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Introduction to Chemical Engineering Thermodynamics

SEVENTH EDITION

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Anil Kumar, Rakesh K. Gupta



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General Thermodynamics Donald Olander, 2007-11-26 Because classical thermodynamics evolved into many branches of science and engineering most undergraduate courses on the subject are taught from the perspective of each area of specialization General Thermodynamics combines elements from mechanical and chemical engineering chemistry including electrochemistry materials science and biology to present a unique and thorough treatment of thermodynamics that is broader in scope than other fundamental texts This book contains classroom tested materials designed to meet the academic requirements for students from a variety of scientific and engineering backgrounds in a single course The first half focuses on classical concepts of thermodynamics whereas the latter half explores field specific applications including a unique chapter on biothermodynamics The book's methodology is unified concise and multidisciplinary allowing students to understand how the principles of thermodynamics apply to all technical fields that touch upon this most fundamental of scientific theories It also offers a rigorous approach to the quantitative aspects of thermodynamics accompanied by clear explanations to help students transition smoothly from the physical concepts to their mathematical representations Each chapter contains numerous worked examples taken from different engineering applications illustrations and an extensive set of exercises to support the material A complete solutions manual is available to professors with qualifying course adoptions

Advanced Thermodynamics Engineering, Second Edition Kalyan Annamalai, Ishwar K. Puri, Milind A. Jog, 2011-03-22 Advanced Thermodynamics Engineering Second Edition is designed for readers who need to understand and apply the engineering physics of thermodynamic concepts It employs a self teaching format that reinforces presentation of critical concepts mathematical relationships and equations with concrete physical examples and explanations of applications to help readers apply principles to their own real world problems Less Mathematical Theoretical Derivations More Focus on Practical Application Because both students and professionals must grasp theory almost immediately in this ever changing electronic era this book now completely in decimal outline format uses a phenomenological approach to problems making advanced concepts easier to understand After a decade teaching advanced thermodynamics the authors infuse their own style and tailor content based on their observations as professional engineers as well as feedback from their students Condensing more esoteric material to focus on practical uses for this continuously evolving area of science this book is filled with revised problems and extensive tables on thermodynamic properties and other useful information The authors include an abundance of examples figures and illustrations to clarify presented ideas and additional material and software tools are available for download The result is a powerful practical instructional tool that gives readers a strong conceptual foundation on which to build a solid functional understanding of thermodynamics engineering

Non-CO2 Greenhouse Gases: Scientific Understanding, Control and Implementation J. van Ham, A.P.M. Baede, L.A. Meyer, R. Ybema, 2013-06-29 In the climate change discussion non CO2 greenhouse gases NCGGs received official political recognition for the first time in

1997 when agreement was reached on the Kyoto Protocol As a result methane nitrous oxide HFCs PFCs and SF6 now provide attractive options for detailing the national targets for the reduction of greenhouse gas emissions meant to control climate change This book is the second volume in this area and addresses three main topics Firstly it documents progress with respect to our knowledge of the sources and sinks of NCGGs Information on this subject is essential in order to reduce the uncertainties in national emissions inventories which serve as the reference values for commitments of countries in the framework of the Kyoto Protocol Secondly this volume deals with the control options for the NCGGs and contains a wealth of information in this area Emerging technologies here provide business opportunities in particular in connection with the flexible mechanisms for mitigation projects in developing countries which have been agreed in Kyoto Thirdly the book treats the policy implementation of mitigation options for greenhouse gas emissions Tools for control policies both on the national and international level and for different sectors of industry are discussed National integrated approaches including the ones from the United States Environmental Protection Agency and the Netherlands Ministry of Environment which both sponsored the conference provide guidance for defining the most effective greenhouse gases mitigation plans in different situations This volume is being published in support of the IPCC Process and will serve as a reference for IPCC s Third Assessment Report

Principles and Modern Applications of Mass Transfer Operations Jaime Benitez, 2016-12-27 A staple in any chemical engineering curriculum New edition has a stronger emphasis on membrane separations chromatography and other adsorptive processes ion exchange Discusses many developing topics in more depth in mass transfer operations especially in the biological engineering area Covers in more detail phase equilibrium since distillation calculations are completely dependent on this principle Integrates computational software and problems using Mathcad Features 25 30 problems per chapter

Fundamentals of Polymer Engineering, Revised and Expanded Anil Kumar, Rakesh K. Gupta, 2003-01-21 Exploring the characterization thermodynamics and structural mechanical thermal and transport behavior of polymers as melts solutions and solids this text covers essential concepts and breakthroughs in reactor design and polymer production and processing It contains modern theories end of chapter problems and real world examples for a clear understanding of polymer function and development Fundamentals of Polymer Engineering Second Edition provides a thorough grounding in the fundamentals of polymer science for more advanced study in the field of polymers Topics include reaction engineering of step growth polymerization emulsion polymerization and polymer diffusion

Principles and Applications of Mass Transfer Jaime Benitez, 2022-12-13 Principles and Applications of Mass Transfer Core textbook teaching mass transfer fundamentals and applications for the design of separation processes in chemical biochemical and environmental engineering Principles and Applications of Mass Transfer teaches the subject of mass transfer fundamentals and their applications to the design of separation processes with enough depth of coverage to guarantee that students using the book will at the end of the course be able to specify preliminary designs of the most common separation process equipment Reflecting the growth of

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Efficiency and Sustainability in the Energy and Chemical Industries Krishnan Sankaranarayanan, Jakob de Swaan Arons, Hedzer J. van der Kooi, 2004-01-21 Translating fundamental principles of irreversible thermodynamics into day to day engineering concepts this reference provides the tools to accurately measure process efficiency and sustainability in the power and chemical industries helping engineers to recognize why losses occur and how they can be reduced utilizing familiar thermodynamic principles Compares the present industrial society with an emerging metabolic society in which mass production and consumption are in closer harmony with the natural environment The first book to utilize classic thermodynamic principles for clear understanding analysis and optimization of work flows environmental resources and driving forces in the chemical and power industries

Integrated Design and Simulation of Chemical Processes Alexandre C. Dimian, 2003-05-13 This title aims to teach how to invent optimal and sustainable chemical processes by making use of systematic conceptual methods and computer simulation techniques The material covers five sections process simulation thermodynamic methods process synthesis process integration and design project including case studies It is primarily intended as a teaching support for undergraduate and postgraduate students following various process design courses and projects but will also be of great value to professional engineers interested in the newest design methods Provides an introduction to the newest design methods Of great value to undergraduate and postgraduate students as well as professional engineers Numerous examples illustrate theoretical principles and design issues

Introduction to Catalytic Combustion R.E. Hayes, 2021-10-24 In a clear and concise manner this book explains how to

apply concepts in chemical reaction engineering and transport phenomena to the design of catalytic combustion systems Although there are many textbooks on the subject of chemical reaction engineering catalytic combustion is mentioned either only briefly or not at all The authors have chosen three examples where catalytic combustion is utilized as a primary combustion process and natural gas is used as a fuel stationary gas turbines process fluid heaters and radiant heaters these cover much of the area where research is currently most active In each of these there are clear environmental benefits to be gained illustrating catalytic combustion as a cleaner primary combustion process The dominant heat transfer processes in each of the applications are different as are the support systems flow geometrics and operating conditions

Introduction to Chemical Reactor Analysis R.E. Hayes, 2020-12-17 This book provides an introduction to the basic concepts of chemical reactor analysis and design It is intended for both the senior level undergraduate student in chemical engineering and the working professional who may require an understanding of the basics of this subject

Thermodynamic Models for Chemical Engineering Jean-Noel Jaubert, Romain Privat, 2021-06-25 The selection of a relevant thermodynamic model is a prerequisite for the simulation and design of processes in the chemical and energy industries In practice this choice is often a real problem for the engineer or researcher who is not a specialist in thermodynamics In this book we present the main methodologies governing the choice of a thermodynamic model adapted to the user's needs Although this guide is deliberately concise it nevertheless offers several levels of study Beyond the complete model selection algorithms it allows the reader to take a step back from the various thermodynamic modelling approaches and to understand in substance how to calculate thermodynamic properties and phase diagrams according to the chosen approach it also highlights the strengths and weaknesses of most of the models available in process engineering software Page 4 of cover

Equations of State for Fluids and Fluid Mixtures J.V. Sengers, R.F. Kayser, C.J. Peters, H.J. White, 2000-10-30 This book has been prepared under the auspices of Commission I 2 on Thermodynamics of the International Union of Pure and Applied Chemistry IUPAC The authors of the 18 chapters are all recognized experts in the field The book gives an up to date presentation of equations of state for fluids and fluid mixtures All principal approaches for developing equations of state are covered The theoretical basis and practical use of each type of equation is discussed and the strength and weaknesses of each is addressed Topics addressed include the virial equation of state cubic equations and generalized van der Waals equations perturbation theory integral equations corresponding states and mixing rules Special attention is also devoted to associating fluids polydisperse fluids polymer systems self assembled systems ionic fluids and fluids near critical points

Air Pollution Control Engineering Noel de Nevers, 2010-05-07 Air pollution control can be approached from a number of different engineering disciplines environmental chemical civil and mechanical To that end Noel de Nevers has written an engaging overview of the subject While based on the fundamentals of chemical engineering the treatment is accessible to readers with only one year of college chemistry In addition to discussions of individual air pollutants and the theory and practice of air pollution control

devices de Nevers devotes about half the book to topics that influence device selection and design such as atmospheric models and U S air pollution law The generous number of end of chapter problems are designed to develop more complex thinking about the concepts presented and integrate them with readers personal experienceincreasing the likelihood of deeper understanding

Fluid Injection in Deformable Geological Formations Benjamin Loret,2018-10-06 This book offers an introduction to the geomechanical issues raised by both the extraction of actual and potential energy resources and by the treatment of the ensuing environmental concerns Discussions of the operations of injection of fluids into and withdrawal from geological formations link the chapters each devoted to a particular technical aspect or scientific issue or to a particular energy resource Subjects are ordered according to their industrial applications including enhanced oil and gas recovery gas hydrates enhanced geothermal systems hydraulic fracturing and carbon dioxide sequestration An overview of the industrial research and simulation aspects for each subject is provided Fluid Injection in Deformable Geological Formations will be of interest to academic and industrial researchers in a wide variety of fields including computational mechanics civil engineering geotechnical engineering and geomechanics engineering seismology petroleum engineering reservoir engineering and engineering geology

Mathematical and Statistical Applications in Food Engineering Surajbhan Sevda,Anoop Singh,2020-01-30 Written by experts from all over the world the book comprises the latest applications of mathematical and models in food engineering and fermentation It provides the fundamentals on statistical methods to solve standard problems associated with food engineering and fermentation technology Combining theory with a practical hands on approach this book covers key aspects of food engineering Presenting cuttingedge information the book is an essential reference on the fundamental concepts associated with food engineering

Sustainable Energy And Environmental Technologies - Proceedings Of The Third Asia Pacific Conference Xijun Hu,Po Lock Yue,2000-11-28 With the rapid expansion of the Asia Pacific economy in the last decade and the recovery after the recent crisis severe demands will be placed on energy services and the environment Coping with the volatile oil prices that persist in the market introduces an additional factor into the energy supply and demand equation not just for countries in this region but also worldwide Inevitably there will be implications for environmental issues too The future will see a continuing challenge to balance growth with sustainability in the economic social and environmental sectors This conference a sequel to the immensely successful APCSEET conferences held in Singapore and Australia is aimed at meeting that challenge by addressing the pertinent issues related to sustainable energy and environmental protection It provides a forum for participants from academia industry and government agencies to interact report on research in progress and identify opportunities in the fields of sustainable energy and environmental technologies The presentations include not only technical issues such as air pollution control wastewater treatment solid waste management renewable energy and cleaner production but also education and policy issues

Surface Chemistry of Carbon Capture K. S. Birdi,2019-11-06 Surface Chemistry

of Carbon Capture Climate Change Aspects provides comprehensive and up to date literature on carbon capture and storage CCS technology and delineates the surface chemistry of this process Mankind is dependent on energy from gas oil coal atomic energy and various other sources In all fossil fuel combustion processes carbon dioxide CO₂ is produced ca 25 Gt year In the past few decades we have observed a constant increase in CO₂ content in the air currently ca 400 ppm 0.04% This book discusses the technology related to carbon i e CO₂ capture and sequestration CCS from fossil fuel energy plants which is considered an important means of CO₂ control It also covers the adsorption absorption processes of CO₂ on solids and similar procedures to help address growing climate change concerns

Basic Principles and Calculations in Chemical Engineering David M. Himmelblau, James B. Riggs, 2022-07-27 The 1 Guide to Chemical Engineering Principles Techniques Calculations and Applications Revised Streamlined and Modernized with New Examples Basic Principles and Calculations in Chemical Engineering Ninth Edition has been thoroughly revised streamlined and updated to reflect sweeping changes in the chemical engineering field This introductory guide addresses the full scope of contemporary chemical petroleum and environmental engineering applications and contains extensive new coverage and examples related to biotech nanotech green environmental engineering and process safety with many new MATLAB and Python problems throughout Authors David M Himmelblau and James B Riggs offer a strong foundation of skills and knowledge for successful study and practice guiding students through formulating and solving material and energy balance problems as well as describing gases liquids and vapors Throughout they introduce efficient consistent learner friendly ways to solve problems analyze data and gain a conceptual application based understanding of modern processes This edition condenses coverage from previous editions to serve today s students and faculty more efficiently In two entirely new chapters the authors provide a comprehensive introduction to dynamic material and energy balances as well as psychrometric charts Modular chapters designed to support introductory courses of any length Introductions to unit conversions basis selection and process measurements Strategies for solving diverse material and energy balance problems including material balances with chemical reaction and for multi unit processes and energy balances with reaction Clear introductions to key concepts ranging from stoichiometry to enthalpy Coverage of ideal real gases multi phase equilibria unsteady state material humidity psychrometric charts and more Self assessment questions to help readers identify areas they don t fully understand Thought discussion and homework problems in every chapter New biotech bioengineering nanotechnology green environmental engineering and process safety coverage Relevant new MATLAB and Python homework problems and projects Extensive tables charts and glossaries in each chapter Reference appendices presenting atomic weights and numbers Pitzer Z₀ Z₁ factors heats of formation and combustion and more Easier than ever to use this book is the definitive practical introduction for students license candidates practicing engineers and scientists Supplemental Online Content available with book registration Three additional chapters on Heats of Solution and Mixing Liquids and Gases in Equilibrium with Solids and Solving Material and Energy Balances with Process

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Biomechanical Aspects of Soft Tissues Benjamin Loret, Fernando Manuel Fernandes Simoes, 2017-05-08 Biomechanics applies the laws and techniques of mechanics in the study of biological systems and related phenomena Biomechanics uses mathematical and computational tools such as model construction of musculo skeletal system body fluid circulation to aid medical diagnosis therapeutics and surgery planning designing of prostheses and implants or in tissue engineering Present book targets specific topics pertaining to the biomechanics of soft tissues Subjects addressed includes solids and multi species mixtures as open systems a continuum mechanics perspective electro chemo mechanical couplings tissues with a fixed electric charge and growth of biological tissues

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