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# REVIEWS

**Fundamentals of Waves and Oscillations.** By K. U. INGARD. Cambridge University Press, 1988. 595 pp. £65.00 (hardback), £22.50 (paperback).

There are numerous books on different aspects of waves, reflecting the authors' special interests in the subject. The present book differs from these in attempting to embrace a wide variety of wave phenomena modelled by linearized wave equations, in much the same way as Coulson's book *Waves* did nearly fifty years ago. The approach in this case is very much from a physicist's point of view with considerable detail given of the physical modelling and attention paid to the differences between the physical problem and its mathematical counterpart. The book is based on notes prepared for an undergraduate physics course on waves and oscillations for science and engineering students at MIT. It is assumed that students have had introductory courses in mechanics and electromagnetics in which they have encountered the idea of periodic motions.

The book is divided into three parts. Part 1 comprises chapters 1–5 and deals with harmonic oscillations in general terms, part 2 (chapters 6–10) deals with types and aspects of waves and part 3 (chapters 17–21) deals with special topics. Each chapter ends with one or more worked examples together with a large number of problems for the student. Noticeable in the book is the use of 'Displays' which are summarized equations and important ideas complemented where appropriate by sketches, which are displayed in boxes on single pages for easy reference. These are used liberally throughout and will undoubtedly find favour with students required to prepare material for examinations.

Part 1 deals with elementary concepts such as the frequency response to a forced harmonic oscillation for both single and coupled oscillators, the response to an arbitrary driving force and the idea of linear superposition of normal modes in order to describe the 'free' motion due to an initial disturbance. A most important chapter in part 1 deals with the use of the complex amplitude in simplifying the analysis of harmonic motion. The author is right to emphasize this simplifying technique from the start since it is a technique which many students for some unaccountable reason find difficult to grasp.

The aim of part 2 is to provide a unified description of wave theories. Following a consideration of wave kinematics, the linearized equations governing longitudinal and transverse mechanical waves, electromagnetic waves, acoustic waves in fluids, and longitudinal or torsional waves in solids are all shown to lead to the wave equation. There follow sections on a wide variety of topics common to many types of waves including wave reflection and transmission, resonances and normal modes, wave interference and diffraction, refraction and reflection, wave transmission through periodic structures and wave guides and cavities. Part 2 ends with a self-contained chapter on matter waves and the one-dimensional Schrödinger equation. Many students will find this chapter difficult if they have not been introduced to the ideas of quantum mechanics before.

Part 3 is devoted to special topics and here can be found much material not previously collected together in one place. We begin with a chapter on radiation and scattering of acoustic and electromagnetic waves which surely reflects the author's own special interests. Here we find a treatment of monopole radiation from a

pulsating sphere, leading on to the use of quadrupoles for non-uniform spherical sources and a brief mention of spherical harmonics. The Born approximation for acoustic scattering by small bodies is described and the chapter ends with a consideration of Thomson and Rayleigh scattering of electromagnetic waves leading to an explanation of why the sky is blue. A chapter on surface waves goes further than most textbooks on the topic in a consideration of the importance of viscosity on short surface waves and in a description of light scattering by thermal ripples on a liquid surface, or Brillouin scattering. There follows a short illuminating chapter on waves in plasmas and a long one on waves in solids which, like all the chapters in part 3, is entirely self-contained and can be read independently of the others.

The book ends with a chapter on feedback oscillations which are illustrated by a wide variety of applications including valve instability, a vortex sheet, whistles and wind instruments, lasers, and heat-maintained oscillations such as the Rijke tube.

Although presented as a text for undergraduates, there is much more here than could possibly be covered in a typical course on waves. The excellent description of the physics, the disciplined use of displays to summarize the theory, and the interesting choice of material, especially in part 3, promises to make this an essential reference book for many readers.

D. V. EVANS

**Hydrodynamics of Coastal Zones.** By S. R. MASSEL. Elsevier, 1989. 336 pp. US $105.25 or Dfl. 200.

Development of low-lying coastal regions has been an accelerating process, first as ports, then through drainage for agricultural purposes as in The Netherlands, the development of resorts and of industrial areas. This has lead to increased interest in defence against the sea to tame its power to damage, erode, flood, and silt up with sediments. In recent decades extraction of hydrocarbons, sand and gravel and increased input of pollution has augmented this interest; and, most recently, concern about possible significant increases in the volume of the oceans due to the 'greenhouse effect' gives a further spur to extend our understanding of the hydrodynamics of our marginal seas. In all these many areas of application, the primary environmental input to any study involves the level of the sea, its currents, the winds and the waves. Each of these topics and most of the applications can be and mostly are the subject of individual books. Thus the first point of interest is to see how Massel has chosen topics for this book.

As befits a book in an oceanography series there is no reference to man-made structures, such as breakwaters, sea walls or oil rigs, and only occasional references to laboratory wave flumes and experiments therein. The book has a strong bias in that seven of its nine chapters are on surface waves. This accords with the interest and expertise of the author, and is justifiable. Apart from extremely high water levels, which are usually associated with very long waves such as storm surges or tsunamis, surface waves are the most damaging component of coastal hydrodynamics.

After an introductory chapter there are chapters on short waves, long waves, wave refraction by depth variations, and on wave modulation and breaking. Wind waves merit two chapters, on their statistics and on their spectra. Even the remaining two chapters, on currents and on sea-level variations have substantial wave-related sections. If we include tides, surges and wave-induced currents within the topic of water waves, this leaves a short three-page section on wind-driven currents as the

only non-wave topic. The book is thus almost completely about the hydrodynamics of waves in coastal regions. In this respect it should be welcomed since most water-wave books are biased towards ocean waves.

Upon reading the book it becomes clear that Massel has attempted to give an up-to-date account which puts readers in touch with the most useful results in its area. A couple of 1988 references are included. However, even though the subject matter is more limited than the book's title there is far too much relevant material for a thorough treatment. The author's approach is to be concise. The reader is expected to have a good background in the form of basic knowledge of hydrodynamics, partial differential equations, analysis of time series, and of the physical environment. Where useful analytical or experimental results are available, these are often presented in some detail, but the steps by which they are derived are only occasionally given.

As befits such a book there are a large number of references. The book could be billed as a detailed guide to the literature on water waves in coastal regions. Some of the Russian and Polish references may be new to Western readers yet contain interesting results. It is clear that a significant proportion of research in this subject appears only in report and conference proceedings.

Few publications are free from faults. The book is very nicely printed and bound in The Netherlands for a Polish author, so perhaps we can forgive some unusual examples of English phraseology and spelling since they do not cause difficulties for the reader. On the other hand I object to '$1/2\pi$' where '$\frac{1}{2}\pi$' is meant, and to the ambiguous notation '$\cosh^{-1}$' where 'sech' would be more precise. There are also one or two places where conciseness has gained over veracity, but again these examples are not serious since the general tenor of the sections are correct. Here and there I might select different works to emphasize but overall the author is clearly abreast of work in the whole of his chosen field.

To sum up; this is not a book for a beginner, but is a guide for coastal engineers, and others engaged in coastal and offshore work, who wish to be in touch with recent work on the hydrodynamics of waves in coastal regions.

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