

$$\begin{aligned}
 \text{(a)} \quad BF &= \rho V \omega^2 r = \left( 62.3 \frac{\text{lbm}}{\text{ft}^3} \right) (0.01 \text{ in}^3) \left( \frac{2\pi \cdot 1000}{\text{min}} \cdot \frac{\text{min}}{60 \text{ s}} \right)^2 (1.5 \text{ in}) \frac{\text{lb f s}^2}{32.17 \text{ lbm ft}} \cdot \left( \frac{\text{ft}^2}{144 \text{ in}^2} \right)^2 \\
 &= 0.153 \text{ lb f} = 0.683 \text{ N}
 \end{aligned}$$

(b) This points toward the axis of rotation.

**2.73** See the sketch at the right. Work in gage pressure.

$$P_1 = 0$$

$$P_2 = P_1 + \rho g (h_2 - h_1)$$

$$P_3 = P_2 + \frac{\rho \omega^2}{2} (r_3^2 - r_2^2)$$

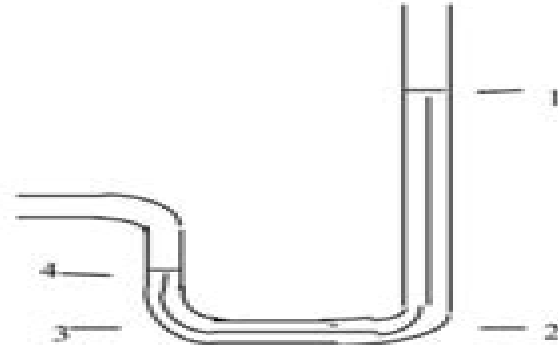
$$P_4 = P_3 + \rho g (h_4 - h_3)$$

Adding these and canceling like terms

$$P_4 = \rho \left[ g(h_4 - h_1) + \frac{\omega^2}{2} (r_3^2 - r_2^2) \right]$$

$$\omega = \frac{2\pi \cdot 10}{60 \text{ s}} = 1.0472 \frac{1}{\text{s}}$$

$$\begin{aligned}
 P_4 &= 62.3 \frac{\text{lbm}}{\text{ft}^3} \left[ 32.2 \frac{\text{ft}}{\text{s}^2} \cdot 4 \text{ ft} + \frac{1}{2} \cdot \left( \frac{1.0472}{\text{s}} \right)^2 \cdot ((22 \text{ ft})^2 - (24 \text{ ft})^2) \right] \cdot \frac{\text{lb f s}^2}{32.2 \text{ lbm ft}} \cdot \frac{\text{ft}^2}{144 \text{ in}^2} \\
 &= 62.3 \cdot [128.8 - 50.44] \frac{1}{32.2 \cdot 144} = 1.053 \text{ psig} = 7.26 \text{ kPa gauge}
 \end{aligned}$$



**2.74** The gasoline-air interface is a parabola, as shown in example 2.19. Using the sketch at the right, we compute the pressure at C, two ways, finding

By path DBC

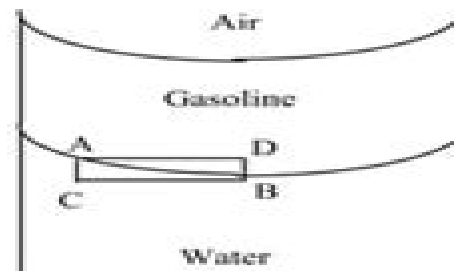
$$P_C = P_D + \rho_{\text{gasoline}} g \Delta z + \rho_{\text{water}} \frac{\omega^2}{2} (\Delta r)^2$$

By path DAC

$$P_C = P_D + \rho_{\text{gasoline}} \frac{\omega^2}{2} (\Delta r)^2 + \rho_{\text{water}} g \Delta z$$

Subtracting the second from the first

$$0 = (\rho_{\text{water}} - \rho_{\text{gasoline}}) \frac{\omega^2}{2} (\Delta r)^2 - (\rho_{\text{water}} - \rho_{\text{gasoline}}) g \Delta z$$



# Fluid Mechanics For Chemical Engineers 3rd Edition

**James O. Wilkes**



## **Fluid Mechanics For Chemical Engineers 3rd Edition:**

**Fluid Mechanics for Chemical Engineers** Noel De Nevers, 2011      **Fluid Mechanics for Chemical Engineers with Engineering Subscription Card** Noel De Nevers, 2004-02

Fluid Mechanics for Chemical Engineers third edition retains the characteristics that made this introductory text a success in prior editions. It is still a book that emphasizes material and energy balances and maintains a practical orientation throughout. No more math is included than is required to understand the concepts presented. To meet the demands of today's market, the author has included many problems suitable for solution by computer. Three brand new chapters are included: Chapter 15 on Two and Three Dimensional Fluid Mechanics, Chapter 19 on Mixing, and Chapter 20 on Computational Fluid Dynamics (CFD).

**Fluid Mechanics for Chemical Engineers** James O. Wilkes, 2017-07-20

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Chemical Engineering Fluid Mechanics Ron Darby,Raj P. Chhabra,2016-11-30 This book provides readers with the most current accurate and practical fluid mechanics related applications that the practicing BS level engineer needs today in the chemical and related industries in addition to a fundamental understanding of these applications based upon sound fundamental basic scientific principles The emphasis remains on problem solving and the new edition includes many more examples *Chemical Engineering Fluid Mechanics, Revised and Expanded* Ronald Darby,Ron Darby,Raj P.

Chhabra,2017-12-19 Combining comprehensive theoretical and empirical perspectives into a clearly organized text *Chemical Engineering Fluid Mechanics* Second Edition discusses the principal behavioral concepts of fluids and the basic methods of analysis for resolving a variety of engineering situations Drawing on the author s 35 years of experience the book covers real world engineering problems and concerns of performance equipment operation sizing and selection from the viewpoint of a process engineer It supplies over 1500 end of chapter problems examples equations literature references illustrations and tables to reinforce essential concepts **Chemical Engineering Computation with MATLAB®** Yeong Koo

Yeo,2017-08-01 Most problems encountered in chemical engineering are sophisticated and interdisciplinary Thus it is important for today s engineering students researchers and professionals to be proficient in the use of software tools for problem solving MATLAB is one such tool that is distinguished by the ability to perform calculations in vector matrix form a large library of built in functions strong structural language and a rich set of graphical visualization tools Furthermore MATLAB integrates computations visualization and programming in an intuitive user friendly environment *Chemical Engineering Computation with MATLAB* presents basic to advanced levels of problem solving techniques using MATLAB as the computation environment The book provides examples and problems extracted from core chemical engineering subject areas and presents a basic instruction in the use of MATLAB for problem solving It provides many examples and exercises and extensive problem solving instruction and solutions for various problems Solutions are developed using fundamental principles to construct mathematical models and an equation oriented approach is used to generate numerical results A wealth of examples demonstrate the implementation of various problem solving approaches and methodologies for problem formulation problem solving analysis and presentation as well as visualization and documentation of results This book also provides aid with advanced problems that are often encountered in graduate research and industrial operations such as nonlinear regression parameter estimation in differential systems two point boundary value problems and partial differential equations and optimization *Molecular Thermodynamics of Fluid-Phase Equilibria* John M. Prausnitz,Rudiger N.

Lichtenthaler,Edmundo Gomes de Azevedo,1998-10-22 The classic guide to mixtures completely updated with new models

theories examples and data Efficient separation operations and many other chemical processes depend upon a thorough understanding of the properties of gaseous and liquid mixtures Molecular Thermodynamics of Fluid Phase Equilibria Third Edition is a systematic practical guide to interpreting correlating and predicting thermodynamic properties used in mixture related phase equilibrium calculations Completely updated this edition reflects the growing maturity of techniques grounded in applied statistical thermodynamics and molecular simulation while relying on classical thermodynamics molecular physics and physical chemistry wherever these fields offer superior solutions Detailed new coverage includes Techniques for improving separation processes and making them more environmentally friendly Theoretical concepts enabling the description and interpretation of solution properties New models notably the lattice fluid and statistical associated fluid theories Polymer solutions including gas polymer equilibria polymer blends membranes and gels Electrolyte solutions including semi empirical models for solutions containing salts or volatile electrolytes Coverage also includes fundamentals of classical thermodynamics of phase equilibria thermodynamic properties from volumetric data intermolecular forces fugacities in gas and liquid mixtures solubilities of gases and solids in liquids high pressure phase equilibria virial coefficients for quantum gases and much more Throughout Molecular Thermodynamics of Fluid Phase Equilibria strikes a perfect balance between empirical techniques and theory and is replete with useful examples and experimental data More than ever it is the essential resource for engineers chemists and other professionals working with mixtures and related processes

**Fluid Mechanics** Carl Schaschke, 2005 This is a collection of problems and solutions in fluid mechanics for students of all engineering disciplines The text is intended to support undergraduate courses and be useful to academic tutors in supervising design projects **Teaching and Learning of Fluid Mechanics** Ashwin Vaidya, 2020-12-02 This book contains research on the pedagogical aspects of fluid mechanics and includes case studies lesson plans articles on historical aspects of fluid mechanics and novel and interesting experiments and theoretical calculations that convey complex ideas in creative ways The current volume showcases the teaching practices of fluid dynamicists from different disciplines ranging from mathematics physics mechanical engineering and environmental engineering to chemical engineering The suitability of these articles ranges from early undergraduate to graduate level courses and can be read by faculty and students alike We hope this collection will encourage cross disciplinary pedagogical practices and give students a glimpse of the wide range of applications of fluid dynamics **Coulson and Richardson's Chemical Engineering** R. P. Chhabra, V.

Shankar, 2017-11-28 Coulson and Richardson's Chemical Engineering has been fully revised and updated to provide practitioners with an overview of chemical engineering Each reference book provides clear explanations of theory and thorough coverage of practical applications supported by case studies A worldwide team of editors and contributors have pooled their experience in adding new content and revising the old The authoritative style of the original volumes 1 to 3 has been retained but the content has been brought up to date and altered to be more useful to practicing engineers This

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**Physical and Chemical Equilibrium for Chemical Engineers** Noel de Nevers,2012-04-25 This book concentrates on the topic of physical and chemical equilibrium Using the simplest mathematics along with numerous numerical examples it accurately and rigorously covers physical and chemical equilibrium in depth and detail It continues to cover the topics found in the first edition however numerous updates have been made including Changes in naming and notation the first edition used the traditional names for the Gibbs Free Energy and for Partial Molal Properties this edition uses the more popular Gibbs Energy and Partial Molar Properties changes in symbols the first edition used the Lewis Randal fugacity rule and the popular symbol for the same quantity this edition only uses the popular notation and new problems have been added to the text Finally the second edition includes an appendix about the Bridgman table and its use

**INTRODUCTION TO NUMERICAL METHODS IN CHEMICAL ENGINEERING, SECOND EDITION** AHUJA, PRADEEP,2019-08-01 This book is an exhaustive presentation of the applications of numerical methods in chemical engineering Intended primarily as a textbook for B E B Tech and M Tech students of chemical engineering the book will also be useful for research and development process professionals in the fields of chemical biochemical mechanical and biomedical engineering The book now in its second edition comprises three parts Part I on General Chemical Engineering is same as given in the first edition of the book It explains solving linear and non linear algebraic equations chemical engineering thermodynamics problems initial value problems boundary value problems and topics related to chemical reaction dispersion and diffusion as well as steady and transient heat conduction Whereas Part II and Part III comprising two chapters and six chapters respectively are newly introduced in the present edition Besides three appendices covering computer programs have been included For practice the book provides students with numerous worked out examples and chapter end exercises including their answers

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**Information Sources in Engineering** Roderick A. Macleod,Jim Corlett,2012-04-17 The current thoroughly revised and updated edition of this approved title evaluates information sources in the field of technology

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*Numerical Methods for Chemical Engineers with MATLAB Applications* A. Constantinides, Navid Mostoufi, 1999 Master numerical methods using MATLAB today's leading software for problem solving This complete guide to numerical methods in chemical engineering is the first to take full advantage of MATLAB's powerful calculation environment Every chapter contains several examples using general MATLAB functions that implement the method and can also be applied to many other problems in the same category The authors begin by introducing the solution of nonlinear equations using several standard approaches including methods of successive substitution and linear interpolation the Wegstein method the Newton Raphson method the Eigenvalue method and synthetic division algorithms With these fundamentals in hand they move on to simultaneous linear algebraic equations covering matrix and vector operations Cramer's rule Gauss methods the Jacobi method and the characteristic value problem Additional coverage includes Finite difference methods and interpolation of equally and unequally spaced points Numerical differentiation and integration including differentiation by backward forward and central finite differences Newton Cotes formulas and the Gauss Quadrature Two detailed chapters on ordinary and partial differential equations Linear and nonlinear regression analyses including least squares estimated vector of parameters method of steepest descent Gauss Newton method Marquardt Method Newton Method and multiple nonlinear regression The numerical methods covered here represent virtually all of those commonly used by practicing chemical engineers The focus on MATLAB enables readers to accomplish more with less complexity than was possible with traditional FORTRAN For those unfamiliar with MATLAB a brief introduction is provided as an Appendix Over 60 MATLAB examples methods and function scripts are covered and all of them are included on the book's CD

**Process Control** B. Wayne Bequette, 2003 Master process control hands on through practical examples and MATLAB R simulations This is the first complete introduction to process control that fully integrates software tools enabling professionals and students to master critical techniques hands on through computer simulations based on the popular MATLAB environment Process Control Modeling Design and Simulation teaches the field's most

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Brosilow, Babu Joseph, 2002 Annotation In this book two of the field's leading experts bring together powerful advances in model based control for chemical process engineering From start to finish Coleman Brosilow and Babu Joseph introduce practical approaches designed to solve real world problems not just theory The book contains extensive examples and exercises and an accompanying CD ROM contains hands on MATLAB files that supplement the examples and help readers solve the exercises a feature found in no other book on the topic Pipe Flow Donald C. Rennels, Hobart M.

Hudson, 2012-04-02 Pipe Flow provides the information required to design and analyze the piping systems needed to support a broad range of industrial operations distribution systems and power plants Throughout the book the authors demonstrate how to accurately predict and manage pressure loss while working with a variety of piping systems and piping components The book draws together and reviews the growing body of experimental and theoretical research including important loss coefficient data for a wide selection of piping components Experimental test data and published formulas are examined integrated and organized into broadly applicable equations The results are also presented in straightforward tables and diagrams Sample problems and their solution are provided throughout the book demonstrating how core concepts are applied in practice In addition references and further reading sections enable the readers to explore all the topics in greater depth With its clear explanations Pipe Flow is recommended as a textbook for engineering students and as a reference for professional engineers who need to design operate and troubleshoot piping systems The book employs the English gravitational system as well as the International System or SI Multiphase Particulate Systems in Turbulent Flows

Wioletta Podgórska, 2019-09-17 Multiphase Particulate Systems in Turbulent Flows Fluid Liquid and Solid Liquid Dispersions



provides methods necessary to analyze complex particulate systems and related phenomena including physical chemical and mathematical description of fundamental processes influencing crystal size and shape suspension rheology interfacial area of drops and bubbles in extractors and bubble columns Examples of mathematical model formulation for different processes taking place in such systems is shown Discussing connections between turbulent mixing mechanisms and precipitation it discusses influence of fine scale structure of turbulence including its intermittent character on breakage of drops bubbles cells plant cell aggregates An important aspect of the mathematical modeling presented in the book is multi fractal taking into account the influence of internal intermittency on different phenomena Key Features Provides detailed descriptions of dispersion processes in turbulent flow interactions between dispersed entities and continuous phase in a single volume Includes simulation models and validation experiments for liquid liquid gas liquid and solid liquid dispersions in turbulent flows Helps reader learn formulation of mathematical models of breakage or aggregation processes using multifractal theory Explains how to solve different forms of population balance equations Presents a combination of theoretical and engineering approaches to particulate systems along with discussion of related diversity with exercises and case studies

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