# DEPARTMENTS

## BOOK REVIEWS

### Optics and Lasers, Including Fibers and Optical Waveguides

M. Young, 4th revised ed., 353 pages, 188 illus., index, bibliography. ISBN 0-387-55010-0. Springer-Verlag, 175 Fifth Ave., New York 10010 (1992) $34.50 hardbound.

**Reviewed by David M. Roessler,** General Motors Research, Physics Department, 30500 Mound Road, Warren, MI 48090-9055.

One measure of this book's success is the rapidity with which new editions appear: the first was published in 1977, a second followed in 1984, a third in 1986, and now we have the fourth. The first three editions constituted Vol. 5 in the Springer Series in Optical Sciences (edited by T. Tamir). The fourth edition stands on its own and, even without scanning the contents, one notes that the book, at less than a dime a page, is a bargain compared to many similar texts at this level.

This edition is more than 60 pages longer than the third edition and, even though the first chapter is an extended preface or book review in itself, Dr. Young has been able to include new material without sacrificing the existing text. The latter has been modified only as needed to improve clarity or correct minor details. The new material includes brief sections on edge response, scanning confocal microscopy, and liquid crystals, with slightly longer sections on digital image processing (including video microscopy) and optical-fiber connectors.

What should be in a book bearing the title *Optics and Lasers?* One knows that there cannot be an exhaustive treatment of so broad a field and that the author must be selective. Inclusion of the word lasers in the main title is misleading: only 1 of the 12 chapters is dedicated to this topic and it receives little more coverage than either ray optics or optical instruments. About half of the book is devoted to classical optics so that a title such as *Modern Optics* would also be misleading. However, there is a definite leaning of material, as one progresses through the book, toward the author's own interests—reflected in the title's addendum *Including Fibers and Optical Waveguides.*

The first few chapters range through ray optics, optical instruments, light sources and detectors, wave optics, and interferometry; they are concise but also easy to read. The midsection of the book, Chaps. 7, 8, and 9, respectively, deal with holography and Fourier optics, lasers, and electromagnetic and polarization effects. This order, as in previous editions, is somewhat surprising. Much of the chapter on electromagnetic and polarization effects, with the possible exception of the half-dozen pages on nonlinear optics, would appear earlier in many optics books—certainly before holography and image processing.

The last three chapters coherently describe topics of considerable current interest and deal with material that has governed the author's activities in optical-fiber communication for the last 20 years. The treatment is very frank and candidly discusses the key concepts in optical waveguides and fibers and in integrated optics. It is refreshing to read text that flows from personal experience rather than a rewriting of other textbooks, however deft.

There are about a dozen problems, on average, at the end of each chapter and they are very good. The third edition experimented with collecting many of these problems into a last chapter, but Young has now reverted to the more traditional format. Many of the problems are thought provoking and others lead to interesting results. As such, they often represent an extension of the text rather than a regurgitation. However, while much of the book can be self taught, some students may need assistance with a few of these problems precisely because they will not find all the relevant material explicitly presented in the preceding chapter. This need not intimidate instructors because, as was true with earlier editions, the author has offered to provide a solutions manual, free of charge, to qualified requesters!

The writing style throughout the book is friendly and one senses the tutorial intent. The print is easy on the eye, the figures are clean, and the photographs, though few in number, are helpful. There is an extensive subject index and Young has indicated the more important occurrences using boldface type. There is also a bibliography containing, for each chapter, a dozen or more suggestions for further reading. Most of the references are to other textbooks rather than to review articles or detailed papers.

According to the author, his book serves a dual purpose, as a textbook for a college course and as a handbook for the optical practitioner. The first objective has been achieved. However, the book is more a refresher course for people loosely engaged in optics than a resource guide or handbook of optical data.

Teachers who wish to adopt this book for a one-semester college course will find considerably more material than could be covered in such a time frame. Most of it is at an introductory level, although some of the topics in the last few chapters are more advanced. This gives some flexibility in the emphasis of the course but does mean that the instructor will need to spend some time selecting the appropriate parts to cover.

The majority of optics practitioners will inevitably wish to find additional information on the subjects of special interest to them and must remind themselves that this book is intended as an introductory text. It may be true that subjects such as the scattering of light by particles or causality and dispersion relations are outside the scope of the book,

but it is somewhat surprising that optical absorption is mentioned so briefly. However, there is no consensus on what must be included in books such as this. Some readers will be upset that topics such as color, displays, or the optical properties of materials in general are either omitted or given very short shrift. Others will note that filters are covered sparingly and there is little on thin films or phenomena such as Newton's rings. Similarly, the section on ray optics contains only half-a-dozen paragraphs on aberrations: it includes the comment "the average user of optics need not have any knowledge of aberration theory; nevertheless he is well advised to bear in mind the purpose for which a given lens was originally intended."

Overall, here is a book that is a pleasure to use and is inexpensive. Teachers who wish to adopt this book will naturally avail themselves of this newest edition. Optics practitioners already in possession of the third edition may not feel there is sufficient new material to justify an upgrade at this stage and may wish to wait for a fifth edition.

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## Opto-Mechanical Systems Design

Paul R. Yoder, Jr., 2nd ed., revised and expanded, 688 pages, illus., index, references, appendixes. ISBN 0-8247-8754-4. Marcel Dekker, 270 Madison Avenue, New York, NY 10016 (1993) $110 hardbound.

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Both optical and mechanical aspects are important in the design of modern optical systems. Despite the importance of optomechanics in modern optical engineering, it has not been recognized as a separate discipline until quite recently. One of the problems in optomechanics has been the lack of good reference texts. In 1986 the publication of the first edition of Paul Yoder's *Opto-Mechanical Systems Design* remedied this situation. The book proved a popular reference and was reprinted several times. Although the first edition remains a valuable reference, especially for basic concepts, there has been considerable progress in the field since its publication. Now the publication of a revised and expanded second edition provides an up-to-date reference for optomechanics.

The second edition is an excellent general reference in optomechanical design. Each chapter is self-contained, so that a design engineer can use it as a quick reference for extracting information. An extensive bibliography is provided with each chapter. Superb illustrations, both drawings and photographs, complement the technical discussion. One of the strengths of the book is the extensive collection of design examples. These examples serve to demonstrate design concepts and provide a starting point for new designs.

Although I suspect that many engineers will either ignore or skim the first chapter on the optomechanical design process, it is worth a careful reading. This chapter provides a template for organizing an optomechanical project, from conceptualization through the final documenting of the design. Of particular interest is the section on tolerances. The size of the tolerances in an optical budget has an important effect on the cost and risk of an optical project. Unfortunately, tolerancing is often ignored by designers. Familiarity with this section may help many projects.

The second chapter is a thorough review of environmental influences on optomechanical systems. It pulls together a wide assortment of information that would normally require a fairly extensive literature search to assemble.

The third chapter, on material characteristics, is exceptionally thorough and covers both optical and mechanical properties. A welcome addition in the second edition is an expanded section on adhesives. While teaching optomechanical design, I probably get more requests for information on adhesives than on any other topic. This section provides information on different types of adhesives as well as techniques for adhesive bonding.

Chapters 4 and 5 cover the mounting of single and multiple lenses. Centering and centering tolerances are discussed at length. A variety of low-cost techniques are provided for mounting simple single elements. For more advanced techniques, a complete set of design equations is presented, along with worked design examples. The treatment is up to date, with discussion on new mounting techniques such as that for mounting toroidal glass to metal interfaces.

Chapters 6 and 7 cover zero-power optical elements, small mirrors, prisms, windows, and filters. Information on sizing prisms through the use of tunnel diagrams is provided, along with aberration theory. Emphasis is placed on mounting windows and not on optical design of windows. Information is provided on optical aberrations introduced by windows.

Chapter 8 is a very thorough discussion of lightweight nonmetallic mirror technology. Although more advanced topics such as optimization of stiffness to weight in structured mirrors are not considered in depth, this chapter serves as a good starting point for anyone working with lightweight mirrors. Considerable information on new technologies in lightweight mirrors has been added to this edition.

Chapters 9, 10, and 11 deal with the problems of mounting large mirrors in a variety of orientations. Everything from very simple strap mounts to complex active mounts for the Keck telescope is presented. Where possible, the new edition provides design equations for the performance of the various types of mirror mounts.

The chapter on metallic mirrors, Chap. 12, is the most comprehensive discussion of this topic that I have seen. For anyone working with metal mirrors, this chapter alone should justify the price of the book. The chapter has been heavily updated since the first edition and includes information on metal matrix composites. Diamond turning is also discussed at length. With the growing importance of both metal mirrors and diamond turning, this material is especially timely.

The final chapter, on optical instrument structural design, has been substantially revised from the first edition. A variety of instruments, from hand-held binoculars to giant telescopes, is covered. Information is provided on athermal structures, including configurations based on uniform expansion, and metering rods. Appropriately, an appendix on testing methods for optical instruments under adverse environmental conditions is included.

Although it is hard to find fault with the impressive collection of information in the second edition, there are some important subjects that are not covered. The entire subject of precision motion and adjustment is neglected, as is vibration control in optical systems. Control of stray light in optical systems is omitted, although it is debatable as to whether or not this topic belongs in an optomechanical text. Unfortunately, window strength is not discussed. These omissions are not serious flaws; after all, the book already covers many topics in great detail.

This book is probably the best single reference currently available in optomechanics. It can serve as a stand-alone text for the beginner or as a reference text for the practicing engineer. I suspect that its great utility to workers in the field makes it a hard book to find in the library—one of your coworkers probably has checked it out first! The biggest complaint I have is that the cost of the book is likely to prevent the wide distribution that the second edition deserves. I strongly recommend the book to both individuals and libraries. Optical designers, optical fabricators, and mechanical engineers working with optical instruments would do well to keep a copy handy.