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Light and Matter: electromagnetism, optics, spectroscopy and lasers

Subject area
Physics, Physical Chemistry, Electrical Engineering, Material Science

Description
This book introduces the reader to the nature of light, explains key procedures which occur as light travels through matter and delves into the effects and applications, exploring spectroscopy, lasers, nonlinear optics, fibre optics, quantum optics and light scattering.

Authors
Yehuda B Band

Publishers/Suppliers
John Wiley & Sons Ltd (eu.wiley.com/WileyCDA)

Date/Edition
2006

ISBN
978-0-471-89931-0

Level
Undergraduate, research

Price
£39.99

The interaction of light and matter is important to many areas of science and technology, including chemistry, electrical engineering, material science and physics. This book sets out a solid theoretical foundation and is aimed at both practitioners and advanced students.

The book’s subtitle
‘Electromagnetism, Optics, Spectroscopy and Lasers’ is a fair summary of the content. Overall, the book has a physics or engineering approach. It is strong in electromagnetism, non-linear optics and various laser phenomena. The discussion focuses on the interaction of visible and ultraviolet light with matter, associated with electronic transitions. There is some, but limited discussion of molecular spectroscopy involving vibrational, rotational and/or nuclear transitions. The ‘optics’ sections of the book introduce effects like refraction, dispersion, nonlinear optics, quantum-optical processes and light propagation in optical fibres. Light propagation through multiple optical elements (eg a sequence of lenses and/or slits) is not included. Clear, easy-to-understand, black-and-white diagrams support the text. A few key diagrams are reproduced in colour in the colour-plate section in the centre of the book.

Revision problems are placed through the text, near the topic or concept being revised, instead of being collated at the end of chapters. Hints and answers, where appropriate, are printed immediately after the problem. A weakness of the book is that many of the problems are of the derive-an-equation type, and do not have a detailed answer (derivation). The number of problems per chapter is highly variable, ranging from 1 problem for each two pages of content in chapters 1 and 9 to 2 problems in the 22-page chapter 10. Students will want more revision problems especially in the latter chapters, and significantly more numerical problems to get an appreciation of the magnitude of the effects and properties discussed in the text.

The preface states that an elementary course in electricity and magnetism is assumed. Some of this assumed knowledge, electromagnetism and Maxwell’s equations, the Schrödinger equation and perturbation theory, is summarised briefly in the Appendices. Not stated, but also assumed is a strong grasp of mathematics. For example, Maxwell’s equations are introduced on page 2 in their concise vector notation form involving grad operators, dot and cross vector products, and partial derivatives. This is not a book for the faint of heart, nor those lacking mathematical confidence.

This is a first edition, and has several minor, but annoying aspects. Abbreviations are defined, and many are listed in the index, but I found it hard to keep track of the abbreviations. Perhaps Professor Band will add a glossary to the website (www.bgu.ac.il/~band/Light&Matter.html) associated with the book. (One very useful feature of the website is the links to related websites.) There is a list of more than 100 references, which is very good. There is a separate bibliography, arranged by topic, which will be very useful for those needing more information, but it is unclear how the bibliography topics are arranged, as the sequence corresponds neither to the chapter order, nor to alphabetical order.
From the publisher...

**Light and Matter: Electromagnetism, Optics, Spectroscopy and Lasers**

By Yehuda B. Band

Light and Matter: Electromagnetism, Optics, Spectroscopy and Lasers provides comprehensive coverage of the interaction of light and matter and resulting outcomes. Covering theory, practical consequences and applications, this modern text serves to bridge the gap between electromagnetism, optics, spectroscopy and lasers. The book introduces the reader to the nature of light, explains key procedures which occur as light travels through matter and delves into the effects and applications, exploring spectroscopy, lasers, nonlinear optics, fiber optics, quantum optics and light scattering. Extensive examples ensure clarity of meaning while the dynamic structure allows sections to be studied independently of one another.


Who should read and buy this book? Graduate students and practitioners in physics, engineering, and perhaps some areas of physical chemistry, who need to have a firm understanding of theory, would benefit from this book. Those who are looking for an 'applied' book would be disappointed.