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Book Reviews

Boundary-Layer Theory by H. Schlichting, Seventh Edition, (translated by J. Kestin), New York: McGraw-Hill Book Company, xxii + 817 pp., 1979. Price $28.00.

REVIEWED BY ROBERT L. STREET

Boundary-Layer Theory has held a preeminent place in the fluid mechanics literature for almost thirty years. The seventh edition, the first to be published first and only in English, comes eleven years after the sixth edition. I am sure many of us felt that it was "time."

According to the author the principal thrust of the book is "the intent to emphasize and to present theoretical considerations in a form accessible to engineers." In the seventh edition he worked to retain the original character of the book and "provide the reader with a *bird's-eye view* of this important branch of the physics of fluids." These goals are the source of both strength and weakness in the book. It already contained much of the classic essence of the field. Additions and changes had to be balanced against increased heft (now over 800 pages) and loss of important fundamentals. The result is a compromise. There has been a general updating, sharpening of parts of the text, removal of some out-of-date material; many new references were added, and a modest number of new items have been inserted. Some of the additions noted by the author are worth commentary.

The numerical integration of equations is mentioned descriptively (Chap. IV) and discussed for the case of boundary-layer equations for laminar and turbulent flows (Chap. IX, Sec. i). This latter section is new and gives a good description of the numerical technique, leads to the literature, and validation of some specific results. However, I wonder if eight pages among 800 is proper weight for some of the most important methodologies in current practice, an area which has spawned innumerable papers and at least four books.

The sections on the second-order boundary-layer (Chap. VII, Sec. f and Chap. IX, Sec. j) are welcome. The latter is new; the former revised. Together they gave a "first-order" introduction to asymptotic and inner/outer expansions. As always in this book, the feel of these text pieces is comfortable—clear theory, useful examples, numerical results, comparison with experiment, and a sense of the importance of the results.

The treatment of stability in laminar boundary layers has been significantly changed (Chap. XVI) in the light of the direct solutions available for the 4th order Orr-Sommerfeld equation. The previous approach using the inviscid solution (for the 2nd order equation) and a viscous correction has been eliminated. The concluding remark (Sec. f) to the chapter is a fine touch, summarizing the transition process in a boundary layer in words and picture.

In summary, if you do not own an earlier copy of *Boundary-Layer Theory* and your work involves boundary layers, then you should have a copy of the seventh edition. It remains the comprehensive treatise and a major source book for neophytes and veterans. The blend of mathematics, fundamental physics, and experimental results leads the reader to understanding of key features, ideas and approaches. Then, one can branch to the multitudinous in-depth monographs on specific areas.

The tougher issue is, if you own an earlier edition, should you buy the seventh? If you own the sixth, probably not; otherwise, yes.

An Introduction to Viscous Flow by W. E. Hughes, Hemisphere Publishing Corp., New York, 1979, 219 pp., Price: $22.50.

REVIEWED BY WARREN M. HAGIST

This little book, which concentrates on laminar flows in its six chapters, is intended for use at the undergraduate level. In his preface, Dr. Hughes states that it is suitable as a text for a second course (which it is), but the writing is lucid enough so that it could easily be used in a first course if the instructor were willing to supplement chapter 1 with some of the details of the derivations of the integral forms of the basic equations and provide additional material on turbulent flows.

The second chapter begins by discussing and working through the Poiseuille and Couette flows from a free-body diagram of a fluid element. This is followed by derivations of the continuity and momentum equations in differential form and a discussion of the deformation and strain rates, culminating with the Navier-Stokes equations. The chapter concludes with a discussion of non-Newtonian fluids and derivations of the velocity distribution in a circular pipe for both a power-law fluid and a Bingham plastic.

Chapter 3 entitled "Hydrodynamic Lubrication" takes the student through the usual two-dimensional discussions and derivations for the stepped slider, inclined slider, and journal bearings. A rather short fourth chapter introduces the student to the two-dimensional form of the differential energy equation and works out the temperature distributions in Couette and Poiseuille flow. It concludes with a derivation of the general energy equation and the relationship between it and Bernoulli's equation.

The last two chapters are concerned with boundary layers; momentum effects in chapter 5, and thermal effects in chapter 6. After a general discussion of the boundary layer concept and the flow past objects of various shapes, Dr. Hughes proceeds through the two-dimensional order of magnitude development of the boundary layer equations, the Blasius solution, and a third degree polynomial approximate solution. Following this is a section on the turbulent boundary