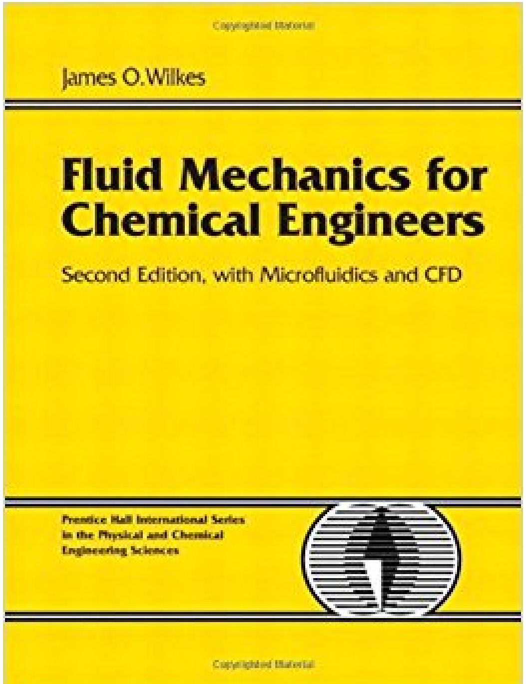
Fluid Mechanics For Chemical Engineers With Microfluidics And CFD (2nd Edition)



Synopsis

The Chemical Engineer's Practical Guide to Contemporary Fluid Mechanics Since most chemical processing applications are conducted either partially or totally in the fluid phase, chemical engineers need a strong understanding of fluid mechanics. Such knowledge is especially valuable for solving problems in the biochemical, chemical, energy, fermentation, materials, mining, petroleum, pharmaceuticals, polymer, and waste-processing industries. Fluid Mechanics for Chemical Engineers, Second Edition, with Microfluidics and CFD, systematically introduces fluid mechanics from the perspective of the chemical engineer who must understand actual physical behavior and solve real-world problems. Building on a first edition that earned Choice Magazine's Outstanding Academic Title award, this edition has been thoroughly updated to reflect the field's latest advances. This second edition contains extensive new coverage of both microfluidics and computational fluid dynamics, systematically demonstrating CFD through detailed examples using FlowLab and COMSOL Multiphysics. The chapter on turbulence has been extensively revised to address more complex and realistic challenges, including turbulent mixing and recirculating flows. Part I offers a clear, succinct, easy-to-follow introduction to macroscopic fluid mechanics, including physical properties; hydrostatics; basic rate laws for mass, energy, and momentum; and the fundamental principles of flow through pumps, pipes, and other equipment. Part II turns to microscopic fluid mechanics, which covers Differential equations of fluid mechanics Viscous-flow problems, some including polymer processing Laplace's equation, irrotational, and porous-media flows Nearly unidirectional flows, from boundary layers to lubrication, calendering, and thin-film applications Turbulent flows, showing how the k/Ã Â method extends conventional mixing-length theory Bubble motion, two-phase flow, and fluidization Non-Newtonian fluids, including inelastic and viscoelastic fluids Microfluidics and electrokinetic flow effects including electroosmosis, electrophoresis, streaming potentials, and electroosmotic switching Computational fluid mechanics with FlowLab and COMSOL Multiphysics Fluid Mechanics for Chemical Engineers, Second Edition, with Microfluidics and CFD, includes 83 completely worked practical examples, several of which involve FlowLab and COMSOL Multiphysics. There are also 330 end-of-chapter problems of varying complexity, including several from the University of Cambridge chemical engineering examinations. The author covers all the material needed for the fluid mechanics portion of the Professional Engineer's examination. The author's Web site, www.engin.umich.edu/~fmche/, provides additional notes on individual chapters, problem-solving tips, errata, and more.

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Preface This text has evolved from a need for a single volume that embraces a wide range of topics in fluid mechanics. The material consists of two parts Ã¢â ¬â • four chapters on macroscopic or relatively large-scale phenomena, followed by eight chapters on microscopic or relatively small-scale phenomena. Throughout, we have tried to keep in mind topics of industrial importance to the chemical engineer. Part IÃ¢â ¬â •Macroscopic fluid mechanics. Chapter 1 is concerned with basic fluid concepts and definitions, and also a discussion of hydrostatics. Chapter 2 covers the three basic rate laws, in the form of mass, energy, and momentum balances. Chapters 3 and 4 deal with fluid flow through pipes and other types of chemical engineering equipment, respectively. Part IIÃ¢â ¬â •Microscopic fluid mechanics. Chapter 5 is concerned with the fundamental operations of vector analysis and the development of the basic differential equations that govern fluid flow in general. Chapter 6 presents several examples that show how these basic equations can be solved to give solutions to representative problems in which viscosity is important, including polymer-processing, in rectangular, cylindrical, and spherical coordinates. Chapter 7 treats the broad class of inviscid flow problems known as irrotational flows; the theory also applies to flow in porous media, of importance in petroleum production and the underground storage of natural gas. Chapter 8 analyzes two-dimensional flows in which there is a preferred orientation to the velocity, which occurs in situations such as boundary layers, lubrication, calendering, and thin films. Turbulence and analogies between momentum and energy transport are treated in Chapter 9. Bubble motion, two-phase flow in horizontal and vertical pipes, and fluidization Ã¢â ¬â • including the motion of bubbles in fluidized beds Ã¢â ¬â • are discussed in Chapter 10. Chapter 11 introduces the concept of non-Newtonian fluids. Finally, Chapter 12 discusses the Matlab PDE Toolbox as an instrument for the numerical solution of problems in fluid mechanics. In our experience, an undergraduate fluid mechanics course can be based on Part I plus selected parts of Part II. And a graduate course can be based on essentially the whole of Part II, supplemented perhaps by additional material on topics such as approximate methods, stability, and computational fluid mechanics. There is an average of about five completely worked examples in each chapter. The numerous end-of-chapter problems have been classified roughly as easy (E), moderate (M), or difficult (D). Also, the University of Cambridge has very kindly given permission Ã¢â ¬â • graciously endorsed by Prof. J.F. Davidson, F.R.S. Ã¢â ¬â • for several of their chemical engineering examination problems to be reproduced in original or modified form, and these have been given the additional designation of Ã¢â ¬Å"(C).Ã¢â ¬Â• The website engin.umich/~fmche is maintained as a Ã¢â ¬Å" bulletin boardÃ¢â ¬Â• for giving additional information about Fluid Mechanics for Chemical Engineers Ã¢â ¬â • hints for problem solutions, errata, how to contact the authors, etc. Ã¢â ¬â • as proves desirable. I gratefully acknowledge the contributions of my colleague Stacy Bike, who has not only made many constructive suggestions for improvements, but has also written the chapter on non-Newtonian fluids. I very much appreciate the assistance of several other friends and colleagues, including Nitin Anturkar, Brice Carnahan, Kevin Ellwood, Scott Fogler, Lisa Keyser, Kartic Khilar, Ronald Larson, Donald Nicklin, Margaret Sansom, Michael Solomon, Sandra Swisher, Rasin Tek, and my wife Mary Ann Gibson Wilkes. Also very helpful were Joanne Anzalone, Barbara Cotton, Bernard Goodwin, Robert Weisman and the staff at Prentice Hall, and the many students who have taken my courses. Others are acknowledged in specific literature citations. The text was composed on a Power Macintosh 8600/200 computer using the TeXtures Ã¢â ¬Å"typesettingÃ¢â ¬Â• program. Eleven-point type was used for the majority of the text. Most of the figures were constructed using the MacDraw Pro, Claris-CAD, Excel, and Kaleidagraph applications. Professor Fox, to whom this book is dedicated, was a Cambridge engineering graduate who worked from 1933Ã¢â ¬â •1937 at Imperial Chemical Industries Ltd., Billingham, Yorkshire. Returning to Cambridge, he taught engineering from 1937Ã¢â ¬â •1946 before being selected to lead the Department of Chemical Engineering at the University of Cambridge during its formative years after the end of World War II. As a scholar and a gentleman, Fox was a shy but exceptionally brilliant person who had great insight into what was important and who quickly brought the department to a preeminent position. He succeeded in combining an industrial perspective with intellectual rigor. Fox relinquished the leadership of the department in 1959, after he had secured a permanent new building for it (carefully designed in part by himself) before his untimely death in

1964. Fox was instrumental in bringing Kenneth Denbigh, John Davidson, Peter Danckwerts and others into the department. Danckwerts subsequently wrote an appreciation (P.V. Danckwerts, Ã¢â ¬Å“Chemical Engineering Comes to Cambridge,Ã¢â ¬Â• The Cambridge Review, pp. 53Ã¢â ¬â •55, 28 February 1983) of Fox’s talents, saying, with almost complete accuracy: Ã¢â ¬Å“Fox instigated no research and published nothing.Ã¢â ¬Â• How times have changed Ã¢â ¬â • today, unless he were known personally, his resume would probably be cast aside and he would stand little chance of being hired, let alone of receiving tenure! However, his lectures, meticulously written handouts, enthusiasm, genius, and friendship were a great inspiration to me, and I have much pleasure in acknowledging his impact on my career. James O. Wilkes 1 August 1998 --This text refers to the Paperback edition.

The Chemical Engineer’s Practical Guide to Contemporary Fluid Mechanics Since most chemical processing applications are conducted either partially or totally in the fluid phase, chemical engineers need a strong understanding of fluid mechanics. Such knowledge is especially valuable for solving problems in the biochemical, chemical, energy, fermentation, materials, mining, petroleum, pharmaceuticals, polymer, and waste-processing industries."Fluid Mechanics for Chemical Engineers, Second Edition, with Microfluidics and CFD, " systematically introduces fluid mechanics from the perspective of the chemical engineer who must understand actual physical behavior and solve real-world problems. Building on a first edition that earned "Choice Magazine"’s Outstanding Academic Title award, this edition has been thoroughly updated to reflect the field’s latest advances. This second edition contains extensive new coverage of both microfluidics and computational fluid dynamics, systematically demonstrating CFD through detailed examples using FlowLab and COMSOL Multiphysics. The chapter on turbulence has been extensively revised to address more complex and realistic challenges, including turbulent mixing and recirculating flows.Part I offers a clear, succinct, easy-to-follow introduction to macroscopic fluid mechanics, including physical properties; hydrostatics; basic rate laws for mass, energy, and momentum; and the fundamental principles of flow through pumps, pipes, and other equipment. Part II turns to microscopic fluid mechanics, which coversDifferential equations of fluid mechanics Viscous-flow problems, some including polymer processingLaplace’s equation, irrotational, and porous-media flows Nearly unidirectional flows, from boundary layers to lubrication, calendering, and thin-film applicationsTurbulent flows, showing how the k/Ã Â method extends conventional mixing-length theoryBubble motion, two-phase flow, and fluidizationNon-Newtonian fluids, including inelastic and viscoelastic fluidsMicrofluidics and electrokinetic flow effects including electroosmosis, electrophoresis, streaming potentials, and electroosmotic switchingComputational fluid mechanics with FlowLab and COMSOL Multiphysics"Fluid Mechanics for Chemical Engineers, Second Edition, with Microfluidics and CFD, " includes 83 completely worked practical examples, several of which involve FlowLab and COMSOL Multiphysics. There are also 330 end-of-chapter problems of varying complexity, including several from the University of Cambridge chemical engineering examinations. The author covers all the material needed for the fluid mechanics portion of the Professional Engineer's examination.The author's Web site, www.engin.umich.edu/~fmche/, provides additional notes on individual chapters, problem-solving tips, errata, and more.

This book is a little too concise in places, and too exhaustive in others. Instead of spending so much time showing derivations of useful mathematics, the authors would benefit the reader more by providing additional examples of applications of the final equation. Many times I got lost trying to decide if the equation they showed was the actual one I was supposed to apply, or if there was another a page or two later that would work better. In many cases, once the equation was displayed they would simply move on to the next topic, leaving the reader to determine how to best apply it.In an age where these type of calculations have been replaced by computers, there is no need to delve so deeply into pages and pages of derivations. I appreciate the calculus and algebra someone applied decades and centuries ago, but that won't overly help me when I'm working on the job site today. My manager would actually be upset if I spent an hour deriving the equation explaining flow at boundary layers. He wants the quick, 5 minute calculation to tell him where the mixing is occurring.Yes, if the power goes out I'll be able to solve a problem. However, if the power goes out at the plant and they can't turn it back on, I'm going home.

Well written and documented, I hope you liked calculus because everything is written from a calculus perspective

Shipped securely. The book is whatever, not the best Fluids book, but not the worst.

Yes very good

It does cover most of the topics on the syllabus and it's easy to follow and undesrstand.

Clear interpretation and great examples

Used this book for a summer class and it was very clear and to the point. Not too wordy.

school book needed.. Wish I could sell it back..

Fluid Mechanics for Chemical Engineers with Microfluidics and CFD (2nd Edition) Fluid Mechanics for Chemical Engineers (McGraw-Hill Chemical Engineering) Fluid Mechanics for Chemical Engineers (UK Higher Education Engineering Chemical Engineering) Fluid Mechanics for Chemical Engineers Computational Fluid Mechanics and Heat Transfer, Third Edition (Series in Computational and Physical Processes in Mechanics and Thermal Sciences) Computational Fluid Mechanics and Heat Transfer, Second Edition (Series in Computional and Physical Processes in Mechanics and Thermal Sciences) Practical Fluid Mechanics for Civil Engineers Fluid Mechanics for Engineers: A Graduate Textbook Chemical Engineering Fluid Mechanics, Third Edition Biofluid Mechanics, Second Edition: An Introduction to Fluid Mechanics, Macrocirculation, and Microcirculation (Biomedical Engineering) Process Fluid Mechanics, (Prentice-Hall International Series in the Physical and Chemical Engineering Sciences) Advanced Transport Phenomena: Fluid Mechanics and Convective Transport Processes (Cambridge Series in Chemical Engineering) Polymer Melt Processing: Foundations in Fluid Mechanics and Heat Transfer (Cambridge Series in Chemical Engineering) Computational Fluid Mechanics and Heat Transfer:2nd (Second) edition Advanced Molecular Quantum Mechanics: An Introduction to Relativistic Quantum Mechanics and the Quantum Theory of Radiation (Studies in Chemical Physics) Brief Introduction to Fluid Mechanics - text only, 2ND EDITION Fluid, Electrolyte, and Acid-Base Disorders in Small Animal Practice, 4e (Fluid Therapy In Small Animal Practice) Munson, Young and Okiishi’s Fundamentals of Fluid Mechanics, 8th Edition Fox and McDonald’s Introduction to Fluid Mechanics, 9th Edition Fluid Mechanics and Thermodynamics of Turbomachinery, Seventh Edition