Modeling Of Humidification In Comsol Multiphysics 4

This book presents select proceedings of the International Conference on Innovations in Thermo-Fluid Engineering and Sciences (ICITFES 2020). It covers topics in theoretical and experimental fluid dynamics, numerical methods in heat transfer and fluid mechanics, different modes of heat transfer, multiphase flow, fluid machinery, fluid power, refrigeration and air conditioning, and cryogenics. The book will be helpful to the researchers, scientists, and professionals working in the field of fluid mechanics and machinery, and thermal engineering.

The need for alternative sources of energy with low to zero emissions has led to the development of polymer electrolyte membrane fuel cells. PEM fuel cells are electro-chemical devices that convert chemical energy to electricity by using hydrogen as the fuel and oxygen as the oxidant with water as the byproduct of this reaction. One of the major barriers to the commercialization of these cells is the losses that occur at the cathode due to the slow oxygen diffusion and sluggish electrochemical reaction, which are further amplified by the presence of liquid water. Numerous numerical and mathematical models are found in the literature, which investigate the transport phenomena in the cathode and their effects on the cell performance. In this thesis, the discussion of a two-dimensional, steady state, half cell model is put forward. The conservation equations for mass, momentum, species charge and energy are solved using the commercial software COMSOL Multiphysics. The conservation equations are applied to the cathode bipolar plate, gas diffusion layer and catalyst layer. The flow of gaseous species are assumed to be uniform in the channel. The catalyst layer is assumed to be composed of a uniform distribution of catalyst, liquid water, electrolyte, and void space. The Stefan-Maxwell equation is used to model the multi-species diffusion in the gas diffusion and catalyst layers. Due to the low relative species' velocity, the Darcy law is used to describe the transport of gas and liquid phases in the gas diffusion and catalyst layers. A serpentine flow field is used to distribute the oxidant over the active cathode electrode surface, with pressure loss in the flow direction along the channel. A sensitivity analysis is carried out to investigate the effects of pressure drop in the channel, permeability, inlet relative humidity and shoulder/channel ratio on the performance of the cell. Electron transport is shown to play an important role in determining the overall performance of the cathode. With a serpentine flow field, the oxygen consumption occurs more aggressively at the areas under the land since electrons are readily available at these areas. In addition, the reaction increases along the catalyst layer thickness and occurs more rapidly at the catalyst layer/membrane interface. The losses due to electron transport are much higher than those due to the proton transport. The sensitivity analysis put forward illustrated that with the increase of pressure drop along the channel flow field, the performance of the cell and liquid water removal are enhanced. Similarly, an increase in permeability of the porous material results in an increase in liquid water removal and cell performance. Further, the investigation of the inlet relative humidity effects revealed that the electrolyte conductivity has a significant effect on the performance up to a point. On a similar fashion, a decrease in shoulder/channel width ratio leads to an increase in performance and an increase in the leakage between neighboring channels. Finally, the addition of heat is shown to have a negative effect on the cell performance. Some recommendations can be drawn from the results of this thesis. It is recommended to develop a model to study the flow in the channel flow field in order to investigate the effects of the channel flow on the transport of species in the cell. Further, the geometry of the channel should be studied. Finally, the production of water should be analyzed. The analysis should be extended to investigate its production in vapor form only and its production as a mixture of vapor and liquid.

Fuel cells are attractive electrochemical energy converters featuring potentially very high thermodynamic efficiency factors. The focus of this volume of Advances in Chemical Engineering is on quantitative approaches, particularly based on chemical engineering principles, to analyze, control and optimize the steady state and dynamic behavior of low and high temperature fuel cells (PEMFC, DMFC, SOFC) to be applied in mobile and stationary systems. Updates and informs the reader on the latest research findings using original reviews Written by leading industry experts and scholars Reviews and analyzes developments in the field

Computational studies on fuel cell-related issues are increasingly common. These studies range from engineering level models of fuel cell systems and stacks to molecular level, electronic structure calculations on the behavior of membranes and catalysts, and everything in between. This volume explores this range. It is appropriate to ask what, if anything, does this work tell us that we cannot deduce intuitively? Does the emperor have any clothes? In answering this question resolutely in the affirmative, I will also take the liberty to comment a bit on what makes the effort worthwhile to both the perpetrator(s) of the computational study (hereafter I will use the blanket terms modeler and model for both engineering and chemical physics contexts) and to the rest of the world. The requirements of utility are different in the two spheres. As with any activity, there is a range of quality of work within the modeling community. So what constitutes a useful model? What are the best practices, serving both the needs of the promulgator and consumer? Some of the key com- nents are covered below. First, let me provide a word on my 'credentials' for such commentary. I have participated in, and sometimes initiated, a c- tinuous series of such efforts devoted to studies of PEMFC components and cells over the past 17 years. All that participation was from the experim- tal, qualitative side of the effort.

Fuel Cells and Hydrogen Production

Proton Exchange Membrane Fuel Cells

An Introduction to Engineering and Design

Design and Applications

Liquid Atomization

Basic Principles, Thermal Modeling, and Its Application

This book examines the characteristics of Proton Exchange Membrane (PEM) Fuel Cells with a focus on deriving realistic finite element models. The book also explains in detail how to set up measuring systems, data analysis, and PEM Fuel Cells' static and dynamic characteristics. Covered in detail are design and operation principles such as polarization phenomenon, thermodynamic analysis, and overall voltage; failure modes and mechanisms such as permanent faults, membrane degradation, and water management; and modelling and numerical simulation including semi-empirical, one-dimensional, two-dimensional, and three-dimensional models. It is appropriate for graduate students, researchers, and engineers who work with the design and reliability of hydrogen fuel cells, in particular proton exchange membrane fuel cells.

Heat and Mass Transfer in Capillary-Porous Bodies describes the modern theory of heat and mass transfer on the basis of the thermodynamics of irreversible processes. This book provides a systematic account of the phenomena of heat and mass transfer in capillary-porous bodies. Organized into 10 chapters, this book begins with an overview of the processes of the transfer of heat and mass of a substance. This text then examines the application of the theory to the investigation of heat and mass exchange in walls and in technological processes for the manufacture of building materials. Other chapters consider the thermal properties of building materials by using the methods of the thermodynamics of mass transfer. The final chapter deals with the method of finite differences, which is applicable to the solution of problems of non-steady heat conduction. This book is a valuable resource for scientists, post-graduate students, engineers, and students in higher educational establishments for architectural engineering.

Appropriate for one-year transport phenomena (also called transport processes) and separation processes course. First semester covers fluid mechanics, heat and mass transfer; second semester covers separation process principles (includes unit operations). The title of this Fourth Edition has been changed from Transport Processes and Unit Operations to Transport Processes and Separation Process Principles (Includes Unit Operations). This was done because the term Unit Operations has been largely superseded by the term Separation Processes which better reflects the present modern nomenclature being used. The main objectives and the format of the Fourth Edition remain the same. The sections on momentum transfer have been greatly expanded, especially in the sections on fluidized beds, flow meters, mixing, and non-Newtonian fluids. Material has been added to the chapter on mass transfer. The chapters on absorption, distillation, and liquid-liquid extraction have also been enlarged. More new material has been added to the sections on ion exchange and crystallization. The chapter on membrane separation processes has been greatly expanded especially for gas-membrane theory.

Engineering Principles of Unit Operations in Food Processing, volume 1 in the Woodhead Publishing Series, In Unit Operations and Processing Equipment in the Food Industry series, presents basic principles of food engineering with an emphasis on unit operations, such as heat transfer, mass transfer and fluid mechanics. Brings new opportunities in the optimization of food processing operations Thoroughly explores applications of food engineering to food processes Focuses on unit operations from an engineering viewpoint

Transfer of Mass and Heat in Polymer Electrolyte Membrane Fuel Cell Cathode

Capacitive Sensors

Multiphase Flow in Porous Media

Photovoltaic and Solar Energy

Two-Phase Flow for Automotive and Power Generation Sectors

Mass Transfer in Engineering Practice

Next-Generation Actuators Leading Breakthroughs is the proceedings of the final symposium of MEXT Grant-in-Aid for Scientific Research on Priority Areas: Next-Generation Actuators Leading Breakthroughs, held in January 2010. Since the realization of next-generation actuators requires an interdisciplinary approach, the research has been organized according to a broad technological perspective that consists of: actuators for small motion of nano-meters, small-size actuators of micro-meters structures, intelligent actuators for functional motions, power actuators for large force/torque and actuators for special environments. Next-Generation Actuators Leading Breakthroughs also deals with common fundamental technologies for these actuators, such as intelligent materials, machining processes, control technologies, evaluation methods, and system integration. It provides cutting-edge research for researchers, postgraduates, and practitioners in mechanical, electrical, and materials industries.

Covering the basics of liquid atomization, this book familiarizes readers with the physical processes of liquid atomization, the main types of atomizers and their design, measurements of spray characteristics, experimental investigations of atomizers, and application of atomizers. It demonstrates how to calculate and design atomizers and how to mea

The study of multiphase flow through porous media is undergoing intense development, mostly due to the recent introduction of new methods. After the profound changes induced by percolation in the eighties, attention is nowadays focused on the pore scale. The physical situation is complex and only recently have tools become available that allow significant progress to be made in the area. This volume on Multiphase Flow in Porous Media, which is also being published as a special issue of the journal Transport in Porous Media, contains contributions on the lattice-Boltzmann technique, the renormalization technique, and semi-phenomenological studies at the pore level. Attention is mostly focused on two- and three-phase flows. These techniques are of tremendous importance for the numerous applications of multiphase flows in oil fields, unsaturated soils, the chemical industry, and environmental sciences.

Capacitive sensors produce spectacular resolution of movement to one part in 10-10 meters and maintain exceptional long-term stability in hostile environments. They are increasingly used for a variety of jobs in consumer and industrial equipment, including wall stud sensors, keypads, lamp dimmers, micrometers, calipers, rotation encoders, and more. The most focused, authoritative book available in the field, Capacitive Sensors brings you complete information on the research, design, and production of capacitive sensors. This all-in-one source provides detailed, comprehensive coverage of key topics, including underlying theory, electrode configuration, and practical circuits. In addition, you'll find reviews of a number of tested systems never before published. Capacitive Sensors is a must-have for product designers and mechanical and electrical engineers interested in using this fast-developing technology to get top price and performance advantages.

Proceedings of the 20th AISEM 2019 National Conference

Theoretical, Computational, and Experimental Solutions to Thermo-Fluid Systems

Nanostructured Materials for Next-Generation Energy Storage and Conversion

Advanced Computational Techniques for Heat and Mass Transfer in Food Processing

PEM Water Electrolysis

The Optimization of Heat Extraction from Compost

The expected end of the ioil agei will lead to increasing focus and reliance on alternative energy conversion devices, among which fuel cells have the potential to play an important role. Not only can phosphoric acid and solid oxide fuel cells already efficiently convert todayis fossil fuels, including methane, into electricity, but other types of fuel cells, such as polymer electrolyte membrane fuel cells, have the potential to become the cornerstones of a possible future hydrogen economy. This handbook offers concise yet comprehensive coverage of the current state of fuel cell research and identifies key areas for future investigation. Internationally renowned specialists provide authoritative introductions to a wide variety of fuel cell types and hydrogen production technologies, and discuss materials and components for these systems. Sustainability and marketing considerations are also covered, including comparisons of fuel cells with alternative technologies.

The Tsinghua UniversityiUniversity of Waterloo Joint Research Center for Micro/Nano Energy & Environment Technology (JCMEET) is a platform. It was established on Nov.11, 2017. The Chairperson of University Council of Tsinghua University, Dr. Xu Chen, and the President of the University of Waterloo, Dr. Feridun Hamdullahpur, attended the opening ceremony and unveiled the nameplate for the joint research center on 29th of March, 2018. The research center serves as a platform for researchers at both universities to conduct joint research in the targeted areas, and to meet regularly for information exchange, talent exchange, and knowledge mobilization, especially in the fields of micro/nano, energy, and environmental technologies. The center focuses on three main interests: micro/nano energy technology, micro/nano pollution control technology, and relevant fundamental research. In order to celebrate the first anniversary of the Joint Research Center, we were invited to serve as the Guest Editors of this Special Issue of Materials focusing on the topic of micro/nano-materials for clean energy and environment. It collects research papers from a broad range of topics related to micro/nanostructured materials aimed at future energy resources, low emission energy conversion, energy storage, energy efficiency improvement, air emission control, air monitoring, air cleaning, and many other related applications. This Special Issue provides an opportunity and example for the international community to discuss how to actively address the energy and environment issues that we are facing.

"Composting is an exothermic process that results in the degradation of organic matter into a useful material that can be used as a soil amendment in agricultural applications. Since it is exothermic, useful energy from the process can be captured in the form of electricity or heat for air and water. A pilot scale experiment was developed to observe the effects of flow rate in a heat exchanger energy extraction system where copper tubes are inserted in composted filled barrels. Results showed that greater energy was extracted with higher flow rates. The compost temperatures were most affected during heat extraction at the thermophilic stage of composting with comparatively higher flow rates (500 mL min-1 to 1000 mL min-1) being optimal. At later composting stages it is more useful to ramp down the flow rate to below 500 mL min-1.A 3D finite element model was built based on previously published models (Courvoisier & Clark, 2012) that represent composting through changes in process variables (temperature, humidity, oxygen concentration, etc.) in the solid, liquid and gas phases of the compost. In this study an updated model was created using COMSOLTM Multiphysics to simulate mass and energy balances in a cylindrical composter. The model was then validated against the empirical data from the barrel composters. Results showed an agreement between the temperature values from the beginning of the composting till peak thermophilic temperatures at which point they diverged due to a lack of adequate heat transfer boundary conditions in themodel. This work would serve as the first step towards designing optimal compost heat extraction systems based on simulation and empirical data." --

This book showcases the state of the art in the field of sensors and microsystems, revealing the impressive potential of novel methodologies and technologies. It covers a broad range of aspects, including: bio-, physical and chemical sensors; actuators; micro- and nano-structured materials; mechanisms of interaction and signal transduction; polymers and biomaterials; sensor electronics and instrumentation; analytical microsystems, recognition systems and signal analysis; and sensor networks, as well as manufacturing technologies, environmental, food and biomedical applications. The book gathers a selection of papers presented at the 20th AISEM National Conference on Sensors and Microsystems, held in Naples, Italy in February 2019, the event brought together researchers, end users, technology teams and policy makers.

Thermal Analysis and Design of Passive Solar Buildings

Engineering Principles of Unit Operations in Food Processing

Select Proceedings of ICITFES 2020

Model-based Interpretation of the Performance and Degradation of Reformate Fueled Solid Oxide Fuel Cells

Sensors and Microsystems

VDI Heat Atlas

Fuel Cell Engines is an introduction to the fundamental principles of electrochemistry, thermodynamics, kinetics, material science and transport applied specifically to fuel cells. It covers scientific fundamentals and provides a basic understanding that enables proper technical decision-making.

For more than 50 years, the Springer VDI Heat Atlas has been an indispensable working means for engineers dealing with questions of heat transfer. Featuring 50% more content, this new edition covers most fields of heat transfer in industrial and engineering applications. It presents the interrelationships between basic scientific methods, experimental techniques, model-based analysis and their transfer to technical applications.

The book provides a systematic and profound account of scientific challenges in fuel cell research. The introductory chapters bring readers up to date on the urgency and implications of the global energy challenge, the prospects of electrochemical energy conversion technologies, and the thermodynamic and electrochemical principles underlying the operation of polymer electrolyte fuel cells. The book then presents the scientific challenges in fuel cell research as a systematic account of distinct components, length scales, physicochemical processes, and scientific disciplines. The main part of the book focuses on theory and modeling. Theoretical tools and approaches, applied to fuel cell research, are presented in a self-contained manner. Chapters are arranged by different fuel cell materials and components, and sections advance through the hierarchy of scales, starting from molecular-level processes in proton-conducting media or electrocatalytic systems and ending with performance issues at the device level, including electrochemical performance, water management, durability, and analysis of failure mechanisms. Throughout, the book gives numerous examples of formidable scientific challenges as well as of tools to facilitate materials design and development of diagnostic methods. It reveals reserves for performance improvements and uncovers misapprehensions in scientific understanding that have misled or may continue to mislead technological development. An indispensable resource for scientifically minded and practically oriented researchers, this book helps industry leaders to appreciate the contributions of fundamental research, and leaders of fundamental research to appreciate the needs of industry.

Membrane Contactors: Fundamentals, Applications and Potentialities, Volume 11 covers new operations that could be efficiently used to improve the performance of a variety of industrial production cycles in applications ranging from biotechnology to agrofood. This book focuses on the basic "principles of work": required membrane materials and properties; major operating parameters; the importance of module configuration and design and; the performance of membrane contactors in specific processes. The authors' dynamic approach to this subject makes Membrane Contactors: Fundamentals, Applications and Potentialities, Volume 11 the most comprehensive book currently available on all aspects related to the 'membrane contactor world. * Describes new unit operations in process engineering * Covers a wide variety of industrial applications, from biotechnology to agrofood * Applicable to process intensification and sustainable growth strategies

Humidity Sensors

Advanced Solar-Distillation Systems

A Volume in the Encyclopedia of Sustainability Science and Technology, Second Edition

Proton Exchange Membrane Fuel Cells 9

ECS Transactions: Volume 25

Unit Operations and Processing Equipment in the Food Industry

This volume discusses the theoretical fundamentals and potential applications of the original electro-Fenton (EF) process and its most innovative and promising versions, all of which are classified as electrochemical advanced oxidation processes. It consists of 15 chapters that review the latest advances and trends, material selection, reaction and reactor modeling and EF scale-up. It particularly focuses on the applications of EF process in the treatment of toxic and persistent organic pollutants in water and soil, showing highly efficient removal for both lab-scale and pre-pilot setups. Indeed, the EF technology is now mature enough to be brought to market, and this collection of contributions from leading experts in the field constitutes a timely milestone for scientists and engineers.

Gas Separation by Adsorption Processes provides a thorough discussion of the advancement in gas adsorption process. The book is comprised of eight chapters that emphasize the fundamentals concept and principles. The text first covers the adsorbents and adsorption isotherms, and then proceeds to detailing the equilibrium adsorption of gas mixtures. Next, the book covers rate processes in adsorbers and adsorber dynamics. The next chapter discusses cyclic gas separation processes, and the remaining two chapters cover pressure-swing adsorption. The book will be of great use to students, researchers, and practitioners of disciplines that involve gas separation processes, such as chemical engineering.

Chilling of meat carcasses immediately after slaughter is important for microbial safety and quality of the meat. Rapid chilling may reduce potential bacterial growth, and may help control post-mortem biochemical changes affecting color and texture of the meat (e.g., pale, soft, exudative meat). However, excessive rapid chilling may lead to other quality issues (e.g., 'cold shortening'), and reduced yield due to excessive moisture loss. Therefore, optimization of carcass chilling is important for producing high quality and safe meat, without compromising yield. Computer models to simulate heat and mass transfer during chilling of meat carcasses can be used to determine optimal operating conditions to maximize chilling rates and minimize moisture loss and potential growth of foodborne pathogens and spoilage microorganisms. The objective of this research was to develop and validate computer models for simulating air-chilling of meat carcasses; particularly chicken, pork, and beef carcasses. The models considered heat conduction and internal moisture diffusion subjected to convection, surface-to-ambient thermal radiation, and moisture evaporation. Three-dimensional geometries of the carcasses were generated from computer tomography images. The thermal properties corresponding to the meat, bone and fat sections was considered. The models were developed using a combination of computer aided engineering software (e.g., COMSOL MultiphysicsRTM, Materialise Mimics, and MatlabRTM). The models provided accurate predictions using input parameters available for meat processors such as air relative humidity, air velocity, chiller set-point temperature, and carcass weight. RMSE for temperature predictions was 1.3 +/- 0.6 °C, 1.48 +/- 0.41°C, 1.6 +/- 0.3°C for chicken, pork, and beef carcasses, respectively. In addition, moisture loss predictions resulted in RMSE values of 0.11%, 0.31%, and 0.24% for chicken, pork, and beef carcasses, respectively. The developed models were integrated with predictive microbial models of pathogens of interest including Salmonella spp. and Shiga toxin-producing Escherichia coli. The proposed models can be used not only for process optimization, but can help support food safety management systems in developing critical limits for hazard analysis, estimating potential impact of chilling deviations, and simulating multiple processing scenarios for quantitative microbial risk assessment.

This study covers all the transport properties of food materials and systems - exploring viscosity, moisture diffusivities, thermal conductivity and diffusivity, transport and permeability of small molecules, and heat and mass transfer coefficients. The authors provide physical, mathematical or empirical models of the transport processes for each application, as well as principal property values and measuring methods for various food products and systems.

Fuel Cell Engineering

Transport Properties of Foods

Electro-Fenton Process

Device and Materials Modeling in PEM Fuel Cells

New Trends and Scale-Up

Introduction to Software for Chemical Engineers, Second Edition

Excellent, informative volume focuses on dynamics of nonradiating fluids, problems involving waves, shocks and stellar winds, physics of radiation, radiation transport, and the dynamics of radiating fluids. 1984 edition.

This issue of ECS Transactions is devoted to all aspects of research, development, and engineering of proton exchange membrane (PEM) fuel cells and attacks, as well as low-temperature direct-fuel cells. The intention of the symposium is to bring together the international community working on the subject and to enable effective interactions between the research and engineering communities. This issue is sold as a two-part set.

This book is primarily intended to serve as a textbook and reference work for graduate and professional training coursework on solar desalination of water. The book begins with an introduction to the increasing demand for potable water, various types of water pollution and its impacts on human health, and goes on to cover basics of desalination technologies. It covers all aspects of solar-energy based distillation and desalination for producing potable water resources, including radiation and heat transfer concepts, a history of solar distillation systems, and background on solar collectors. The contents include thermal modeling and parametric study of solar distillation. Energy and exergy aspects are analyzed in detail, including energy matrices of solar distillation. A special chapter on exeroeconomics introduces fundamental equations which include the general balance equation, thermodynamic balance equations, and economic balance equations. A chapter on Economic Analysis of Solar Distillation completes the coverage. The book includes solved examples and end-of-chapter exercises in the form of both problems and objective-type questions. The this book are useful to students, researchers, professionals, and policymakers looking for a comprehensive resource on solar desalination.

The field of Chemical Engineering and its link to computer science is in constant evolution and new engineers have a variety of tools at their disposal to tackle their everyday problems. Introduction to Software for Chemical Engineers, Second Edition provides a quick guide to the use of various computer packages for chemical engineering applications. It covers a range of software applications from Excel and general mathematical packages such as MATLAB and MathCAD to process simulators, CHEMCAD and ASPEN, equation-based modeling languages, gProms, optimization software such as GAMS and AIMS, and specialized software like CFD or DEM codes. The different packages are introduced and applied to solve typical problems in fluid mechanics, heat and mass transfer, mass and energy balances, unit operations, reactor engineering, process and equipment design and control. This new edition offers a wider view of packages including open source software such as R, Python and Julia. It also includes complete examples in ASPEN Plus, adds ANSYS Fluent to CFD codes, Lingo to the optimization packages, and discusses Engineering E It offers a global idea of the capabilities of the software used in the chemical engineering field and provides examples for solving real-world problems. Written by leading experts, this book is a must-have reference for chemical engineers looking to grow in their careers through the use of new and improving computer software. Its user-friendly approach to simulation and optimization as well as its example-based presentation of the software, makes it a perfect teaching tool for both undergraduate and master levels.

Membrane Contactors: Fundamentals, Applications and Potentialities

Gas Separation by Adsorption Processes

Polymer Electrolyte Fuel Cells

Physical Principles of Materials and Operation

Transport Phenomena Fundamentals

Fuel Cell Engines

This book focuses on the two-phase flow problems relevant in the automotive and power generation sectors. It includes fundamental studies on liquid–gas two-phase interactions, nucleate and film boiling, condensation, cavitation, suspension flows as well as the latest developments in the field of two-phase problems pertaining to power generation systems. It also discusses the latest analytical, numerical and experimental techniques for investigating the role of two-phase flows in performance analysis of devices like combustion engines, gas turbines, nuclear reactors and fuel cells. The wide scope of applications of this topic makes this book of interest to researchers and professionals alike.

Passive solar design techniques are becoming increasingly important in building design. This design reference book takes the building engineer or physicist step-by-step through the thermal analysis and design of passive solar buildings. In particular it emphasises two important topics; the maximum utilization of available solar energy and thermal storage, and the sizing of an appropriate auxiliary heating/cooling system in conjunction with good thermal control. Thermal Analysis and Design of Passive Solar Buildings is an important contribution towards the optimization of buildings as systems that act as natural filters between the indoor and outdoor environments, while maximizing the utilization of solar energy. As such it will be an essential source of information to engineers, architects, HVAC engineers and building physicists.

Nanostructured Materials for Next-Generation Energy Storage and Conversion: Photovoltaic and Solar Energy, is volume 4 of a 4-volume series on sustainable energy. Photovoltaic and Solar Energy while being a comprehensive reference work, is written with minimal jargon related to various aspects of solar energy and energy policies. It is authored by leading experts in the field, and lays out theory, practice, and simulation studies related to solar energy and allied applications including policy, economic and technological challenges. Topics covered include: introduction to solar energy, fundamentals of solar radiation, heat transfer, thermal collection and conversion, solar economy, heating, cooling, dehumidification systems, power and process heat, solar power conversion, policy and applications pertinent to solar energy as viable alternatives to fossil fuels. The aim of the book is to present all the information necessary for the design and analysis of solar energy systems for engineers, material scientists, economics, policy analysts, graduate students, senior undergraduates, solar energy practitioner, as well as policy or lawmakers in the field of energy policy, international energy trade, and libraries which house technical handbooks related to energy, energy policy and applications.

Computational methods have risen as a powerful technique for exploring the system phenomena and solving real-life problems. Currently, there are two principle computational approaches for system analysis: continuous and discrete. In the continuous approach, the governing equations can be obtained by applying the fundamental laws, such as conservation of mass, momentum, and energy over an infinitesimal control volume. On the other hand, the discrete approach concentrates on mimicking the molecular movement within the system. Both approaches have pros and cons, and continuous development and improvement in the existing computational methods are ongoing. Advanced Computational Techniques for Heat and Mass Transfer in Food Processing provides, in a single source, information on the use of methods based on numerical and computational analysis as applied in food science and technology. It explores the use of various numerical/computational techniques for the simulation of fluid flow and heat and mass transfer within food products. Key Features: Explores various numerical techniques used for modeling and validation Describes the knowhow of numerical and computational techniques for food process operations Covers a detailed numerical or computational approach of the principles of heat and mass transfer in the food processing operation Discusses the detailed computational simulation procedure of the food operation Recent years have witnessed a rapid development in the field of computational techniques owing to its abundant benefit to the food processing industry. The relevance of advanced computational methods has helped in understanding the fundamental physics of thermal and hydrodynamic behavior that can provide benefits to the food processing industry in numerous applications. As a single information source for those interested in the use of methods based on numerical and computational analysis as applied in food science and technology, this book will ably serve any food academician or researcher in learning the advanced numerical techniques exploring fluid flow, crystallization, and other food processing operations.

Journal of Engineering for Gas Turbines and Power

Development and Validation of Heat and Mass Transfer Models for Meat Carcass Chilling

Transport Processes and Separation Process Principles (includes Unit Operations)

Transfer of Mass and Heat in the Cathode of Polymer Electrolyte Membrane Fuel Cell

Advances in Reliability, Calibration and Application

Exploring Engineering

Winner in its first edition of the Best New Undergraduate Textbook by the Professional and Scholarly Publishing Division of the American Association of Publishers (AAP), Kosky, et al is the first text offering an introduction to the major engineering fields, and the engineering design process, with an interdisciplinary case study approach. It introduces the fundamental physical, chemical and material bases for all engineering work and presents the engineering design process using examples and hands-on projects. Organized in two parts to cover both the concepts and practice of engineering: Part I, Minds On, introduces the fundamental physical, chemical and material bases for all engineering work while Part II, Hands On, provides opportunity to do design projects An Engineering Ethics Decision Matrix is introduced in Chapter 1 and used throughout the book to pose ethical challenges and explore ethical decision-making in an engineering context Lists of "Top Engineering Achievements" and "Top Engineering Challenges" help put the material in context and show engineering as a vibrant discipline involved in solving societal problems New to this edition: Additional discussions on what engineers do, and the distinctions between engineers, technicians, and managers (Chapter 1) New coverage of Renewable Energy and Environmental Engineering helps emphasize the emerging interest in Sustainable Engineering New discussions of Six Sigma in the Design section, and expanded material on writing technical reports Re-organized and updated chapters in Part I to more closely align with specific engineering disciplines new end of chapter excercises throughout the book

PEM Water Electrolysis, a volume in the Hydrogen Energy and Fuel Cell Primers series presents the most recent advances in the field. It brings together information that has thus far been scattered in many different sources under one single title, making it a useful reference for industry professionals, researchers and graduate students. Volumes One and Two allow readers to identify technology gaps for commercially viable PEM electrolysis systems for energy applications and examine the fundamentals of PEM electrolysis and selected research topics that are top of mind for the academic and industry community, such as gas cross-over and AST protocols. The book lays the foundation for the exploration of the current industrial trends for PEM electrolysis, such as power to gas application and a strong focus on the current trends in the application of PEM electrolysis associated with energy storage. Presents the fundamentals and most current knowledge in proton exchange membrane water electrolyzers Explores the technology gaps and challenges for commercial deployment of PEM water electrolysis technologies Includes unconventional systems, such as ozone generators Brings together information from many different sources under one single title, making it a useful reference for industry professionals, researchers and graduate students alike

The fourth edition of Transport Phenomena Fundamentals continues with its streamlined approach to the subject, based on a unified treatment of heat, mass, and momentum transport using a balance equation approach. The new edition includes more worked examples within each chapter and adds confidence-building problems at the end of each chapter. Some numerical solutions are included in an appendix for students to check their comprehension of key concepts. Additional resources online include exercises that can be practiced using a wide range of software programs available for simulating engineering problems, such as, COMSOL(R), Maple(R), Fluent, Aspen, Mathematica, Python and MATLAB(R), lecture notes, and past exams. This edition incorporates a wider range of problems to expand the utility of the text beyond chemical engineering. The text is divided into two parts, which can be used for teaching a two-term course. Part I covers the balance equation in the context of diffusive transport--momentum, energy, mass, and charge. Each chapter adds a term to the balance equation, highlighting that term's effects on the physical behavior of the system and the underlying mathematical description. Chapters familiarize students with modeling and developing mathematical expressions based on the analysis of a control volume, the derivation of the governing differential equations, and the solution to those equations with appropriate boundary conditions. Part II builds on the diffusive transport balance equation by introducing convective transport terms, focusing on partial, rather than ordinary, differential equations. The text describes paring down the full, microscopic equations governing the phenomena to simplify the models and develop engineering solutions, and it introduces macroscopic versions of the balance equations for use where the microscopic approach is either too difficult to solve or would yield much more information that is actually required. The text discusses the momentum, Bernoulli, energy, and species continuity equations, including a brief description of how these equations are applied to heat exchangers, continuous contactors, and chemical reactors. The book introduces the three fundamental transport coefficients: the friction factor, the heat transfer coefficient, and the mass transfer coefficient in the context of boundary layer theory. Laminar flow situations are treated first followed by a discussion of turbulence. The final chapter covers the basics of radiative heat transfer, including concepts such as blackbodies, graybodies, radiation shields, and enclosures.

Design, Modelling and Performance Assessment Techniques

Foundations of Radiation Hydrodynamics

NASA Tech Briefs

Heat and Mass Transfer in Capillary-Porous Bodies

Next-Generation Actuators Leading Breakthroughs