



Applications of Nonlinear Fiber Optics (Optics and Photonics)

By Govind Agrawal

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Most of the material in this volume is new. The first three chapters deal with three important fiber-optic components--fiber-based gratings, couplers, and interferometers--that serve as the building blocks of lightwave technology. In view of the enormous impact of rare-earth-doped fibers, amplifiers and lasers made by using such fibers are covered in Chapters 4 and 5. The last three chapters describe important applications of nonlinear fiber optics and are devoted to pulse-compression techniques, fiber-optic communication systems, and soliton-based transmission schemes. This volume should serve well the need of the scientific community interested in such fields as ultrafast phenomena, optical amplifiers and lasers, and optical communications. It will also be useful to graduate students as well as scientists and engineers involved in lightwave technology.

- * Training resource for engineers involved with lightwave technology
- * Covers the importance of nonlinear effects in designing WDM lightwave systems
- * Up to date information for researchers

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Editorial Review

Review

As the field grew, Agrawal decided to split this text off from his *Nonlinear Fiber Optics*, which is more concerned with the discipline's fundamentals. This edition is intended for senior undergraduates, graduate students, engineers and technicians in the telecommunications industry, and scientists working with fiber optics and optical communications. It covers the building blocks of light-wave technology--fiber-based gratings, couplers, and interferometers--as well as amplifiers and lasers made using rare-earth-doped fibers; pulse-compression techniques; fiber-optic communication systems; and soliton-based transmission schemes. Book News, Inc.®, Portland, OR

About the Author

Govind P. Agrawal was born on July 24, 1951 in the town of Kashipur of the Nainital district in U.P. He received his B.Sc. degree from the University of Lucknow in 1969 with honors. He was awarded a gold medal for achieving the top position in the university. Govind joined the Indian Institute of Technology at New Delhi in 1969 and received the M.Sc. and Ph.D. degrees in 1971 and 1974, respectively. After holding positions at the Ecole Polytechnique (France), the City University of New York, and the Laser company, Quantel, Orsay, France, Dr. Agrawal joined in 1981 the technical staff of the world-famous AT&T Bell Laboratories, Murray Hill, N.J., USA, where he worked on problems related to the development of semiconductor lasers and fiber-optic communication systems. He joined in 1989 the faculty of the Institute of Optics at the University of Rochester where he is a Professor of Optics. His research interests focus on quantum electronics, nonlinear optics, and optical communications. In particular, he has contributed significantly to the fields of semiconductor lasers, nonlinear fiber optics, and optical communications. He is an author or coauthor of more than 250 research papers, several book chapters and review articles, and four books entitled "Semiconductor Lasers" (Van Nostrand Reinhold, 2nd ed. 1993), "Nonlinear Fiber Optics" (Academic Press, 3rd ed. 2001), "Fiber-Optic Communication Systems" (Wiley, 2nd ed. 1997), and "Applications of Nonlinear Fiber Optics" (Academic Press, 2001). He has also edited the books "Contemporary Nonlinear Optics" (Academic Press, 1992) and "Semiconductor Lasers: Past, Present and Future" (AIP Press, 1995). The books authored by Dr. Agrawal have influenced an entire generation of scientists. Several of them have been translated into Chinese, Japanese, Greek, and Russian.

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Since the publication of the first edition of *Nonlinear Fiber Optics* in 1989, this field has virtually exploded. A major factor behind such tremendous growth was the advent of fiber amplifiers, made by doping silica or fluoride fibers with rare-earth ions such as erbium and neodymium. Such amplifiers revolutionized the design of fiber-optic communication systems, including those making use of optical solitons whose very existence stems from the presence of nonlinear effects in optical fibers. Optical amplifiers permit propagation of lightwave signals over thousands of kilometers as they can compensate for all losses encountered by the signal in the optical domain. At the same time, fiber amplifiers enable the use of massive wavelength-division

multiplexing (WDM) and have led to the development of lightwave systems with capacities exceeding 1 Tb/s. Nonlinear fiber optics plays an increasingly important role in the design of such high-capacity lightwave systems. In fact, an understanding of various nonlinear effects occurring inside optical fibers is almost a prerequisite for a lightwave-system designer.

While preparing the third edition of Nonlinear Fiber Optics, my intention was to bring the book up to date so that it remains a unique source of comprehensive coverage on the subject of nonlinear fiber optics. An attempt was made to include recent research results on all topics relevant to the field of nonlinear fiber optics. Such an ambitious objective increased the size of the book to the extent that it was necessary to split it into two separate books, thus creating this new book Applications of Nonlinear Fiber Optics. The third edition of Nonlinear Fiber Optics deals with the fundamental aspects of the field. This book is devoted to the applications of nonlinear fiber optics, and its use requires knowledge of the fundamentals covered in Nonlinear Fiber Optics. Please note that when an equation or section number is prefaced with the letter A, that indicates that the topic is covered in more detail in the third edition of Nonlinear Fiber Optics.

Most of the material in this volume is new. The first three chapters deal with three important fiber-optic components--fiber-based gratings, couplers, and interferometers--that serve as the building blocks of lightwave technology. In view of the enormous impact of rare-earth-doped fibers, amplifiers and lasers made by using such fibers are covered in Chapters 4 and 5. The last three chapters describe important applications of nonlinear fiber optics and are devoted to pulse-compression techniques, fiber-optic communication systems, and soliton-based transmission schemes. This volume should serve well the need of the scientific community interested in such fields as ultrafast phenomena, optical amplifiers and lasers, and optical communications. It will also be useful to graduate students as well as scientists and engineers involved in lightwave technology.

The potential readership is likely to consist of senior undergraduate students, graduate students enrolled in the M.S. and Ph.D. programs, engineers and technicians involved with the telecommunication industry, and scientists working in the fields of fiber optics and optical communications. This volume may be a useful text for graduate and senior-level courses dealing with nonlinear optics, fiber optics, or optical communications that are designed to provide mastery of the fundamental aspects. Some universities may even opt to offer a high-level graduate course devoted solely to nonlinear fiber optics. The problems provided at the end of each chapter should be useful to instructors of such a course.

Many individuals have contributed either directly or indirectly to the completion of this book. I am thankful to all of them, especially to my students, whose curiosity led to several improvements. Some of my colleagues have helped me in preparing this book. I thank Taras Lakoba, Zhi Liao, Natalia Litchinitser, Bishnu Pal, and Stojan Radic for reading several chapters and making helpful suggestions. I am grateful to many readers for their feedback. Last, but not least, I thank my wife, Anne, and my daughters, Sipra, Caroline, and Claire, for understanding why I needed to spend many weekends on the book instead of spending time with them.

Govind Agrawal
Rochester, NY

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