DEPARTMENTS

BOOK REVIEWS

Fiber Optics & Optoelectronics

Peter K. Cheo, 451 pages, illus., index, and references. ISBN 0-13-315045-3. Prentice Hall, Englewood Cliffs, NJ 07632 (1990) $57 hardbound.

Reviewed by Mustafa A. G. Abushagur, University of Alabama in Huntsville, Department of Electrical and Computer Engineering, Huntsville, Alabama 35899.

This book is the second revised and updated edition of the book titled *Fiber Optics: Devices and Systems,* published in 1985. The author added a chapter on single mode fibers, divided the chapter on photodetectors and optical receivers into two chapters, and revised and updated the other chapters with current information. The book is intended, as mentioned by the author, for senior and first-year graduate students. I think that the book is suitable for graduate students more than for seniors because of the level of the mathematics.

The book has 14 chapters. The first 7 chapters (after the introduction) mainly address the fiber as a dielectric waveguide, with emphasis on wave propagation, dispersion of the light beam and pulse broadening, mode coupling, and fiber fabrication and characterization. Chapters 8, 9, and 10 discuss the light-emission process in semiconductors, properties of semiconductor heterojunctions, semiconductor lasers, and optical transmitters. Chapters 12 and 13 cover semiconductor photodetectors and optical receivers. The last chapter is devoted to optical fiber systems. Each chapter is followed by a number of problems (mostly "derive..." and "show that..." problems) and a number of references. The book contains no worked examples, except for a few illustrative examples embedded in the text.

Chapter 1 outlines the content of the book and introduces the different components of fiber optic systems and where each topic is discussed in the book. Chapter 2 gives needed background in electromagnetic field relations, starting with Maxwell's equations and then solving for wave propagation in planar and cylindrical waveguides. Chapter 3 contains a detailed analysis for dielectric planar waveguides. Guided modes are discussed and relations derived for both field and power distribution across the fiber. The analysis demonstrates the shortcomings of the ray optics analysis of the total internal reflection, showing that the propagating field extends beyond the guiding layer. This result gives the reason for the presence of waveguide dispersion. Dielectric cylindrical waveguide analysis is considered in Chap. 4. Wave propagation solutions are derived for both step and graded-index fibers. This chapter includes very clear illustrations and pictures of some of the fundamental guided modes in the fiber. In Chap. 5, dispersion, mode coupling, and loss mechanisms are explained. These limiting factors are caused by the physical and geometrical properties of the fiber. The effect of these limitations on pulse broadening and signal attenuation are analyzed. Single-mode fibers are discussed in Chap. 6 as an alternative to graded-index fibers for high data rate transmission. Double-cladded single-mode fibers in particular are analyzed, and their properties are discussed in detail. Elliptical core polarization-preserving fibers are also explained. Chapter 7 covers a range of topics including glass properties, fiber manufacturing, and fiber measurements and splicing. The chapter gives very good introduction to splicing based on the transfer of energy from source to fiber or between two fibers.

The second section of the book (starting with Chap. 8) covers sources and transmitters. In Chap. 8, the quantum theory of semiconductors is reviewed. Radiative transition mechanisms are discussed with emphasis on the electron-hole transitions between the valence and conduction bands. A wealth of illustrations for gain and transition parameters is included. Chapter 9 starts with a review of the basics of the pn-junction operation under the influence of different biasing conditions, followed by an analysis for single and double heterojunctions. Chapter 10 is devoted to semiconductor lasers. Different geometries of the laser structure are introduced. Gain-guided and index-guided stripe geometry lasers are explained clearly. Chapter 10 also includes very well-written sections on distributed feedback and quantum-well lasers with up-to-date research results. (These lasers are a foundation for new high data rate telecommunication systems.) A section on laser arrays also is included. The chapter on transmitters discusses the frequency response of the laser and modulation techniques both direct and external to the laser cavity. Noise characteristics are also addressed.

The last set of chapters deals with the receiver end of the system (detector and receiver circuits). Chapter 12 includes an explanation for the photodetection process in semiconductor pn, p-i-n, and avalanche photodiodes. The theory of operation, characteristics, and noise sources and their effect on signal detection is presented. This chapter concludes with an analysis of high-speed and long-wavelength photodetectors. Optical receiver circuits and signal-to-noise ratio analysis are covered in Chap. 13.

The last chapter (Chap. 14) is on optical fiber communication system design. The chapter includes a number of design charts that are not clearly explained in the text. Two system design examples are analyzed in detail: an optical local area network and a coherent light-wave communication system, for some particular numerical cases.

The book does not cover or even mention some hot topics in fiber communication systems, such as solitons and fiber amplifiers, but most of the required theory is present in the book. These topics are very critical to current long-haul fiber telecommunication systems.

Laser-Induced Plasmas and Applications

Edited by Leon J. Radziemski and David A. Cremers, 448 pages, illus., index, and references. ISBN 0-8247-8078-7. Marcel Dekker, 270 Madison Ave., New York, NY 10016 (1990) $110 hardbound.

Reviewed by Roger Becker, University of Dayton, Research Institute, Dayton OH 45469.

This book is a compendium of chapters on related topics with different authors. The emphasis is on the many applications of laser-induced plasmas, although many of the applica-

tions chapters discuss plasma formation and plasma properties. The intended readers are possible users of laser plasmas rather than investigators in plasma physics per se. As such, particular chapters covering the reader's area of interest will have special appeal. Even so, because the editors have assembled topics with related phenomenology, many of the chapters will be of interest to most readers.

The first chapter reviews the theory of the initiation or breakdown of laser-driven plasmas. How little our knowledge on this topic has progressed since the early 1970s is striking. Very little is known about breakdown in condensed media. The treatment on the expansion of the plasma shares the relatively highly mathematical presentation of the first chapter. Here, the frequent use of figures is helpful in enabling the reader to identify the theory most suitable to his needs. The diagnostics chapter concentrates on recent advances, especially with regard to x-ray diagnostics, which take up half the chapter.

Although the fourth chapter on laser-sustained plasmas does an excellent job of preserving as much generality as possible, the chapter addresses an area where research has been directed at a particular problem, laser propulsion in space. As such, Chapter 4 forms a bridge to the applications chapters. The first of these concerns the most well-known application, laser fusion. The authors have succeeded admirably in condensing this heavily investigated area into a 53-page overview, even including a historical perspective. The description of semiconductor processing is relatively brief, with almost no mention of plasmas.

Chapters 7 through 9 give a deep and informative account of spectroscopic applications of laser plasmas. The specific role and properties of plasmas in experiments are given careful treatment. These chapters give many examples in which laser plasmas have successfully been used to analyze samples. The book concludes with a short review of x-ray generation, particle acceleration, and power switching.

One quarter of the book is devoted to the physics of plasma production by lasers. The book also contains a lengthy chapter on optical plasma diagnostics, directed especially at laser fusion. The range of applications is wide, with an emphasis on compositional analysis. Laser space propulsion and semiconductor fabrication are given special attention, in addition to laser fusion. A common feature in these applications is that the ambient medium is a gas of at most a few atmospheres pressure. This feature justifies the substantial coverage given to the expansion of plasma subjected to intense laser radiation.

The book is edited well, with a consistent writing style. Although each chapter is self contained, there are cross references between chapters. The text is clear and accessible to the general reader. There is a generous use of illustrations, and each chapter has an extensive and excellent reference list. This reviewer knows of no comparable reference.

BOOKS RECEIVED

Insight into Optics, edited by O. S. Heavens and R. W. Ditchburn. 309 pp., illus., index. ISBN 0-471-92769-4. John Wiley & Sons, Inc., 1 Wiley Drive, Somerset NJ 08875-1272 (1991) $49.95 hardbound. Covers optical rays, wave theory, diffraction, polarized light, electromagnetic theory of dielectric media, electromagnetic theory of absorptive materials, scattering of light, electro- and magneto-optics, interaction of radiation and matter, holography, nonlinear optics, radiometry and photometry, interferometry, optical instruments, assessment of optical images, lasers, temporal analysis-photon correction, velocity of light and relativistic optics, quantum theory of light, and limitations of optical experiments.

Applied Laser Spectroscopy, edited by Wolfgang Demtroder and Massimo Inguscio. 499 pp., illus., index, references. ISBN 0-306-43717-1. Plenum Press, 233 Spring Street, New York NY 10013 (1990) $115 hardbound. Covers fundamentals of laser spectroscopy and quantum optics, spectroscopic techniques and new coherent sources, laser spectroscopy of atoms and molecules, and interdisciplinary applications of laser spectroscopy.

A Digital Optical Cellular Image Processor, edited by Kung-Shiuh Haung. 258 pp., illus., index, references. ISBN 981-02-03373-3. World Scientific Publishing Co. Pte. Ltd., 687 Hartwell Street, Teaneck, NJ 07666 (1990) $28 hardbound. Covers previous works on image algebra; cellular logic architectures; digital optical cellular logic processors; binary image algebra fundamentals, development, and relationship to other computing theories; digital optical cellular image processor (DOCIP) architectures and control and programming; and implementation of a prototype DOCIP.

Microwave Imaging Techniques, edited by Bernard D. Steinberg and Harish M. Subbaram. 361 pp., illus., index, references. ISBN 0-471-50078-X. John Wiley & Sons, Inc., 1 Wiley Drive, Somerset NJ 08875-1272 (1991) 64.95 hardbound. Covers microwave imaging, mathematics of microwaves, wideband effects, problems in microwave imaging, diversity, transmitter-location diversity, deconvolution, adaptive beamforming, data reduction, superresolution, and display techniques.

Cognition through Color, edited by Jules Davidoff. 217 pp., illus., index, references. ISBN 0-262-04115-4. The MIT Press, 55 Hayward Street, Cambridge, MA 02142 (1991) $32.50 hardbound. Includes neurophysiology of modularity, neuropsychology of the color module, modularity studied by equiluminance, temporary representation of modular approaches, and boundaries and surfaces.

Photoreactive Polymers: the Science and Technology of Resists, edited by Arnost Reiser. 409 pp., illus., index, references. ISBN 0-471-855502-2. John Wiley & Sons, Inc., 1 Wiley Drive Somerset, NJ 08875-1272 (1989) 57.95 hardbound. Covers negative photoresists, photophysics and photochemistry in solid polymers, photoinitiated polymerization, positive resists based on diazonaphthoquinones, rudiments of imaging science, deep-UV lithography, electron beam lithography, x-ray and ion beam lithographies, and multilayer techniques and plasma processing.