



# Fundamentals of Nonlinear Optics

By Peter E. Powers

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**Fundamentals of Nonlinear Optics** encompasses a broad spectrum of nonlinear phenomena from second-harmonic generation to soliton formation. The wide use of nonlinear optical phenomena in laboratories and commercial devices requires familiarity with the underlying physics as well as practical device considerations. This text adopts a combined approach to analyze the complimentary aspects of nonlinear optics, enabling a fundamental understanding of both a given effect and practical device applications.

After a review chapter on linear phenomena important to nonlinear optics, the book tackles nonlinear phenomena with a look at the technologically important processes of second-harmonic generation, sum-frequency and difference-frequency generation, and the electro-optic effect. The author covers these processes in considerable detail at both theoretical and practical levels as the formalisms developed for these effects carry to subsequent topics, such as four-wave mixing, self-phase modulation, Raman scattering, Brillouin scattering, and soliton formation.

Consistently connecting theory, process, effects, and applications, this introductory text encourages students to master key concepts and to solve nonlinear optics problems?preparing them for more advanced study. Along with extensive problems at the end of each chapter, it presents general algorithms accessible to any scientific graphical and programming package.

Watch the author speak about the book.

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## Editorial Review

### Review

Peter Powers's rigorous but simple description of a difficult field keeps the reader's attention throughout. ... All chapters contain a list of references and large numbers of practice examples to be worked through. ... By carefully working through the proposed problems, students will develop a sound understanding of the fundamental principles and applications. ... the book serves perfectly for an introductory-level course for second- and third-order nonlinear optical phenomena. The author's writing style is refreshing and original. I expect that **Fundamentals of Nonlinear Optics** will fast become popular among students, professors, and professionals interested in basic and applied research in the field.

?Aristides Marcano, *Physics Today*, Vol. 65, October 2012

**Fundamentals of Nonlinear Optics** is well written and up to date. ... The problem sets at the end of each chapter reinforce and enhance the material presented, and may give students confidence in handling real-world problems.

?Reva Garg, *Optics & Photonics News*, September 2012

This book fills a longstanding need for a nonlinear optics textbook at an advanced college/introductory graduate level. One of its best features is inclusion of many of the subtleties that are often glossed over in other books on the subject. ... Another excellent feature is the provision of a large number of problems at the end of each chapter.

?Mark Cronin-Golomb, Tufts University, Medford, Massachusetts, USA

The book is very well written. I like very much his writing style. His choice of topics is excellent and the book is well organized. The problem sets are also well formulated to give the students confidence in handling real-world problems ... . Professor Powers has mastered the subject matter.

?C.L. Tang, Cornell University, Ithaca, New York, USA

The author introduces key concepts in simplified terms, and then generalizes to realistic treatments that emphasize how the various equations are actually used in everyday practice. The diversity of specific topics, worked problems, and homework problems should make the book of interest to a wide audience.

?Jeff F. Young, University of British Columbia, Canada

This book is of great interest both to students and researchers wishing to develop or expand their knowledge of nonlinear optics. It contains details of derivations and practical implementation that are often missing from other texts. It also has extensive problems at the end of each chapter that reinforce and enhance the material presented.

?Marc Dignam, Queen's University, Ontario, Canada

The author provides a sound, logically presented introduction to the subject with good coverage.

?Malcolm Dunn, University of St. Andrews, Scotland

### About the Author

**Peter E. Powers** is a professor of physics and electro-optics and the Brother Leonard A. Mann Chair in the Sciences at the University of Dayton. Dr. Powers previously worked at Sandia National laboratories as a post-doctoral research associate. He earned a Ph.D. in applied and engineering physics from Cornell University. His research interests include nonlinear optics and its application to other branches of physics and applied physics.

*Special Note:* CRC Press wishes to honor and celebrate the life and works of the author, who passed on May 10, 2014 after a long battle with cancer. He was Brother Leonard A. Mann Chair in the Sciences and Professor of Physics at the University of Dayton—a dedicated educator, scientist, mentor, and leader. He is survived by his wife and four children. At the time of his passing, he had been planning a second edition of his popular textbook. He will be deeply missed.

## **Users Review**

### **From reader reviews:**

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#### **Jill Lee:**

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**Kathleen Hernandez:**

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