Preface

General Approach

The sixth edition of *Fluid Mechanics* sees some additions and deletions but no philosophical change. The basic outline of eleven chapters, plus appendices, remains the same. The triad of integral, differential, and experimental approaches is retained. Many problem exercises, and some fully worked examples, have been changed. The informal, student-oriented style is retained. A number of new photographs and figures have been added. Many new references have been added, for a total of 418. The writer is a firm believer in "further reading," especially in the postgraduate years.

Learning Tools

The total number of problem exercises continues to increase, from 1089 in the first edition, to 1674 in this sixth edition. Most of these are basic end-of chapter problems, classified according to topic. There are also Word Problems, multiple-choice Fundamentals of Engineering Problems, Comprehensive Problems, and Design Projects. The appendix lists approximately 700 Answers to Selected Problems. The example problems have been newly restructured in the text, following the sequence of steps outlined in Section 1.3.

Content Changes

There are some revisions in each chapter. Chapter 1 has been revised so that the history of fluid mechanics comes earlier, in Section 1.2. Problem-solving techniques have been moved to Section 1.3. The discussion of the velocity field, Section 1.7, has been shortened, and the mathematical material moved to Chapter 4. The brief but useful discussion of nonnewtonian fluids has been improved. A reviewer helped the author improve the treatment of experimental uncertainty, Section 1.13. The discussion of the Fundamentals of Engineering (FE) Exam has been updated, and the text contains 85 FE-type problems.

Chapter 2, thanks to reviewer requests, has been relieved of the heavy Navier-Stokes discussion, now put back into Chapter 4. The emphasis returns to plain hydrostatics. The treatment of manometers has been improved. Instead of relying entirely on moment-of-inertia hydrostatic-force formulas, a new example shows how to work directly with pressure distributions. The treatment of rigid-body motion has been shortened to avoid excessive three-dimensional excursions, and Section 2.10 on pressure measurement introduces digital manometers.

In Chapter 3, the development of control volume analysis has been significantly shortened. Example 3.5, a $\mathbf{V}(x, y, z)$ field integration example, has been replaced by one less sophisticated, a sluice gate. Bernoulli's equation still comes last and is not broken out into a new chapter. I try to stress that the Bernoulli relation is dangerously restricted and often misused by both students and graduate engineers. The reviewers have suggested a better way of explaining when the Bernoulli equation is invalid. Example 3.22, a complicated and unsatisfying transient-flow case, has been replaced by a better example.

Chapter 4 now begins the treatment of the acceleration vector, removed from Chapter 2. At the persuasive suggestion of the reviewers, Section 4.10, *Illustrative Potential Flows,* has been moved to Chapter 8. Twenty new problems have been added here.

Chapter 5 continues to emphasize the *pi theorem* method of finding dimensionless groups. But I have added a discussion, an example, and some problems, for the method of Ipsen (a 1960 textbook), which is a terrific alternate approach that yields all the pi groups at once. At the reviewers' request, I added four new examples, and "more air, not so much water."

Chapter 6 has added a *Type-4* pipe-flow problem treatment: finding the correct pipe length. Under minor losses, new data on diffuser losses has been added. Under flow measurement, a treatment of particle image velocimetry has been added.

Chapter 7 adds new data on automobile drag, including the world record for high mileage, 12,665 miles per gallon! A discussion of the Airbus A-380 is also added.

Chapter 8 now contains all the potential-flow material that had been in Chapter 4. New data on the lift and drag of rotating cylinders has been added, which casts much doubt on the accuracy of the classical figure used in earlier editions and in other books.

Chapter 9 needed few changes, in the writer's opinion. *New Trends in Aeronautics* was updated, and 25 new problems were added.

Chapter 10 was aided by reviewer suggestions. A new section, with problems and data, has been added on the performance of free propellers. More discussion and data have been included on wind turbines, which certainly have a great future.

Appendix B, *Compressible Flow Tables,* has been greatly shortened by using coarser increments in Mach number. The tables give the flavor of a function, and the flow functions can easily be obtained from Excel, MATLAB, or an ordinary calculator.

Supplements

A number of supplements are available to students and/or instructors. A print version of the Student Study Guide has been developed by Jerry Dunn of Texas A&M University. Students may also obtain, in DVD format, EES, fluid mechanics videos developed by Gary Settles of Pennsylvania State University and CFD images and animations prepared by Fluent Inc. In ARIS format for students, Fundamentals of Engineering (FE) Exam quizzes, prepared by Edward Anderson of Texas Tech University, and some algorithmic problems are available.

Instructors may obtain a series of PowerPoint slides and images, plus the full Solutions Manual, in pdf format. The Solutions Manual provides complete and detailed solutions, including problem statements and artwork, to the end-of-chapter problems. It may be photocopied for posting or preparing transparencies for the classroom.

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