

Preface to the Second Edition

The book *Fundamentals of Semiconductor Lasers* is a bridge between textbooks and journal papers on laser diodes (LDs). In the second edition, misprints in the first edition are corrected, and a multiple-layer model is added in Chap. 3 to analyze antiguiding. Based on the multiple-layer model, the basics of antiguiding and several journal papers on single horizontal transverse mode operations in LDs with antiguiding structures are explained in Chap. 5. In Chap. 6, a journal letter on single longitudinal mode operations in the first manufactured phase-shifted DFB-LD is described. The entire manuscript was written using the *Système International d'Unités* (SI). As a result, Appendix E in the second edition looks rather more complicated than Appendix E in the first edition. It should be noted that the manuscripts for the first edition were written in SI units except for Appendix E, which was written in CGS Gaussian units to express wave equations in simple formulas. In Appendix H, two definitions of photon density are compared and the rate equations with each definition are derived in order to avoid confusion when reading journal papers.

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Semiconductor lasers have been actively studied since the first laser oscillation in 1962. Through continuing efforts based on physics, characteristics of semiconductor lasers have been extensively improved. As a result, they are now widely used. For example, they are used as the light sources for bar-code readers, compact disks (CDs), CD-ROMs, magneto-optical disks (MOs), digital video disks (DVDs), DVD-ROMs, laser printers, lightwave communication systems, and pumping sources of solid-state lasers. From these facts, it may be said that semiconductor lasers are indispensable for our contemporary life.

This textbook explains the physics and fundamental characteristics of semiconductor lasers with regard to system applications. It is aimed at senior undergraduates, graduate students, engineers, and researchers. The features of this book are as follows:

1. The required knowledge to read this book is electromagnetism and introductory quantum mechanics taught in undergraduate courses. After reading this book, students will be able to understand journal papers on semiconductor lasers without difficulty.
2. To solve problems in semiconductor lasers, sometimes opposite approaches are adopted according to system applications. These approaches are compared and explained.
3. In the research of semiconductor lasers, many ideas have been proposed and tested. Some ideas persist, and others have faded out. These ideas are compared and the key points of the persisting technologies are revealed.
4. The operating principles are often the same, although the structures seem to be different. These common concepts are essential and important; they allow us to deeply understand the physics of semiconductor lasers. Therefore, common concepts are emphasized in several examples, which lead to both a qualitative and a quantitative understanding of semiconductor lasers.

This book consists of two parts. The first part, Chapters 1–4 and reviews fundamental subjects such as the band structures of semiconductors, optical transitions, optical waveguides, and optical resonators. Based on these fundamentals, the

second part, Chapters 5–8 explains semiconductor lasers. The operating principles and basic characteristics of semiconductor lasers are discussed in Chapter 5. More advanced topics, such as dynamic single-mode lasers, quantum well lasers, and control of spontaneous emission, are described in Chapters 6–8.

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