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Book reviews

Transport phenomena

W.J. Beek, K.M.K. Muttzall, J.W. van Heuven; John Wiley and Sons Ltd., 1999, 2nd edition, 342 pp, £34.95 (paperback), £100.00 (hardback), ISBN: 0-471-99990-3 (paperback), 0-471-99977-6 (hardback)

This is a textbook covering the classical topics within transport phenomena, which includes the transport of momentum (fluid dynamics), heat and mass. It is intended to serve as a basis for a course within the curricula of, for instance, chemical or mechanical engineering. In the preface to this second edition the authors emphasize its suitability for 'vocational studies'.

The book is part of a tradition in transport phenomena here in The Netherlands, which has its origins in a series of lecture notes written in the 1950s by Prof. H. Kramers, who taught the subject at Delft Technical University. Also the well-known book 'Transport Phenomena' by Bird, Stewart and Lightfoot has benefited from this tradition.

In the preface to this second edition, the authors defend the existence of their book, next to the one by Bird et al., with the argument that this book mainly serves vocational studies and students 'not opting for an academic career' (p. xi). This argument is, in my opinion, not necessary: this book is sufficiently fundamental in its treatment, and one wonders if students in the more vocational studies would wish to wrestle with transport phenomena at this level. Nevertheless, the book has right of existence: experience teaches us that a subject can only be fully appreciated if it has been studied in at least two texts; not until then is it possible to distil out the essentials. The trend towards one worldwide standard textbook in each subject is therefore not a good one. Having more points of view enriches our understanding.

The organization of the book is in four chapters, Chapter 1 is an introduction to the basic concepts, and Chapters 2, 3 and 4 are devoted to momentum, heat and mass transfer, respectively. Each chapter is then subdivided into sections. All the classical topics are covered. One new topic, which is not included, is that of computational fluid dynamics. Rightly or wrongly, computational fluid dynamics now plays such a central role as a tool in transport phenomena that an introduction to the method and some of its possibilities and limitations might well be included in a textbook such as this.

The book is pleasing to read: the typeface used and the general layout make it very readable. Diagrams help to visualize the material. As the authors state, estimating orders of magnitude is an important aspect of the study and application of transport phenomena. A feature of the book are the many pieces of information helpful for doing that, for instance the list of drag coefficients in Table II.4 and the list of heat transfer coefficients in Table III.6. The authors have struck a good balance between giving detail of derivations and clarity of the exposition. Another prominent feature of the book is the problems included after each subsection, some of which are also discussed.

As mentioned above, diversity surely enhances our understanding, but it also leads to more glitches. This book is not without blemishes either. One aspect, which is essential for understanding flow phenomena, is the *sign of shear stresses*. The convention in this book (as in Bird et al.) is to consider shear stresses as momentum fluxes. This means that the shear stress τ acts on the fluid at *greater* coordinate, one consequence of which is that it appears with a minus sign in the famous force balance on a central plug of fluid leading to the laminar velocity profile in a pipe. The *direction* in which τ acts is then expressed in its numerical value. If the student does not appreciate this, he or she will wade through the entire subject in constant confusion about signs. This book does not make this clear. In fact, we are even told on page 44 that the sign with which τ appears in the force balance is a consequence of the direction in which it acts.

Overall, I can recommend the book to the student or lecturer of transport phenomena as an enrichment. It is also suitable as the main textbook for a university course, making a somewhat less daunting impression than some of the other books on the subject.

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After receiving this book for review I started browsing through it and that gave me an as yet unidentified bad feeling.