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Compressible Fluid Flow; 3.10 Dimensional Analysis Correlation for the Terminal Velocity; 3.11 Summary; 3.E Example Problems; 3.P Practice Problems; 4 Applications in Heat Transfer; 4.1 Introduction; 4.2 Steady-State Heat Transfer with End Effects; 4.3 Film and Penetration Theory Approximations; 4.4 Small Biot Number Approximation; 4.5 Small Peclet Number Approximation; 4.6 Boundary-Layer or Large Peclet Number Approximation; 4.7 Heat Transfer with Phase Change 4.8 Temperature-Dependent Physical Properties 4.9 Thermally Driven Free Convection: Boussinesq Approximation; 4.10 Dimensional Analysis Correlation for Cooking a Turkey; 4.11 Summary; 4.E Example Problems; 4.P Practice Problems; 5 Applications in Mass Transfer; 5.1 Introduction; 5.2 Film Theory Approximation; 5.3 Penetration Theory Approximation; 5.4 Small Peclet Number Approximation; 5.5 Small Damkohler Number Approximation; 5.6 Large Peclet Number Approximation; 5.7 Quasi-Steady-State Approximation; 5.8 Membrane Permeation with Nonconstant Diffusivity 5.9 Solutally Driven Free Convection Due to Evapotranspiration 5.10 Dimensional Analysis for a Membrane-Lung Oxygenator; 5.11 Summary; 5.E Example Problems; 5.P Practice Problems; 6 Applications in Mass Transfer with Chemical Reaction; 6.1 Introduction; 6.2 Concept of the Microscale Element; 6.3 Scaling the Microscale Element; 6.4 Slow Reaction Regime; 6.5 Intermediate Reaction Regime; 6.6 Fast Reaction Regime; 6.7 Instantaneous Reaction Regime; 6.8 Scaling the Macroscale Element; 6.9 Kinetic Domain of the Slow Reaction Regime; 6.10 Diffusional Domain of the Slow Reaction Regime 6.11 Implications of Scaling Analysis for Reactor Design 6.12 Mass-Transfer Coefficients for Reacting Systems; 6.13 Design of a Continuous Stirred Tank Reactor; 6.14 Design of a Packed Column Absorber; 6.15 Summary; 6.P Practice Problems; 7 Applications in Process Design; 7.1 Introduction; 7.2 Design of a Membrane Lung Oxygenator; 7.3 Pulsed Single-Bed Pressure-Swing Adsorption; 7.4 Thermally Induced Phase-Separation Process; 7.5 Fluid-Wall Aerosol Flow Reactor for Hydrogen Production; 7.6 Summary; 7.P Practice Problems; Appendix A Sign Convention for the Force on a Fluid Particle Appendix B Generalized Form of the Transport Equations

Sommario/riassunto

This book is unique as the first effort to expound on the subject of systematic scaling analysis. Not written for a specific discipline, the book targets any reader interested in transport phenomena and reaction processes. The book is logically divided into chapters on the use of systematic scaling analysis in fluid dynamics, heat transfer, mass transfer, and reaction processes. An integrating chapter is included that considers more complex problems involving combined transport phenomena. Each chapter includes several problems that are explained in considerable detail. These are followed by se
