and testing strategies, which is particularly important for devices operating at extreme optical stresses with challenging lifetime requirements in a real word environment. Finally, the last part 3 “Laser Diagnostics” comprising three chapters, is devoted mainly to advanced experimental diagnostics techniques for material integrity, mechanical stress, deep level defects, various dynamic laser degradation effects, surface- and interface quality, and most importantly heating and disordering of mirrors and mirror coatings. The topics of characterization techniques comprising micro-Raman- and micro-thermoreflectance-probing, 2K photoluminescence spectroscopy, micro-electroluminescence and photoluminescence scanning, and deep-level-transient spectroscopy have been pioneered by the author for the specific applications over many years guaranteeing many competent and well represented insights. These techniques are brilliantly discussed and the information distributed in many articles by the author has been successfully unified in a book form. In my personal judgment and liking, I consider the parts 2 and 3 on reliability and diagnostics as the most valuable and true novel contribution of the book, which in combination with the extremely well-covered laser design of part 1 clearly fill the gap in the current diode laser literature, which in this detail has certainly been neglected in the past. In summary, I can highly recommend this excellent, well-organized and clearly written book to readers who are already familiar with basic diode laser theory and who are active in the academic and industrial fabrication and characterization of semiconductor lasers. Due to its completeness, it also serves as an excellent reference of the current state-of-the-art in reliability engineering and device and material diagnostics. Needless to mention that the quality of the book, its representations and methodical structure meet the highest expectation and are certainly a tribute from the long and broad experience of the author in academic laser science and the industrial commercialization of high power diode lasers. In my opinion, this book was a pleasure to read and due to its quality and relevance deserves a large audience in the power diode laser community! Prof. em. Dr. Heinz Jäckel, High Speed Electronics and Photonics, Swiss Federal Institute of Technology ETH Zürich, Switzerland June 16, 2013 ========== “Semiconductor Laser Engineering, Reliability and Diagnostics: A Practical Approach to High Power and Single Mode Devices”. By Peter W. Epperlein Dr. Chung-en Zah, Research Director, Semiconductor Technologies Research, S&T Division, Corning Incorporate, Corning NY, USA This book covers for the first time the three closely interrelated key laser areas of engineering (design), reliability and diagnostics in one book, written by the well-known practitioner in cutting-edge optoelectronics industries, Dr. Peter W. Epperlein. The book closes the gap in the current book literature and is thus a unique and excellent example of how to merge design, reliability and diagnostics aspects in a very professional, profound and complete manner. All physical and technological principles, concepts and practical aspects required for developing and fabricating highly-reliable high-power single-mode laser products are precisely specified and skilfully formulated along with all the necessary equations, figures, tables and worked-out examples making it easy to follow through the nine chapters. Hence, this unique book is a milestone in the diode laser literature and is an excellent reference book not only for diode laser researchers and engineers, but also diode laser users. The engineering part starts with a very informative and clear, well-presented account of all necessary basic diode laser types, principles, parameters and characteristics for an easy and quick understanding of laser functionality within the context of the book. Along with an elaborate and broad discussion of relevant laser material systems, applications, typical output powers, power-limiting factors and reliability tradeoffs, basic fabrication and packaging technologies, this excellent introductory section is well suited to become quickly and easily familiar with practical aspects and issues of diode laser technologies. Of special importance and high usefulness is the first analytic and quantitative discussion in a book on issues of coupling laser power into optical single mode fibers. The second section discusses in a well-balanced, competent and skilful way waveguide topics such as basic high-power design approaches, transverse vertical and lateral waveguide concepts, stability of the fundamental transverse lateral mode and fundamental mode waveguide optimization techniques by considering detrimental effects such as heating, carrier injection, spatial hole burning, lateral current spreading and gain profile variations. Less well-known approaches to force large-area lasers into a single mode operation are well-identified and carefully discussed in depth and breadth. All these topics are elaborated in a very complete, rigorous and scientific way and are clearly articulated and easy to read. In particular, the book works out the complex interaction between the many different effects to optimize high-power single-mode performance at ultimate reliability and thus is of great benefit to every researcher and engineer engaged in this diode laser field. Another novelty and highlight is, for the first time ever in book form, a comprehensive yet concise discussion of diode laser reliability related issues. These are elaborated in four distinct chapters comprising laser

degradation physics and modes, optical strength enhancement approaches including mirror passivation/coating and non-absorbing mirror technologies, followed by two highly relevant product-oriented chapters on reliability design engineering concepts and techniques and an elaborate reliability test plan for laser chip and module product qualification. This original and novel approach to link laser design to reliability aspects and requirements provides both, most useful insight into degradation processes such as catastrophic optical mirror damage on a microscopic scale, and a wide selection of effective remedial actions. These accounts, which are of highest significance for lasers operating at the optical stress limit due to extremely high output power densities and most demanding lifetime requirements are very professionally prepared and discussed in an interesting, coherent and skilful manner. The diagnostics part, consisting of three very elaborate chapters, is most unique and novel with respect to other diode laser books. It discusses for the first time ever on a very high level and in a competent way studies on material integrity, impurity trapping effects, mirror and cavity temperatures, surface- and interface quality, mirror facet disorder effects, mechanical stress and facet coating instability, and diverse laser temperature effects, dynamic laser degradation effects and mirror temperature maps. Of highest significance to design, performance and reliability are the various correlations established between laser device and material parameters. The most different and sophisticated experiments, carried out by the author at micrometer spatial resolutions and at temperatures as low as 2K, provide highly valuable insights into laser and material quality parameters, and reveal for the first time the origins of high power limitations on an atomic scale due to local heating effects and deep level defects. It is of great benefit, that the experimental techniques such as Raman spectroscopy, various luminescence techniques, thermoreflectance and deep-level transient spectroscopy, pioneered by the author for the specific experiments on lasers, are discussed with great expertise in depth and breadth, and the numerous paper articles published by the author are now represented in this book. The book has an elaborate table of contents and index, which are very useful, over 200 illustrative figures and tables, and extensive lists of references to all technical topics at the end of each of the nine chapters, which make it easy to follow from cover to cover or by jumping in at random areas of special interest. Moreover, experimental and theoretical concepts are always illustrated by practical examples and data. I can highly recommend this extremely relevant, well-structured and well-formulated book to all practising researchers in industrial and academic diode laser R&D environments and to post-graduate engineering students interested in the actual problems of designing, manufacturing, testing, characterising and qualifying diode lasers. Due to its completeness and novel approach to combine design, reliability and diagnostics in the same book, it can serve as an ideal reference book as well, and it deserves to be welcomed wordwide by the addressed audience. Dr. Chung-en Zah, Research Director, Semiconductor Technologies Research, S&T Division, Corning Incorporate, Corning NY, USA ========== “Semiconductor Laser Engineering, Reliability and Diagnostics: A Practical Approach to High Power and Single Mode Devices”. By Peter W. Epperlein Cordinatore Prof. Lorenzo Pavesi, UNIVERSITÀ DEGLI STUDI DI TRENTO, Dipartimento di Fisica / Laboratorio di Nanoscienze This book represents a well thought description of three fundamental aspects of laser technology: the functioning principles, the reliability and the diagnostics. From this point of view, and, as far as I know, this is a unique example of a book where all these aspects are merged together resulting in a well-balanced presentation. This helps the reader to move with ease between different concepts since they are presented in a coherent manner and with the same terminology, symbols and definitions. The book reads well. Despite the subtitle indicates that it is a practical approach, the book is also correct from a formal point of view and presents the necessary equations and derivations to understand both the physical mechanisms and the practicalities via a set of useful formulas. In addition, there is the more important aspect of many real-life examples of how a laser is actually manufactured and which the relevant parameters that determine its behaviour are. It impresses the amounts of information that are given in the book: this would be more typical of a thick handbook on semiconductor laser than of an agile book. Dr. Epperlein was able to identify the most important concepts and to present them in a clear though concise way. I am teaching a course on Optoelectronics and I'm going to advise students to refer to this book, because it has all the necessary concepts and derivations for a systematic understanding of semiconductor lasers with many worked-out examples, which will help the student to grasp the actual problems of designing, manufacturing, testing and using semiconductor lasers. All the various concepts are joined to very useful figures, which, if provided to instructors as files, can be a useful add-on for the use of the book as text for teaching. Concepts are always detailed with numbers to give a feeling of their practical use. In conclusion, I do find the book suitable for my teaching duties and will refer it to my students. Prof. Dr. Lorenzo Pavesi, Head of the Department of Physics, Head of the Nanoscience Laboratory, University of Trento, Italy 31 May 2013 ========== “Semiconductor Laser Engineering, Reliability and Diagnostics: A Practical Approach to High Power and Single Mode Devices”. By Peter W. Epperlein Robert W. Herrick, Ph.D., Senior Component Reliability Engineer, Intel Corp., Santa Clara, California, USA Dr. Epperlein has done the semiconductor laser community a great service, by releasing the most complete book on the market on the practical issues of how to make reliable semiconductor lasers. While dozens of books have been written over the past couple of decades on semiconductor laser design, only a handful have been written on semiconductor laser reliability. Prior to the release of this book, perhaps 40% of the material could be obtained elsewhere by combining five books: one on laser design, one on laser reliability, one on reliability calculations, and a couple of laser review books. Another 40% could be pieced together by collecting 50 -100 papers on the subjects of laser design, laser fabrication, characterization, and reliability. The remaining 20% have not previously been covered in any comprehensive way. Only the introductory material in the first half of the first chapter has good coverage elsewhere. The large majority of the knowledge in this book is generally held as “trade secret” by those with the expertise in the field, and most of those in the know are not free to discuss. The author was fortunate enough to work for the first half of his career in the IBM research labs, with access to unparalleled resources, and the ability to publish his work without trade secret restrictions. The results are still at the cutting edge of our understanding of semiconductor laser reliability today, and go well beyond the empirical “black box” approach many use of “try everything, and see what works.” The author did a fine job of pulling together material from many disparate fields. Dr. Epperlein has particular expertise in high power single mode semiconductor lasers, and those working on those type of lasers will be especially interested in this book, as there has never been a book published on the fabrication and qualification of such lasers before. But those in almost any field of semiconductor lasers will learn items of interest about device design, fabrication, reliability, and characterization. Unlike most other books, which intend to convey the scientific findings or past work of the author, this one is written more as a “how to” manual, which should make it more accessible and useful to development engineers and researchers in the field. It also has over 200 figures, which make it easier to follow. As with many books of this type, it is not necessary to read it from cover-to-cover; it is best skimmed, with deep diving into any areas of special interest to the reader. The book is remarkable also for how comprehensive it is – even experts will discover something new and useful. Dr.

Epperlein’s book is an essential read for anyone looking to develop semiconductor lasers for anything other than pure research use, and I give it my highest recommendation. Robert W. Herrick, Ph.D., Senior Component Reliability Engineer, Intel Corp., Santa Clara, California, USA
Materials, Systems and Applications
Solid-State Lasers for Materials Processing
Free Electron Lasers
Lasers
Basics of Laser Physics
A revised and updated book dealing principally with the design and development of lasers. It is the only book available dealing exclusively with solid-state lasers. Emphasis is placed on engineering and practical considerations.
An introductory guide to laser technologies in very diverse fields from nuclear and particle physics to medicine, astronomy and ultra-precise metrology written by reputable laser experts who think that science should be entertaining.
This book provides a comprehensive overview of laser sources and their applications in various fields of science, industry, and technology. After an introduction to the basics of laser physics, different laser types and materials for lasers are summarized in the context of a historical survey, outlining the evolution of the laser over the past five decades. This includes, amongst other aspects, gas lasers, excimer lasers, the wide range of solid-state and semiconductor lasers, and femtosecond and other pulsed lasers where particular attention is paid to high-power sources. Subsequent chapters address related topics such as laser modulation and nonlinear frequency conversion. In closing, the enormous importance of the laser is demonstrated by highlighting its current applications in everyday life and its potential for future developments. Typical applications in advanced material processing, medicine and biophotonics as well as plasma and X-ray generation for nanoscale lithography are discussed. The book provides broad and topical coverage of laser photonics and opto-electronics, focusing on significant findings and recent advances rather than in-depth theoretical studies. Thus, it is intended not only for university students and engineers, but also for scientists and professionals applying lasers in biomedicine, material processing and everyday consumer products. Further, it represents essential reading for engineers using or developing high-power lasers for scientific or industrial applications.
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 Disk Lasers
Lasers and Holography
Semiconductor Laser Engineering, Reliability and Diagnostics
Industrial Applications of Lasers
Diode Lasers in Neurosurgery
A comprehensive introduction to the burgeoning field of photonics The field of photonics is finding increasing applications across a broad range of industries. While many other books provide an overview of the subject, Fundamentals of Light Sources and Lasers closes a clear gap in the current literature by concentrating on the principles of laser operation as well as providing coverage of important concepts necessary to fully understand the principles involved. The scope of the book includes everything a professional needs to get up to speed in the field, as well as all the material necessary to serve as an excellent introductory laser course for students. Ideal for self-study as well as structured coursework, the book offers thorough coverage of: * The nature of light and atomic emission * Basic quantum mechanics and laser processes * Cavity optics, fast-pulse production, and nonlinear optical phenomena * Laser technology, including visible gas lasers, UV gas lasers, infrared gas lasers, solid-state lasers, semiconductor lasers and tunable dye lasers Extensive real-world case studies are included to help readers appreciate the practical applications of the material covered. *An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department.
A practical, hands-on guidebook for the efficient modeling of VCSELs Vertical Cavity Surface Emitting Lasers (VCSELs) are a unique type of semiconductor laser whose optical output is vertically emitted from the surface as opposed to conventional edge-emitting semiconductor lasers. Complex in design and expensive to produce, VCSELs nevertheless represent an already widely used laser technology that promises to have even more significant applications in the future. Although the research has accelerated, there have been relatively few books written on this important topic. Analysis and Design of Vertical Cavity Surface Emitting Lasers seeks to encapsulate this growing body of knowledge into a single, comprehensive reference that will be of equal value for both professionals and academics in the field. The author, a recognized expert in the field of VCSELs, attempts to clarify often conflicting assumptions in order to help readers achieve the simplest and most efficient VCSEL models for any given problem. Highlights of the text include: * A clear and comprehensive theoretical treatment of VCSELs * Detailed derivations for understanding the operational principles of VCSELs * Mathematical models for the investigation of electrical, optical, and thermal properties of VCSELs * Case studies on the mathematical modeling of VCSELs and the implementation of simulation programs
Lasers continue to be an amazingly robust field of activity. Anyone seeking a photon source is now confronted with an enormous number of possible lasers and laser wavelengths to choose from, but no single, comprehensive source to help them make that choice. The Handbook of Lasers provides an authoritative compilation of lasers, their properties, and original references in a readily accessible form. Organized by lasing media-solids, liquids, and gases-each section is subdivided into distinct laser types. Each type carries a brief description, followed by tables listing the lasing element or medium, host, lasing transition and wavelength, operating properties, primary literature citations, and, for broadband lasers, reported tuning ranges. The importance and value of the Handbook of Lasers cannot be overstated. Serving as both an archive and as an indicator of emerging trends, it reflects the state of knowledge and development in the field, provides a rapid means

of obtaining reference data, and offers a pathway to the literature. It contains data useful for comparison with predictions and for developing models of processes, and may reveal fundamental inconsistencies or conflicts in the data.

This book reviews basic electromagnetic (EM) wave theory and applies it specifically to lasers in order to give the reader not only tangible examples of how the theory is manifested in real life, but also practical knowledge about lasers, and their operation and usage. The latter can be useful for those involved with using lasers. As a short treatise on this subject matter, this book is not intended to dwell deeply into the details of EM waves nor lasers. A bibliography is provided for those who wish to explore in more depth the topics covered in this book. Rather the aim of this book is to offer a quick overview, which will allow the reader to gain a competent general understanding of EM waves and lasers.

Pulsed Metal Vapour Lasers

The Power and Precision of Light

Chemical Processing with Lasers

High Speed Diode Lasers

High Power Laser Handbook

Light is a powerful thing. Light from the sun gives humans life and can be used in a variety of ways using a focused beam of light called a laser. From DVD players to laser pointers, there are many different kinds of lasers. Even fiber optics communication and cutting devices use laser technology to produce great things. This book explores the possibilities of light, bringing amazing facts about lasers to the eyes of enthusiastic readers interested in this cutting-edge technology.

These proceedings gather a selection of invited and contributed papers presented during the 16th International Conference on X-Ray Lasers (ICXRL 2018), held in Prague, Czech Republic, from 7 to 12 October 2018. The conference is part of an ongoing series dedicated to recent developments in the science and technology of X-ray lasers and other coherent X-ray sources, with an additional focus on supporting technologies, instrumentation and applications. The book highlights advances in a wide range of fields including laser and discharge-pumped plasma X-ray lasers, the injection and seeding of X-ray amplifiers, high-order harmonic generation and ultrafast phenomena, X-ray free electron lasers, novel schemes for (in)coherent XUV, X-ray and ?-ray generation, XUV and X-ray imaging, optics and metrology, X-rays and ?-rays for fundamental science, the practical implementation of X-ray lasers, XFELs and super-intense lasers, and the applications and industrial uses of X-ray lasers.

A practical book with a variety of uses, this book can help applications engineers spark problem-solving techniques through the use of lasers. Industrial Application of Lasers, Second Edition takes the reader through laser fundamentals, unusual properties of laser light, types of practical lasers available, and commonly used accessory equipment. The book also applies this information to existing and developing applications. Current uses of lasers, including laser welding and cutting, electronic fabrication techniques, lightwave communications, laser-based applications in alignment, surveying, and metrology are all covered as well as discussing the potential for future applications such as all-optical computers,remote environmental monitoring, and laser-assisted thermonuclear fusion. Explains basic laser fundamentals as well as emphasizing how lasers are used for real applications in industry Describes the importance of laser safety Discusses potentially important future applications such as remote environmental monitoring Includes rare expert lore and opinion

This timely publication presents a review of the most recent developments in the field of Semiconductor Disk Lasers. Covering a wide range of key topics, such as operating principles, thermal management, nonlinear frequency conversion, semiconductor materials, short pulse generation, electrical pumping, and laser applications, the book provides readers with a comprehensive account of the fundamentals and latest advances in this rich and diverse field. In so doing, it brings together contributions from world experts at major collaborative research centers in Europe and the USA. Each chapter includes a tutorial style introduction to the selected topic suitable for postgraduate students and scientists with a basic background in optics - making it of interest to a wide range of scientists, researchers, engineers and physicists working and interested in this rapidly developing field. It will also serve as additional reading for students in the field.

Lasers and Nuclei

Lasers in Dermatology

Procedures in Cosmetic Dermatology Series: Lasers and Lights

Laser Fundamentals

Applications of Ultrahigh Intensity Lasers in Nuclear Science

A comprehensive, up-to-date review of the physics and applications of a major class of laser, the most important example of which is the copper vapour laser. A collection of 50 papers written by the world's leaders in the field. Papers cover: the early history of pulsed metal vapour lasters; the plasma kinetics and excitation mechanisms of self terminating and recombination metal vapour lasers; beam quality issues for applications; frequency harmonic generation for mid-UV applications; high-precision processing of metals, ceramics, glasses and plastics using metal vapour lasers; applications in medicine, including oncology and dermatology; applications in science such as spectroscopy and mass spectrometry. A practical source of information on the physics, engineering and applications of metal vapour lasers. Audience: scientists, teachers and graduate researchers

working in the fields of gas lasers, laser optics, gas discharges, optoelectronics and laser applications in industry, science and medicine.
Lasers in Dermatology: An Introductory Guide provides a comprehensive guide to all aspects of cutaneous laser treatment. Practical aspects of laser selection and treatment are combined with easily understood sections on basic science, laser safety and current regulations. The author is internationally recognised for his research in the laser treatment of skin disease, and has close links with the development of training programmes for the use of lasers in Dermatology.
This book is the result of the authors' many years of experience in using neurosurgical lasers. They began using laser diodes in their speciality at the start of the 1990s, making them pioneers in the field. The first part of the book deals with the general physical bases and comparative bio-tissue effects of the various kinds of surgical laser, safety measures required and legislation concerning powerful lasers. The second part focuses on laser diodes alone. The authors describe in detail how they use them to operate on intracranial and intraspinal tumours, in intraventricular endoscopy, and in surgery involving epilepsy. Details are given of: technical data; the choice of parameters depending on how the lasers are used (contact and non-contact, and the type of lesion being operated on) as well as their indications in neurosurgery. The authors emphasise the practical recommendations that make this book a valuable companion for current and potential users working in neurosurgery and other surgical applications. They also mention the new and future uses of laser diodes which are currently being developed and which show that this equipment really does represent a new generation of lasers. About 100 colour illustrations and tables are used to explain and underscore the authors' points.
This book is composed of seven invited papers which present the current status of high speed diode lasers. Fast carrier and photon dynamics in directly modulated MQW lasers is analyzed and novel design approaches are considered which were critical for the demonstration and record of 40 GHz modulation bandwidth. Attention is centered on the challenges in creation of high speed and low chirp single mode DFB lasers. Recent progress in mode-locked diode lasers is covered, specifically by the examples of 160 fs pulse generation and appearance of microwave pulse repetition rates. Future trends in increasing of high speed laser performance are also examined.
Fundamental Relations and Technical Realizations
Proceedings of the 16th International Conference on X-Ray Lasers
Generation of Light by Stimulated Emission
Photonics and Lasers
Physics and Technology