DEPARTMENTS

BOOK REVIEWS

Elliptical Fiber Waveguides

R. B. Dyott, 217 pages, illustrations, index, references, and three appendices. ISBN 0-89006-477-6. Artech House, Inc., 685 Canton St., Norwood, MA 02062 (1995) $79 hardbound.

Reviewed by Ashish M. Vengsarkar, AT&T Bell Laboratories, Rm. 6E-218, 600 Mountain Ave., Murray Hill, NJ 07974.

Elliptical core fibers have matured since their introduction in the 1970s and have now found acceptance in key applications where their presence has become a necessity. Two features that have made them relevant are their polarization-holding properties and their ability to discriminate between higher order modes. These features and the resulting devices are highlighted in R. B. Dyott's *Elliptical Fiber Waveguides* — a handbook that starts with basic definitions and properties of the waveguides and goes on to cover a wide range of applications.

The first three chapters cover the fundamentals of waveguide theory, a subject that has been extensively and elegantly covered in several textbooks over the years. These chapters serve merely as a review of some of the terms to be used in the subsequent portions of the book. In Chap. 4, Dyott jumps right into the elliptical coordinate system and derives the Mathieu equations, which describe the modes in an elliptical core fiber. Several figures of the various Mathieu functions provide good physical insight into the behavior of the modes. Standard modal properties, such as the propagation constant, power distribution, and the far-field radiation patterns are briefly mentioned, sometimes with an acknowledgment that the subject is too lengthy to merit more attention.

One of the more lively (and often controversial) research areas in elliptical core fibers relates to higher order mode properties, especially the cutoff wavelengths, and Dyott devotes an entire chapter (Chap. 5) to treat this topic. The determination of the higher order mode cutoff wavelength is of significant importance to researchers working on the design of two-mode fiber sensors and higher order mode dispersion compensators. This description is fairly detailed and most of the work found in the literature is referenced.

Chapter 6 covers the fabrication of elliptical core fibers and the measurement of key properties. However, only one manufacturing technique, namely, modified chemical vapor deposition for preform fabrication, followed by grinding flats, is described in this chapter. Further, the measurement methods for attenuation, group velocity, birefringence, and polarization mode dispersion are sketchy and one can find better expositions on this subject in books on optical fiber measurements. Also, the description of the polarization crosstalk factor and methods of finding the higher order cutoff wavelength is relevant to this book and yet very little space is devoted to this subject.

In Chap. 7 we are introduced to the D-fiber: an elliptical core fiber with one side of the cladding polished such that it is aligned with the major axis of the core (the shape of the fiber resembles the letter D, and hence the appellation). The D-fiber is highly versatile in the sense that several useful devices can be constructed due to two major features not present in the standard elliptical core fiber: (1) The axes of the elliptical core are easily identifiable from the exterior, and (2) the evanescent field is accessible. Using these properties, one can envision several applications, such as power transfer to adjacent fibers via evanescent coupling or photoinduced gratings, and optoelectronic devices with the D-fiber as the basis. This chapter is an obvious favorite of the author and he presents several ideas for future devices in addition to describing some of the current applications. Chapter 8 describes the fiber optic gyroscope, the higher order mode fiber sensors and, very briefly, the fiber dispersion compensator. Finally, in Chap. 9, rare-earth-doped elliptical fibers and their applications are presented.

The book is a collection of a wide variety of information pertaining to elliptical fibers in one bound volume. Some of the key references pertaining to elliptical fiber waveguide fabrication are missing, however. For example, the author fails to mention the early work on elliptically clad fibers [*Applied Optics* **18,** 4080–4084 (1979)], the exposed cladding technique [*Appl. Phys. Lett.* **33,** 814–816 (1978)], and improvements in preform deformation [*J. Lightwave Technol.* **LT-2,** 639–641 (1984)]. The introductory sections that set the tone for the crux of individual chapters are too short and the author's reluctance to expound has an adverse effect on the readability of the book in general.

Dyott is an acknowledged expert in this field and one of the pioneers who has made possible the tranformation of elliptical core fibers into products (via the Andrew Corporation) for the photonics industry. He could have taken ownership of this field and effectively described the work of various researchers in a comprehensive fashion. Instead, he chooses to constantly name the authors in the main text. While giving credit to the original authors is a noble thought, it affects continuity and detracts from the flow of thought. A rewritten script that culls from the multitude of references would make the book more readable. In the current form, the text jumps from one reference to another and one viewpoint to the next, without pausing to give an expert opinion on the salient features of each topic. While the preface mentions that this book is an introduction to the subject, it does not identify the audience it addresses. This subtle flaw runs through the book — as a text, it fails to elucidate the different phenomena at a basic level, as a good read it lacks

continuity, and as an in-depth exposition it merely scratches the surface of every topic it seeks to explore.

In summary, this book is a collection of reports on the diverse aspects of elliptical core fibers and is recommended only as a starting point for a graduate student or a fiber optics engineer intent on exploring the field further.

Coherent Quantum Optics and Technology

Motoichi Ohtsu, 241 pages, illustrations, bibliographic references, appendix, and index. ISBN 0-7923-2079-4. KTK Scientific Publishers, Tokyo (1992). (Sold and distributed in the USA and Canada by Kluwer Academic Publishers, 101 Philip Dr., Assinippi Park, Norwell, MA 02061.) $125 hardbound.

Reviewed by Timothy P. Grayson, USAF Wright Laboratory, WL/AARI-2, Bldg. 622, 3109 P St., W-PAFB, OH 45433-7700.

The title *Coherent Quantum Optics and Technology* conjures an image, at least to this reviewer, of discussions of nonclassical states of light as related to coherence theory. Indeed, the field of quantum optics is typically thought to include such topics as squeezed light, photon statistics, cavity QED, and atomic cooling and trapping, among other things. This is not the focus of this book, however, and as such the title is quite misleading. In words taken from the preface, coherent quantum optics is defined by the author as "...a field of study to investigate the principles and methods of generating a very smooth lightwave with low fluctuations, controlling and manipulating atoms and photons and their application systems." As this definition may imply, the main focus of this book is a survey-type description of laser theory, methods of laser stabilization, and applications of ultrastable lasers.

In the preface, Motoichi Ohtsu provides a fairly accurate synopsis of the appropriate readership of this book. Chapters 1 through 4 are general in nature, perhaps at the level of undergraduate physics and engineering students, while the later chapters address more specific areas of current research, perhaps more oriented toward the active researcher. In either case, the book is more suitable as survey material rather than as a textbook. This is due first to the lack of problems at the end of the chapters and second to the lack of detail in many places. While the first four or five chapters include a fair amount of math, the details of calculations are left to references, and the later chapters are almost exclusively conceptual in nature.

Chapter 1 is a review of the concept of coherent light and the representation of optical fields in quantum mechanics. This quantum treatment of light is not really used much, though, in the remainder of the book other than for illustrative purposes, such as to describe squeezed states. Chapter 2 then provides a review of basic laser theory in the semiclassical picture, while Chap. 3 continues this discussion by addressing specific technical issues in various laser systems.

Chapter 4 proceeds to discuss noise in lasers. Topics range from fundamental quantum noise sources to practical systematic noise sources in various laser systems. Chapter 5 moves away from the general review material and more toward areas of current research by discussing various state-of-the-art schemes to reduce both intensity and frequency noise in lasers. This is followed in Chap. 6 by descriptions of specific experiments that have demonstrated some of these noise reduction schemes. Chapter 7 provides a fairly thorough sampling of applications of the ultrastable lasers resulting from the work in Chap. 6. While many different types of laser systems are discussed, ranging from dye to gas to solid state, a very heavy emphasis is placed on semiconductor lasers. This is understandable, given Ohtsu's research interests.

It is not until Chap. 8 that much fundamental quantum optics is discussed. While both atomic cooling and trapping and cavity QED are mentioned in Chaps. 5 and 7, they are mentioned only as methods of stabilizing lasers and as applications of ultrastable lasers, respectively. Chapter 8, on the other hand, is a brief survey of much of the cutting edge of quantum optics, including generation of short wavelength light, ultra-fast waveform generation and detection, generation and application of nonclassical light including squeezed light and quantum nondemolition measurement, manipulation of atoms and photons, and laser power storage. His descriptions are extremely sketchy, although references are provided. There are some very technical and subtle inaccuracies that arise during the discussion of nonclassical light, due most likely to the brevity of coverage. These subtleties should not be a serious concern, though, for the introductory reader new to this area of research.

Despite frequent typographical and grammatical errors, the text of the book is actually quite clear and readable. There are numerous illustrations that prove helpful for obtaining a solid understanding of the material, and as mentioned above, many references to more detailed material are provided. The one appendix provides some more mathematical detail about laser rate equations and the origin of relaxation oscillations.

In summary, Ohtsu is to be commended for his enthusiastic attempt to summarize the emerging technology associated with quantum optics in a brief, general manner. His own excitement about the future of this challenging field is quite evident in his writing. However, this is perhaps too large a task to undertake in a work of this nature. Since the vast majority of the book deals with ultrastable laser technology, it may have been more appropriate if the title and content were limited to such. As it is the title is misleading, and this book does not provide a very good introduction to general quantum optics in this reviewer's opinion. Nevertheless, I recommend this book to anyone from an intermediate-level undergraduate through seasoned researcher who is seeking an introduction to the theory, techniques, and applications of ultrastable lasers.

BOOKS RECEIVED

Monolithic Diode-Laser Arrays, by Nils W. Carlson. xii + 396 pp., illus., subject index, references at end of book. Vol. 33 from the Springer Series in Electronics and Photonics. ISBN 0-387-57910-9. Springer Verlag, 175 Fifth Ave., New York, NY 10011 (1994) $69 hardbound. The goal of this book is to give a unified presentation of the physical principles, optical design, operating characteristics, and ultimate performance projections of monolithic diode-laser arrays for single-mode, high-power operation. Emphasis is placed on developing an understanding of the mode discrimination properties of the diode-laser array structures.

Applied Photonics, by Chai Yeh. xiv + 337 pp., illus., subject index, bibliography, references following each chapter. ISBN 0-12-770458-2. Academic Press, Inc., 1250 Sixth Avenue, San Diego, CA 92101-4311 (1994) $65 hardbound. This book is intended to provide state-of-the-art information in the field of photonics for practicing engineers and scientists with college-level training in fundamental science and mathematics. Contents include: photons and interactions; recent advances in semiconductor laser technology; fiber lasers; solid-state lasers; photonic detection; optical amplifiers; solitons in optical fiber telecommunications; phase conjugators; photonic components; photonic switches; photonic interconnects; and photonic image processing.

Optical Engineering *is currently seeking reveiwers for the books listed in the "Books Received" section. In exchange for a publication-worthy critique, reveiwers will receive a complimentary copy of the book they reveiw. Interested individuals should contact Dr. Bradley D. Duncan, Book Reviews Editor, University of Dayton, Center for Electro-Optics, 300 College Park, Dayton, OH 45469-0245. E-mail: bduncan @engr.udayton.edu. Phone: 513 229-2796.*