

FRANCIS A. JENKINS

HARVEY E. WHITE

Fundamentals of Optics

FOURTH EDITION

INTERNATIONAL STUDENT EDITION

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PREFACE TO THE FOURTH EDITION

This fourth edition is written primarily to be used as a textbook by college students majoring in one of the physical sciences. The first, second, and third editions were written by Francis A. Jenkins and Harvey E. White while teaching optics in the physics department at the University of California, Berkeley. With the passing of Professor Jenkins in 1960 this fourth edition has been revised by Harvey E. White.

A considerable number of innovative ideas and new concepts have been developed in the field of optics since the third edition was published in 1957, thereby requiring a sizable amount of new material. Three new chapters, a number of new sections on modern optics, a number of new references, and all new problems at the ends of all chapters have been added to bring the fourth edition up to date.

Fizeau's experiments on the speed of light in air and Foucault's experiments on the speed of light in stationary matter have been moved to Chapter 1. This serves as a better introduction to the important concept of refractive index and leaves the rest of Chapter 19 relatively unchanged.

In Part One, Geometrical Optics, the long and tedious calculations of ray tracing, using logarithms, has been replaced by direct calculations using the relatively new electronic calculators, thereby permitting lens design engineers to program larger computers.

In Part Two, Wave Optics, Chapter 11 has been modified to give a better approach to the subject of wave motion. In Chapter 16 a section has been added on the correlation interferometer. Some of the major features of recent developments have been added at the end of Chapter 28: modern wave optics, spatial filtering, the phase-contrast microscope, and schlieren optics.

In Part Three, Quantum Optics, three new chapters have been added as important new developments: Chapter 29, Light Quanta and Their Origin; Chapter 30, Lasers; and Chapter 31, Holography.

I wish to take this opportunity of thanking Dr. Donald H. White for his assistance in gathering much of the new material used in this the fourth edition.

HARVEY E. WHITE

PREFACE TO THE THIRD EDITION

The chief objectives in preparing this new edition have been simplification and modernization. Experience on the part of the authors and of the many other users of the book over the last two decades has shown that many passages and mathematical derivations were overly cumbersome, thereby losing the emphasis they should have had. As an example of the steps taken to rectify this defect, the chapter on reflection has been entirely rewritten in simpler form and placed ahead of the more difficult aspects of polarized light. Furthermore, by expressing frequency and wavelength in circular measure, and by introducing the complex notation in a few places, it has been possible to abbreviate the derivations in wave theory to make room for new material.

In any branch of physics fashions change as they are influenced by the development of the field as a whole. Thus, in optics the notions of wave packet, line width, and coherence length are given more prominence because of their importance in quantum mechanics. For the same reason, our students now usually learn to deal with complex quantities at an earlier stage, and we have felt justified in giving some examples of how helpful these can be. Because of the increasing use of concentric optics, as well as graphical methods of ray tracing, these subjects have been introduced in the chapters on geometrical optics. The elegant relationships between geometrical optics and particle mechanics, as in the electron microscope and quadrupole lenses,

could not be developed because of lack of space; the instructor may wish to supplement the text in this direction. The same may be true of the rather too brief treatments of some subjects where old principles have recently come into prominence, as in Čerenkov radiation, the echelle grating, and multilayer films.

A difficulty that must present itself to the authors of all textbooks at this level is that of avoiding the impression that the subject is a definitive, closed body of knowledge. If the student can be persuaded to read the original literature to any extent, this impression soon fades. To encourage such reading, we have inserted many references, to original papers as well as to books, throughout the text. An entirely new set of problems, representing a rather greater spread of difficulty than heretofore, is included.

It is not possible to mention all those who have assisted us by suggestions for improvement. Specific errors or omissions have been pointed out by L. W. Alvarez, W. A. Bowers, J. E. Mack, W. C. Price, R. S. Shankland, and J. M. Stone, while H. S. Coleman, J. W. Ellis, F. S. Harris, Jr., R. Kingslake, C. F. J. Overhage, and R. E. Worley have each contributed several valuable ideas. We wish to express our gratitude to all of these, as well as to T. L. Jenkins, who suggested the simplification of certain derivations and checked the answers to many of the problems.

FRANCIS A. JENKINS
HARVEY E. WHITE

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