1. Record Nr. UNINA9910822544203321

| | |
|---|---|
| Autore | Box George E. P |
| Titolo | Convection heat transfer / / Adrian Bejan |
| Pubbl/distr/stampa | Hoboken, N.J., : Wiley, 2013 |
| ISBN | 1-118-33282-2<br>1-118-33008-0<br>1-299-44915-8<br>1-5231-1013-9<br>1-118-67162-7 |
| Edizione | [4th ed.] |
| Descrizione fisica | 1 online resource |
| Classificazione | 426.3<br>621.40225 |
| Disciplina | 621.402/25 |
| Soggetti | Heat - Convection |
| Lingua di pubblicazione | Inglese |
| Formato | Materiale a stampa |
| Livello bibliografico | Monografia |
| Note generali | Previous ed.: 2004<br>Includes bibliographical references and indexes |
| Nota di bibliografia | Includes bibliographical references and indexes. |
| Nota di contenuto | Cover -- Title Page -- Copyright -- Contents -- Preface -- Preface to the Third Edition -- Preface to the Second Edition -- Preface to the First Edition -- List of Symbols -- Chapter 1 Fundamental Principles -- 1.1 Mass Conservation -- 1.2 Force Balances (Momentum Equations) -- 1.3 First Law of Thermodynamics -- 1.4 Second Law of Thermodynamics -- 1.5 Rules of Scale Analysis -- 1.6 Heatlines for Visualizing Convection -- References -- Problems -- Chapter 2 Laminar Boundary Layer Flow -- 2.1 Fundamental Problem in Convective Heat Transfer -- 2.2 Concept of Boundary Layer -- 2.3 Scale Analysis -- 2.4 Integral Solutions -- 2.5 Similarity Solutions -- 2.5.1 Method -- 2.5.2 Flow Solution -- 2.5.3 Heat Transfer Solution -- 2.6 Other Wall Heating Conditions -- 2.6.1 Unheated Starting Length -- 2.6.2 Arbitrary Wall Temperature -- 2.6.3 Uniform Heat Flux -- 2.6.4 Film Temperature -- 2.7 Longitudinal Pressure Gradient: Flow Past a Wedge and Stagnation Flow -- 2.8 Flow Through the Wall: Blowing and Suction -- 2.9 Conduction Across a Solid Coating Deposited on a Wall -- 2.10 Entropy Generation Minimization in Laminar Boundary Layer Flow -- 2.11 Heatlines in Laminar Boundary Layer Flow -- 2.12 Distribution of Heat |

Sources on a Wall Cooled by Forced Convection -- 2.13 The Flow of Stresses -- References -- Problems -- Chapter 3 Laminar Duct Flow -- 3.1 Hydrodynamic Entrance Length -- 3.2 Fully Developed Flow -- 3.3 Hydraulic Diameter and Pressure Drop -- 3.4 Heat Transfer To Fully Developed Duct Flow -- 3.4.1 Mean Temperature -- 3.4.2 Fully Developed Temperature Profile -- 3.4.3 Uniform Wall Heat Flux -- 3.4.4 Uniform Wall Temperature -- 3.5 Heat Transfer to Developing Flow -- 3.5.1 Scale Analysis -- 3.5.2 Thermally Developing Hagen-Poiseuille Flow -- 3.5.3 Thermally and Hydraulically Developing Flow -- 3.6 Stack of Heat-Generating Plates.
3.7 Heatlines in Fully Developed Duct Flow -- 3.8 Duct Shape for Minimum Flow Resistance -- 3.9 Tree-Shaped Flow -- References -- Problems -- Chapter 4 External Natural Convection -- 4.1 Natural Convection as a Heat Engine in Motion -- 4.2 Laminar Boundary Layer Equations -- 4.3 Scale Analysis -- 4.3.1 High-Pr Fluids -- 4.3.2 Low-Pr Fluids -- 4.3.3 Observations -- 4.4 Integral Solution -- 4.4.1 High-Pr Fluids -- 4.4.2 Low-Pr Fluids -- 4.5 Similarity Solution -- 4.6 Uniform Wall Heat Flux -- 4.7 Effect of Thermal Stratification -- 4.8 Conjugate Boundary Layers -- 4.9 Vertical Channel Flow -- 4.10 Combined Natural and Forced Convection (Mixed Convection) -- 4.11 Heat Transfer Results Including the Effect of Turbulence -- 4.11.1 Vertical Walls -- 4.11.2 Inclined Walls -- 4.11.3 Horizontal Walls -- 4.11.4 Horizontal Cylinder -- 4.11.5 Sphere -- 4.11.6 Vertical Cylinder -- 4.11.7 Other Immersed Bodies -- 4.12 Stack of Vertical Heat-Generating Plates -- 4.13 Distribution of Heat Sources on a Vertical Wall -- References -- Problems -- Chapter 5 Internal Natural Convection -- 5.1 Transient Heating from the Side -- 5.1.1 Scale Analysis -- 5.1.2 Criterion for Distinct Vertical Layers -- 5.1.3 Criterion for Distinct Horizontal Jets -- 5.2 Boundary Layer Regime -- 5.3 Shallow Enclosure Limit -- 5.4 Summary of Results for Heating from the Side -- 5.4.1 Isothermal Sidewalls -- 5.4.2 Sidewalls with Uniform Heat Flux -- 5.4.3 Partially Divided Enclosures -- 5.4.4 Triangular Enclosures -- 5.5 Enclosures Heated from Below -- 5.5.1 Heat Transfer Results -- 5.5.2 Scale Theory of the Turbulent Regime -- 5.5.3 Constructal Theory of Benard Convection -- 5.6 Inclined Enclosures -- 5.7 Annular Space Between Horizontal Cylinders -- 5.8 Annular Space Between Concentric Spheres -- 5.9 Enclosures for Thermal Insulation and Mechanical Strength -- References -- Problems.
Chapter 6 Transition to Turbulence -- 6.1 Empirical Transition Data -- 6.2 Scaling Laws of Transition -- 6.3 Buckling of Inviscid Streams -- 6.4 Local Reynolds Number Criterion for Transition -- 6.5 Instability of Inviscid Flow -- 6.6 Transition in Natural Convection on a Vertical Wall -- References -- Problems -- Chapter 7 Turbulent Boundary Layer Flow -- 7.1 Large-Scale Structure -- 7.2 Time-Averaged Equations -- 7.3 Boundary Layer Equations -- 7.4 Mixing Length Model -- 7.5 Velocity Distribution -- 7.6 Wall Friction in Boundary Layer Flow -- 7.7 Heat Transfer in Boundary Layer Flow -- 7.8 Theory of Heat Transfer in Turbulent Boundary Layer Flow -- 7.9 Other External Flows -- 7.9.1 Single Cylinder in Cross Flow -- 7.9.2 Sphere -- 7.9.3 Other Body Shapes -- 7.9.4 Arrays of Cylinders in Cross Flow -- 7.10 Natural Convection Along Vertical Walls -- References -- Problems -- Chapter 8 Turbulent Duct Flow -- 8.1 Velocity Distribution -- 8.2 Friction Factor and Pressure Drop -- 8.3 Heat Transfer Coefficient -- 8.4 Total Heat Transfer Rate -- 8.4.1 Isothermal Wall -- 8.4.2 Uniform Wall Heating -- 8.4.3 Time-Dependent Heat Transfer -- 8.5 More Refined Turbulence Models -- 8.6 Heatlines in Turbulent Flow Near a Wall -- 8.7 Channel Spacings for Turbulent Flow -- References -- Problems -- Chapter 9 Free Turbulent Flows -- 9.1 Free Shear Layers -- 9.1.1 Free

Turbulent Flow Model -- 9.1.2 Velocity Distribution -- 9.1.3 Structure of Free Turbulent Flows -- 9.1.4 Temperature Distribution -- 9.2 Jets -- 9.2.1 Two-Dimensional Jets -- 9.2.2 Round Jets -- 9.2.3 Jet in Density-Stratified Reservoir -- 9.3 Plumes -- 9.3.1 Round Plume and the Entrainment Hypothesis -- 9.3.2 Pulsating Frequency of Pool Fires -- 9.3.3 Geometric Similarity of Free Turbulent Flows -- 9.4 Thermal Wakes Behind Concentrated Sources -- References -- Problems. Chapter 10 Convection with Change of Phase -- 10.1 Condensation -- 10.1.1 Laminar Film on a Vertical Surface -- 10.1.2 Turbulent Film on a Vertical Surface -- 10.1.3 Film Condensation in Other Configurations -- 10.1.4 Drop Condensation -- 10.2 Boiling -- 10.2.1 Pool Boiling Regimes -- 10.2.2 Nucleate Boiling and Peak Heat Flux -- 10.2.3 Film Boiling and Minimum Heat Flux -- 10.2.4 Flow Boiling -- 10.3 Contact Melting and Lubrication -- 10.3.1 Plane Surfaces with Relative Motion -- 10.3.2 Other Contact Melting Configurations -- 10.3.3 Scale Analysis and Correlation -- 10.3.4 Melting Due to Viscous Heating in the Liquid Film -- 10.4 Melting By Natural Convection -- 10.4.1 Transition from the Conduction Regime to the Convection Regime -- 10.4.2 Quasisteady Convection Regime -- 10.4.3 Horizontal Spreading of the Melt Layer -- References -- Problems -- Chapter 11 Mass Transfer -- 11.1 Properties of Mixtures -- 11.2 Mass Conservation -- 11.3 Mass Diffusivities -- 11.4 Boundary Conditions -- 11.5 Laminar Forced Convection -- 11.6 Impermeable Surface Model -- 11.7 Other External Forced Convection Configurations -- 11.8 Internal Forced Convection -- 11.9 Natural Convection -- 11.9.1 Mass-Transfer-Driven Flow -- 11.9.2 Heat-Transfer-Driven Flow -- 11.10 Turbulent Flow -- 11.10.1 Time-Averaged Concentration Equation -- 11.10.2 Forced Convection Results -- 11.10.3 Contaminant Removal from a Ventilated Enclosure -- 11.11 Massfunction and Masslines -- 11.12 Effect of Chemical Reaction -- References -- Problems -- Chapter 12 Convection in Porous Media -- 12.1 Mass Conservation -- 12.2 Darcy Flow Model and the Forchheimer Modification -- 12.3 First Law of Thermodynamics -- 12.4 Second Law of Thermodynamics -- 12.5 Forced Convection -- 12.5.1 Boundary Layers -- 12.5.2 Concentrated Heat Sources -- 12.5.3 Sphere and Cylinder in Cross Flow. 12.5.4 Channel Filled with Porous Medium -- 12.6 Natural Convection Boundary Layers -- 12.6.1 Boundary Layer Equations: Vertical Wall -- 12.6.2 Uniform Wall Temperature -- 12.6.3 Uniform Wall Heat Flux -- 12.6.4 Spacings for Channels Filled with Porous Structures -- 12.6.5 Conjugate Boundary Layers -- 12.6.6 Thermal Stratification -- 12.6.7 Sphere and Horizontal Cylinder -- 12.6.8 Horizontal Walls -- 12.6.9 Concentrated Heat Sources -- 12.7 Enclosed Porous Media Heated from the Side -- 12.7.1 Four Heat Transfer Regimes -- 12.7.2 Convection Results -- 12.8 Penetrative Convection -- 12.8.1 Lateral Penetration -- 12.8.2 Vertical Penetration -- 12.9 Enclosed Porous Media Heated from Below -- 12.9.1 Onset of Convection -- 12.9.2 Darcy Flow -- 12.9.3 Forchheimer Flow -- 12.10 Multiple Flow Scales Distributed Nonuniformly -- 12.10.1 Heat Transfer -- 12.10.2 Fluid Friction -- 12.10.3 Heat Transfer Rate Density: The Smallest Scale for Convection -- 12.11 Natural Porous Media: Alternating Trees -- References -- Problems -- Appendixes -- A Constants and Conversion Factors -- B Properties of Solids -- C Properties of Liquids -- D Properties of Gases -- E Mathematical Formulas -- Author Index -- Subject Index.

Sommario/riassunto

ADRIAN BEJAN, PhD, is the J. A. Jones Professor of Mechanical Engineering at Duke University. An internationally recognized authority on heat transfer and thermodynamics, Bejan has pioneered the methods of entropy generation minimization, scale analysis, heatlines and masslines, intersection of asymptotes, dendritic architectures, and

the constructal law of design in nature. He is the recipient of numerous awards, including the Max Jakob Memorial Award (ASME & AICHE), the Worcester Reed Warner Medal (ASME), and the Ralph Coats Roe Award (ASEE). He is the author of twenty-five books and 550 journal articles, and is listed among the 100 most-cited engineering researchers (all disciplines, all countries). He has been awarded sixteen honorary doctorates by universities in eleven foreign countries.