Electromagnetic radiation

Electromagnetic Vibrations, Waves, and Radiation. By G. Bekefi and A. H. Barrett. Pp. 664. (MIT Press: Cambridge, Massachusetts and London, 1977.) $17.50.

THIS is a textbook for second- or third-year physics and engineering students who have already had courses in mechanics and in electricity and magnetism. The first two chapters go thoroughly over the groundwork of oscillations and waves with lots of examples, not necessarily from electromagnetism — pendulums, coupled springs, seismometers and sound waves. Maxwell's equations are briefly introduced, and used to deduce the wave equation; and then the book settles down to its main task of describing the behaviour of electromagnetic radiation. The aim is to provide a mathematically unsophisticated treatment of the subject, stressing modern applications. The authors succeed rather well in giving quantitative though not formal descriptions of a very wide range of phenomena. Perhaps almost too wide a range: the chapter on sources of radiation discusses not only accelerating charges, Hertzian dipoles and antennas, but also cyclotron and synchrotron radiation, *bremsstrahlung* and black body radiation. The synchrotron radiation from a highly relativistic beam is treated in a very back-of-the-envelope fashion, but interestingly, and with references for the student to follow up.

Photons are mentioned only once, when it is shown that the same expression for the radiation pressure can be obtained in the classical and quantum-mechanical pictures. For most of the topics treated—reflection, interference, waveguides, and so on—no problems are created by sticking to a rigorously classical approach. But a determination to explain everything in terms of oscillations does not work so well in introducing lasers and masers. Stimulated emission is a "process in which atoms jiggling in the correct phase relationship with the wave can give up some of their energy to the wave". The only example of what is mysteriously called "preparing the medium" is with a maser operating with relativistic electrons, which is rather difficult to understand. There is no mention of the simple idea of optical pumping.

Most of the examples are by contrast clearly explained, and I think many students would find this book a good introduction to new ideas. **I. S. Grant**

I. S. Grant is Senior Lecturer in Physics at the University of Manchester, UK.

Probability theory

Elementary Probability Theory. By M. Hausner. Pp. 610. (Plenum: New York, 1977.) $10.75.

THERE have been many very good books on probability theory published in recent years, ranging from the popular introduction to the comprehensive treatise. To be competitive in this field at any level, a new book requires a distinctive approach to the subject and a careful consideration of the intended market. The book under review is at a first-year undergraduate level, adopts a rather conventional approach and is likely to appeal only to a student who proposes to specialise in a study of statistics. This limitation is a pity because the book has the potential to fill a gap which exists for the science student who requires an elementary understanding of probability concepts as they arise in his particular subject, but presented and proven with a certain mathematical rigour. It fails to satisfy in this respect, not by the choice of material, which is admirably suited to the purpose, but by the absence of suitable illustrative examples. The numerous worked problems and more than four hundred exercises are concerned, almost exclusively, with dice, playing cards and other games of chance. The value of probability concepts for the scientist are totally overlooked.

Despite these reservations, the author is to be praised for a splendidly lucid presentation of his subject enhanced by a thoughful layout of tables, diagrams and formulae. Ideas of probability are developed from first principles, assuming no previous knowledge of the subject and requiring a very basic mathematical background of the reader.

Nevertheless, progress is rapid, from the fundamental concepts of permutations, combinations and elementary set theory, which are established in the first two chapters, to a consideration of the general theory of finite probability spaces. An interesting chapter on miscellaneous topics touches on random walk problems, which would have been an interesting area to explore in a scientific context. The treatment of random variables and the significance of variance is conventional, stimulated by a brief excursion into the theory of games. It is, perhaps, curious that a formal discussion of the Normal, Binomial and Poisson distributions is deferred to the final chapter and that no reference is made to the fact that many of the earlier problems could be solved by a consideration of the general properties of these distributions.

The book provides a very good basis for the comprehension and interpretation of statistics and can be recommended for the student who intends to proceed to this subject. **G. J. Lush**

G. J. Lush is Lecturer in the Department of Physics and Astronomy at University College, London, UK.

Group theory

Symmetry and Quantum Systems. By A. B. Wolbarst. Pp. 249. (Van Nostrand, Reinhold: New York, Toronto, London and Melbourne, 1977.) Hardback £9.95; paperback £3.95.

THIS is a pleasantly written and very readable introduction to the applications of group theory in quantum mechanics. The author assumes previous knowledge of physics and mathematics, which a British honours physics student would have in his final year. But it seems unlikely that room could be found in most final-year physics courses for a section on group theory substantial enough to justify using this book. It is, however, likely to be used more in the first stages of post-graduate study.

Wolbarst's book is comparable in standard to the books by McWeeny, by Joshi, or by Petrashen and Trifonov, but the approach is very different. The first third of the text is devoted to establishing a motivation towards the use of group methods in quantum physics. In this process, the author clarifies—in a way that should be helpful to all research physicists in training—the differences between real space and function space, between operators and their representations, and between transformations in real space and the corresponding operations in function space.

The next three chapters treat respectively representations of operators; representations of groups of operators; and irreducible representations. This mainly mathematical section is followed by four chapters in which physical applications are again to the fore—the relationship of symmetry in Hilbert space to symmetry in real space; the uses of continuous groups; perturbations; and symmetry and conservation laws.

Throughout, the presentation is orderly, with excellent summaries at the end of each chapter. Mathematical rigour is not pursued to lengths which might deter the physicists for whom the book is intended; but the treatment is far from anti-mathematical, and the author's balance between rigour and vigour is struck very skilfully. A substantial number of well chosen questions and problems occurs throughout the text, and they form an essential part of the development. Adopted as an expedient to reduce the book's length, this does not seem altogether satisfactory, and one is tempted to ask for the inclusion (in the next edition) of an appendix containing answers to the questions and notes on the problems: this would be particularly useful to readers studying the text without the support of a lecture course.

Richard M. Sillitto

R. M. Sillitto is Senior Lecturer in Physics at the University of Edinburgh, Scotland.

© Macmillan Journals Ltd 1978