Introduction to Optics

LECTURES IN OPTICS
Volume 1
By the Author

*Lectures in Optics, Vol. 1, Introduction*

*Lectures in Optics, Vol. 2, Geometrical Optics*

*Lectures in Optics, Vol. 3, Wave Optics*

*Lectures in Optics, Vol. 4, Visual Optics*

*Lectures in Optics, Vol. 5, Ocular Imaging*
Introduction to Optics

LECTURES IN OPTICS
Volume 1

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SPIE PRESS
Bellingham, Washington  USA
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Introdução à Óptica

INTRODUCTION TO OPTICS

FOREWORD

Optics is a discipline that touches nearly every aspect of our modern life. Data flows through fiber optical cables and is beamed to our displays to bring us vital information regarding our location or our favorite cat video. Optics enables us to peer deep into the cosmos to see Earth-like planets orbiting distant suns, as well as visualize the very bits of molecules that make up the essence of life. Optics enables us to peer into our bodies to find and isolate disease and allows us to implant devices into our eyes to restore and enhance vision. While there are many facets to optics, the fundamental aspects of containing and moving light are contained within geometrical optics.

George Asimellis has written Introduction to Optics, Lectures in Optics, Volume 1, as the first in a series of books covering the discipline of optics. Having taught optics at the undergraduate and graduate level for 20 years, I have viewed many textbooks on geometrical optics. Each of these books covers the same topics, as the material has been well understood for over 150 years. However, many of these textbooks fail to ever make it into the classroom because of their pedantic style.

Dr. Asimellis’ text covers this material, but also captures the richness and spark of excitement in the applications and possibilities described above and many more. The text is a useful resource for students to gain knowledge, as well as a highly readable introduction for the casual science buff interested in learning more about optics. The writing style weaves science, history, and humor into the narrative to keep the reader engaged and provides insight into the evolution of the field. The graphics provide clear and colorful demonstrations of the concepts, while the images are visually stunning. Along the way, you will find familiar characters such as Richard Feynman and Albert Einstein, but also new players such as Chris Clavio, Carlo Bernardini, and Anish Kapoor, who create compelling artwork incorporating the fundamentals of optics. This is a rich and vibrant text that I encourage the reader to explore and enjoy.

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June 2020
“Geometrical Optics is either very simple or else it is very complicated.”


Optics is fundamentally simple. At first glance, optics can be, indeed, formidably complicated. Sign conventions are difficult to memorize, the reciprocal of (meter-converted) distances involved in imaging equations are hard to rationalize, focal distances are impossible to add. These are just a few of the hurdles encountered in the ostensibly easier part of optics, that of geometrical optics. Throw into the mix the wave nature of light, the complicated integrals involved in the description of light propagation through a small aperture, or some aspects of interference and polarization, and you have the perfect recipe for confusion.

This perspective is permeated by the fact that optics instruction is fragmented, most often as part of a Physics 102 course or sometimes as part of classic electromagnetism curriculum. The presentation of optics as a whole is rare.

As a graduate student, I enrolled in two courses, one in Fourier Optics and another in Teaching Methodology. The recommended books were *Introduction to Fourier Optics* by Joseph W. Goodman and *The Feynman Lectures on Physics* by Richard Feynman. Albeit uncorrelated, these two courses changed my view of Optics forever. I appreciated how certain phenomena can be explained in a straightforward manner, for example, through a simple Fourier transform, or by the connection between quantum physics, phase diagrams, and interference.

Geometrical optics can be vastly simplified if we adhere to the Cartesian convention and the vergence method. This formulation provides a much simpler and unified tool to address imaging in geometrical optics, and, to a substantial extent, visual optics.

The philosophy that optics is simple permeates this book series. Once the reader appreciates this essential simplicity, it is a lot easier to build the foundation of fundamental knowledge, from the basics all the way to the more esoteric topics. I feel that without this understanding of the simplicity on which to build, the structure of accumulated knowledge is unsteady at best, and at worst, will crumble under its own weight.

I hope that this first volume of the *Lectures in Optics* series will be appreciated by those seeking a bottom-up textbook, fitting the needs for any college-level optics or optometry optics course.

George Asimellis, PhD
Pikeville, Kentucky
June 2020
Acknowledgments

I would like to thank the following colleagues for their helpful suggestions and recommendations:

**Pantazis Mouroulis**, PhD, Fellow, OSA, SPIE
Senior Research Scientist, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California

**Corina van de Pol**, OD, PhD, FAAO
Assistant Professor, Southern California College of Optometry, Marshall B. Ketchum University, Fullerton, California

**Theophanis Matsopoulos**
European Southern Observatory (ESO) collaborator, München, Germany

I would also like to thank the following members of the Frank M. Allara Library, University of Pikeville for their contribution in providing grammatical and English-language corrections:

Karen Evans, Director of Library Services

Edna Fugate, University Archivist and Reference Librarian

Jerusha Shipstead, Reference and Instruction Librarian

Katherine Williams, Instructional Design Librarian & Coordinator of Instruction

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