Entropy Generation Minimization The Method Of Thermodynamic Optimization Of Finite Size Systems And Finite Time Processes Mechanical And Aerospace Engineering Series By Adrian Bejan 1995 10 20

From engineering fluid mechanics to power systems, information coding theory and other fields, entropy is key to maximizing performance in engineering systems. It serves a vital role in achieving the upper limits of efficiency of industrial processes and quality of manufactured products. Entropy based design (EBD) can shed new light on various flow processes, ranging from optimized flow configurations in an aircraft engine to highly ordered crystal structures in a turbine blade. Entropy Based Design of Fluid Engineering Systems provides an overview of EBD as an emerging technology with applications to aerospace, microfluidics, heat transfer, and other disciplines. The text extends past analytical methods of Entropy Generation Minimization to numerical simulations involving more complex configurations and experimental measurement techniques. The book begins with an extensive development of basic concepts, including the mathematical properties of entropy and exergy, as well as statistical and numerical formulations of the second law. It then goes on to describe topics related to incompressible flows and the Second Law in microfluidic systems. The authors develop

computational and experimental methods for identifying problem regions within a system through the local rates of entropy production. With these techniques, designers can use EBD to focus on particular regions where design modifications can be made to improve system performance. Numerous case studies illustrate the concepts in each chapter, and cover an array of applications including supersonic flows, condensation and turbulence. A one-of-a-kind reference, Entropy Based Design of Fluid Engineering Systems outlines new advances showing how local irreversibilities can be detected in complex configurations so that engineering devices can be re-designed locally to improve overall performance.

An advanced, practical approach to the first and second laws of thermodynamics Advanced Engineering Thermodynamics bridges the gap between engineering applications and the first and second laws of thermodynamics. Going beyond the basic coverage offered by most textbooks, this authoritative treatment delves into the advanced topics of energy and work as they relate to various engineering fields. This practical approach describes real-world applications of thermodynamics concepts, including solar energy, refrigeration, air conditioning, thermofluid design, chemical design, constructal design, and more. This new fourth edition has been updated and expanded to include current developments in energy storage, distributed energy systems, entropy minimization, and industrial applications, linking new technologies in sustainability to fundamental thermodynamics concepts. Worked problems have been

added to help students follow the thought processes behind various applications, and additional homework problems give them the opportunity to gauge their knowledge. The growing demand for sustainability and energy efficiency has shined a spotlight on the real-world applications of thermodynamics. This book helps future engineers make the fundamental connections, and develop a clear understanding of this complex subject. Delve deeper into the engineering applications of thermodynamics Work problems directly applicable to engineering fields Integrate thermodynamics concepts into sustainability design and policy Understand the thermodynamics of emerging energy technologies Condensed introductory chapters allow students to quickly review the fundamentals before diving right into practical applications. Designed expressly for engineering students, this book offers a clear, targeted treatment of thermodynamics topics with detailed discussion and authoritative guidance toward even the most complex concepts. Advanced Engineering Thermodynamics is the definitive modern treatment of energy and work for today's newest engineers.

Thermal Energy Storage Systems and Applications Provides students and engineers with up-to-date information on methods, models, and approaches in thermal energy storage systems and their applications in thermal management and elsewhere Thermal energy storage (TES) systems have become a vital technology for renewable energy systems and are increasingly being used in commercial and industrial applications including space and water heating, cooling, and air conditioning. TES technology has

the potential to be a sustainable, cost-effective, and eco-friendly approach for facilitating more effective use of thermal equipment and correcting the imbalance that can occur between the supply and demand of energy. The Third Edition of Thermal Energy Storage: Systems and Applications contains detailed coverage of new methodologies, models, experimental works, and methods in the rapidly growing field. Extensively revised and updated throughout, this comprehensive volume covers integrated systems with energy storage options, environmental impact and sustainability, design, analysis, assessment criteria, advanced tools in exergy and extended exergy, and more. New and expanded chapters address topics such as renewable energy systems in which thermal energy storage is essential, sensible and latent TES systems, and numerical modelling, simulation, and analysis of TES systems. Integrating academic research and practical information, this new edition: Discusses a variety of practical TES applications, their technical features, and potential benefits Explores recent developments and future directions in energy storage technologies Covers the latest generation of thermal storage systems and a wide range of applications Features new chapters, case studies, and chapter problems throughout the text Includes pertinent background information on thermodynamics, fluid flow, and heat transfer Contains numerous illustrative examples, full references, and appendices with conversion factors and thermophysical properties of various materials Thermal Energy Storage: Systems and Applications, Third Edition is the perfect textbook for advanced

undergraduate and graduate courses in mechanical, chemical, and electrical engineering, and a highly useful reference for energy engineers and researchers.
A new edition of the bestseller on convection heattransfer A revised edition of the industry classic, Convection HeatTransfer, Fourth Edition, chronicles how the field of heattransfer has grown and prospered over the last two decades. Thisnew edition is more accessible, while not sacrificing its thoroughtreatment of the most up-to-date information on current researchand applications in the field. One of the foremost leaders in the field, Adrian Bejan haspioneered and taught many of the methods and practices commonlyused in the industry today. He continues this book's long-standingrole as an inspiring, optimal study tool by providing: Coverage of how convection affects performance, and howconvective flows can be configured so that performance isenhanced How convective configurations have been evolving, from the flatplates, smooth pipes, and single-dimension fins of the earliereditions to new populations of configurations: tapered ducts,plates with multiscale features, dendritic fins, duct and plateassemblies (packages) for heat transfer density and compactness,etc. New, updated, and enhanced examples and problems that reflectthe author's research and advances in the field since the lastedition A solutions manual Complete with hundreds of informative and originalillustrations, Convection Heat Transfer, Fourth Edition isthe most comprehensive and approachable text for students inschools of mechanical engineering.

Atomization and sprays are used in a wide range of industries: mechanical, chemical, aerospace, and civil engineering; material science and metallurgy; food; pharmaceutical, forestry, environmental protection; medicine; agriculture; meteorology and others. Some specific applications are spray combustion in furnaces, gas turbines and rockets, spray drying and cooling, air conditioning, powdered metallurgy, spray painting and coating, inhalation therapy, and many others. The Handbook of Atomization and Sprays will bring together the fundamental and applied material from all fields into one comprehensive source. Subject areas included in the reference are droplets, theoretical models and numerical simulations, phase Doppler particle analysis, applications, devices and more.

Since its publication almost a decade ago, Adrian Bejan's Advanced Engineering Thermodynamics has established itself as the definitive modern treatment of this challenging subject. Now the Second Edition brings this important work fully up to date with current analyses and practices, and explores uncharted territory along the promising frontier of contemporary research. Grounded in the axiomatic formulation and Gibbsian analytical structure of classical thermodynamics, this revised volume offers an incisive examination of the history, concepts, and language of thermodynamics. Readers will find a clear review of the first and second laws of thermodynamics, along with enhanced material on exergy analysis methods, entropy generation minimization, and related design applications. The Second Edition takes an in-depth look at the latest

developments in the field in areas such as power generation, solar energy, low-temperature refrigeration, air conditioning, and thermal design. Bridging the gap between physics and biology, this book, for the first time, provides a fascinating introduction to the constructal theory of macroscopic organization in nature, extending thermodynamics into the realm of naturally organized systems. Geometric shape and structure are deduced from a single principle of thermodynamic optimization. Complete with original problems, worked-out examples, exceptional graphics, and hundreds of references throughout, Advanced Engineering Thermodynamics, Second Edition is the ideal cutting-edge reference for today's professional engineers and researchers as well as a superb resource for advanced engineering students. Praise for the First Edition: "Demonstrates that engineering thermodynamics is still an active research field . . . will be valuable to all those seeking a deeper understanding of thermodynamic systems." —ASLIB Book List "Strikes a balance between the latest developments in the field and the 'classical' approach to the study of thermodynamics." —Engineering Societies Library Incomparable coverage of engineering thermodynamics—in a brand-new, up-to-date edition . . .The first edition of Advanced Engineering Thermodynamics broke fresh ground with its engaging treatment of key topics in thermal engineering. Now, building on the success of its predecessor, this Second Edition balances a detailed examination of the history, concepts, and language of classical thermodynamics with state-of-the-art coverage of the latest developments in analysis and practice. In addition to cutting-edge

material on contemporary research areas such as entropy generation minimization and the constructal theory of organization in nature, readers of the Second Edition will find: A solid review of the first and second laws of thermodynamics, with an emphasis on problem-solving Separate chapters devoted to single-phase systems, multiphase systems, chemically reactive systems, exergy analysis, thermodynamic optimization, and irreversible thermodynamics Thermodynamics applied to specific areas, including power generation, solar energy, refrigeration, air conditioning, and thermal design More problems and worked-out examples throughout the text High-quality original graphics, plus hundreds of classical and contemporary references Moving effortlessly between analysis and essay, this revised edition of Adrian Bejan's trailblazing work will inspire a new generation of researchers and students in all areas of engineering.

This book presents the diverse and rapidly expanding field of Entropy Generation Minimization (EGM), the method of thermodynamic optimization of real devices. The underlying principles of the EGM method - also referred to as "thermodynamic optimization," "thermodynamic design," and "finite time thermodynamics" - are thoroughly discussed, and the method's applications to real devices are clearly illustrated. The EGM field has experienced tremendous growth during the 1980s and 1990s. This book places EGM's growth in perspective by reviewing both sides of the field - engineering and physics. Special emphasis is given to chronology and to the relationship between the more recent work and the pioneering work that outlined the

method and the field. Entropy Generation Minimization combines the fundamental principles of thermodynamics, heat transfer, and fluid mechanics. EGM applies these principles to the modeling and optimization of real systems and processes that are characterized by finite size and finite time constraints, and are limited by heat and mass transfer and fluid flow irreversibilities. Entropy Generation Minimization provides a straightforward presentation of the principles of the EGM method, and features examples that elucidate concepts and identify recent EGM advances in engineering and physics. Modern advances include the optimization of storage by melting and solidification; heat exchanger design; power from hot-dry-rock deposits; the on & off operation of defrosting refrigerators and power plants with fouled heat exchangers; the production of ice and other solids; the maximization of power output in simple power plant models with heat transfer irreversibilities; the minimization of refrigerator power input in simple models; and the optimal collection and use of solar energy.

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This book presents a wide-ranging review of the latest research and development directions in thermal systems optimization using population-based metaheuristic methods. It helps readers to identify the best methods for their own systems, providing details of mathematical models and algorithms suitable for implementation. To reduce mathematical complexity, the authors focus on optimization of individual components rather than taking on systems as a whole.

They employ numerous case studies: heat exchangers; cooling towers; power generators; refrigeration systems; and others. The importance of these subsystems to real-world situations from internal combustion to air-conditioning is made clear. The thermal systems under discussion are analysed using various metaheuristic techniques, with comparative results for different systems. The inclusion of detailed MATLAB® codes in the text will assist readers—researchers, practitioners or students—to assess these techniques for different real-world systems. Thermal System Optimization is a useful tool for thermal design researchers and engineers in academia and industry, wishing to perform thermal system identification with properly optimized parameters. It will be of interest for researchers, practitioners and graduate students with backgrounds in mechanical, chemical and power engineering.

Thermal analyses and optimizations are very ubiquitous and important in academic research and engineering applications. In this field, the entropy generation minimization has been widely used and found to be effective in many cases. Sometimes, it was even used without checking the applicability, and seemed to be a unified theory that could solve all thermal problems. Is this really the case? This book answers this question through detailed theoretical derivations and different numerical examples in heat transfer and heat-work

conversion. It shows clearly that the theory has limitations and a definite application scope, beyond which it may provide unreasonable or incorrect results. Therefore, the entropy generation minimization is far from perfect. This book will be of interest to students, researchers and engineers in thermal science and engineering, as it will help the reader to apply the entropy generation minimization correctly.

Is the heat and mass transfer intensification defined as a new paradigm of process engineering, or is it just a common and old idea, renamed and given the current taste? Where might intensification occur? How to achieve intensification? How the shape optimization of thermal and fluidic devices leads to intensified heat and mass transfers? To answer these questions, Heat & Mass Transfer Intensification and Shape Optimization: A Multi-scale Approach clarifies the definition of the intensification by highlighting the potential role of the multi-scale structures, the specific interfacial area, the distribution of driving force, the modes of energy supply and the temporal aspects of processes. A reflection on the methods of process intensification or heat and mass transfer enhancement in multi-scale structures is provided, including porous media, heat exchangers, fluid distributors, mixers and reactors. A multi-scale approach to achieve intensification and shape optimization is developed and clearly explained.

Providing readers with a tool box of reflections, techniques, methods, supported by literature reviews, Heat & Mass Transfer Intensification and Shape Optimization: A Multi-scale Approach will be a key guide for students, a teaching aid for lecturers and a source of inspiration for future research subjects.

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Despite the vast research on energy optimization and process integration, there has to date been no synthesis linking these together. This book fills the gap, presenting optimization and integration in energy and process engineering. The content is based on the current literature and includes novel approaches developed by the authors. Various thermal and chemical systems (heat and mass exchangers, thermal and water networks, energy converters, recovery units, solar collectors, and separators) are considered. Thermodynamics, kinetics and economics are used to formulate and solve problems with constraints on process rates, equipment size, environmental parameters, and costs. Comprehensive coverage of dynamic optimization of energy conversion systems and separation units is provided along with suitable computational algorithms for deterministic and stochastic optimization approaches based on: nonlinear programming, dynamic programming, variational calculus, Hamilton-Jacobi-Bellman theory, Pontryagin's maximum principles, and special methods of

process integration. Integration of heat energy and process water within a total site is shown to be a significant factor reducing production costs, in particular costs of utilities for the chemical industry. This integration involves systematic design and optimization of heat exchangers and water networks (HEN and WN). After presenting basic, insight-based Pinch Technology, systematic, optimization-based sequential and simultaneous approaches to design HEN and WN are described. Special consideration is given to the HEN design problem targeting stage, in view of its importance at various levels of system design. Selected, advanced methods for HEN synthesis and retrofit are presented. For WN design a novel approach based on stochastic optimization is described that accounts for both grassroot and revamp design scenarios. Presents a unique synthesis of energy optimization and process integration that applies scientific information from thermodynamics, kinetics, and systems theory Discusses engineering applications including power generation, resource upgrading, radiation conversion and chemical transformation, in static and dynamic systems Clarifies how to identify thermal and chemical constraints and incorporate them into optimization models and solutions

This book presents selected extended papers from The First International Conference on Mechanical Engineering (INCOM2018), realized at the Jadavpur

University, Kolkata, India. The papers focus on diverse areas of mechanical engineering and some innovative trends in mechanical engineering design, industrial practices and mechanical engineering education. Original, significant and visionary papers were selected for this edition, specially on interdisciplinary and emerging areas. All papers were peer-reviewed.

This book describes the state of the art at the interface between energy and environmental research. The contributing authors are some of the world leaders in research and education on energy and environmental topics. The coverage is worth noting for its breadth and depth. The book begins with the latest trends in applied thermodynamics: the methods of exergy analysis, entropy generation minimization and thermoeconomics. It continues with the most modern developments in energy processing and conservation techniques: heat transfer augmentation devices, inverse thermal design, combustion and heat exchangers for environmental systems. The environmental impact of energy systems is documented in a diversity of applications such as the flow of hazardous waste through cracks and porous media, thermally induced flows through coastal waters near power plants, and lake ecology in the vicinity of pumped storage systems. The book outlines new research directions such as the manufacturing of novel materials from solid waste, advances in radiative transport, the measurement of convective heat transfer in gas turbines and environmentally acceptable refrigerants. The book is rich in engineering design data that make a concrete statement on topics of world wide interest, e.g., toxic emissions, the depletion of energy resources, global environmental change (global warming), and future trends in the power generation industries. Written by leaders in research

and education, this book is an excellent text or supplement for undergraduate and graduate courses on energy engineering and environmental science.

This new volume of the annual review “Advances in Transport Phenomena” series contains three in-depth review articles on the microfluidic fabrication of vesicles, the dielectrophoresis field-flow fractionation for continuous-flow separation of particles and cells in microfluidic devices, and the thermodynamic analysis and optimization of heat exchangers, respectively.

A comprehensive assessment of the methodologies of thermodynamic optimization, exergy analysis and thermoeconomics, and their application to the design of efficient and environmentally sound energy systems. The chapters are organized in a sequence that begins with pure thermodynamics and progresses towards the blending of thermodynamics with other disciplines, such as heat transfer and cost accounting. Three methods of analysis stand out: entropy generation minimization, exergy (or availability) analysis, and thermoeconomics. The book reviews current directions in a field that is both extremely important and intellectually alive. Additionally, new directions for research on thermodynamics and optimization are revealed.

The goal of this project is to demonstrate by using a heat exchanger as an example, that the minimization of life cycle entropy generation is a useful concept for the optimization of thermal systems. For this purpose the entropy production over the life of the heat exchanger is calculated and in addition the entropy generated during the manufacturing process is accounted for too. In this exploratory phase of the project, the entropy generation during the manufacturing process is calculated based only on the entropy production during the various energy conversion processes that contribute to the manufacturing process. This includes the

metal processing beginning with theore and accounting for a fraction of recycled metal that is usually included it also accounts for the contribution of human labor, although this term is found to be usually negligible. A simulation code was written for the heat exchanger to calculate and minimize its life cycle entropy generation. The results clearly show that minima are found when design parameters such as material selection, tube length, number 0 tubes, operating conditions and others are varied. The results also indicate that this method will continue to be useful when applied to more complex systems such as entire subsystems and complete, integrated systems such as aircraft.

The engineer's ready reference for mechanical power and heat Mechanical Engineer's Handbook provides the most comprehensive coverage of the entire discipline, with a focus on explanation and analysis. Packaged as a modular approach, these books are designed to be used either individually or as a set, providing engineers with a thorough, detailed, ready reference on topics that may fall outside their scope of expertise. Each book provides discussion and examples as opposed to straight data and calculations, giving readers the immediate background they need while pointing them toward more in-depth information as necessary. Volume 4: Energy and Power covers the essentials of fluids, thermodynamics, entropy, and heat, with chapters dedicated to individual applications such as air heating, cryogenic engineering, indoor environmental control, and more. Readers will find detailed guidance toward fuel sources and their technologies, as well as a general overview of the mechanics of combustion. No single engineer can be a specialist in all areas that they are called on to work in the diverse industries and job functions they occupy. This book gives them a resource for finding the information they need, with a focus on topics related to the

productions, transmission, and use of mechanical power and heat. Understand the nature of energy and its proper measurement and analysis Learn how the mechanics of energy apply to furnaces, refrigeration, thermal systems, and more Examine the and pros and cons of petroleum, coal, biofuel, solar, wind, and geothermal power Review the mechanical parts that generate, transmit, and store different types of power, and the applicable guidelines Engineers must frequently refer to data tables, standards, and other list-type references, but this book is different; instead of just providing the answer, it explains why the answer is what it is. Engineers will appreciate this approach, and come to find Volume 4: Energy and Power an invaluable reference.

A comprehensive and rigorous introduction to thermal system designfrom a contemporary perspective Thermal Design and Optimization offers readers a lucid introductionto the latest methodologies for the design of thermal systems andemphasizes engineering economics, system simulation, andoptimization methods. The methods of exergy analysis, entropygeneration minimization, and thermoeconomics are incorporated in anevolutionary manner. This book is one of the few sources available that addresses therecommendations of the Accreditation Board for Engineering andTechnology for new courses in design engineering. Intended forclassroom use as well as self-study, the text provides a review offundamental concepts, extensive reference lists, end-of-chapterproblem sets, helpful appendices, and a comprehensive case studythat is followed throughout the text. Contents include: * Introduction to Thermal System Design * Thermodynamics, Modeling, and Design Analysis * Exergy Analysis * Heat Transfer, Modeling, and Design Analysis * Applications with Heat and Fluid Flow * Applications with Thermodynamics and Heat and Fluid Flow * Economic Analysis *

Thermoeconomic Analysis and Evaluation * Thermoeconomic Optimization Thermal Design and Optimization offers engineering students,practicing engineers, and technical managers a comprehensive andrigorous introduction to thermal system design and optimizationfrom a distinctly contemporary perspective. Unlike traditionalbooks that are largely oriented toward design analysis andcomponents, this forward-thinking book aligns itself with anincreasing number of active designers who believe that moreeffective, system-oriented design methods are needed. Thermal Design and Optimization offers a lucid presentation ofthermodynamics, heat transfer, and fluid mechanics as they areapplied to the design of thermal systems. This book broadens thescope of engineering design by placing a strong emphasis onengineering economics, system simulation, and optimizationtechniques. Opening with a concise review of fundamentals, itdevelops design methods within a framework of industrialapplications that gradually increase in complexity. Theseapplications include, among others, power generation by large andsmall systems, and cryogenic systems for the manufacturing,chemical, and food processing industries. This unique book draws on the best contemporary thinking aboutdesign and design methodology, including discussions of concurrentdesign and quality function deployment. Recent developments basedon the second law of thermodynamics are also included, especiallythe use of exergy analysis, entropy generation minimization, andthermoeconomics. To demonstrate the application of important designprinciples introduced, a single case study involving the design ofa cogeneration system is followed throughout the book. In addition, Thermal Design and Optimization is one of the best newsources available for meeting the recommendations of theAccreditation Board for Engineering and Technology for more designemphasis in engineering curricula. Supported by

extensive reference lists, end-of-chapter problemsets, and helpful appendices, this is a superb text for both theclassroom and self-study, and for use in industrial design,development, and research. A detailed solutions manual is availablefrom the publisher.

Porous and Complex Flow Structures in Modern Technologies represents a new approach to the field, considering the fundamentals of porous media in terms of the key roles played by these materials in modern technology. Intended as a text for advanced undergraduates and as a reference for practicing engineers, the book uses the physics of flows in porous materials to tie together a wide variety of important issues from such fields as biomedical engineering, energy conversion, civil engineering, electronics, chemical engineering, and environmental engineering. Thus, for example, flows of water and oil through porous ground play a central role in energy exploration and recovery (oil wells, geothermal fluids), energy conversion (effluents from refineries and power plants), and environmental engineering (leachates from waste repositories). Similarly, the demands of miniaturization in electronics and in biomedical applications are driving research into the flow of heat and fluids through small-scale porous media (heat exchangers, filters, gas exchangers). Filters, catalytic converters, the drying of stored grains, and a myriad of other applications involve flows through porous media. By providing a unified theoretical framework that includes not only the traditional homogeneous and isotropic media but also models in which the assumptions of representative elemental volumes or global thermal equilibrium fail, the book provides practicing engineers the tools they need to analyze complex situations that arise in practice. This volume includes examples, solved problems and an extensive glossary of symbols.

The generation of globally optimal designs which can minimize capital and/or operating cost

expenditures is a highly sought after objective within the chemical industry. A methodology which can systematically generate such globally optimal solutions to objective functions commonly encountered in the chemical industry is the IDEAS framework. The IDEAS framework decomposes a process network into an operator, OP network, where the unit operations (reactors, distillation columns, heat exchangers, etc.) occur, and a distribution, DN network, where the flow operations (mixing, splitting, recycling, and bypass) occur. The optimal process network structure is identified through solution of an infinite linear program (ILP) that is formulated within the IDEAS framework. The ILP's solution is approximated by finite dimensional linear programs of ever increasing size. The global optimization of complex, multi-pressure distillation networks for the separation of azeotropic mixtures using the IDEAS framework, is presented in chapter 1. The objective function in this case aims at minimizing total network flow in an effort to directly (indirectly) reduce capital (operating) costs. The global optimization of chemical reactor networks is presented in chapter 2-4. There, interesting properties relating to energy consumption and entropy generation for isothermal/isobaric reactor networks are described in the context of the attainable region (AR). Given certain assumptions, namely that all reactors are either of the endothermic or exothermic kind, a proof is presented that energy consumption and entropy generation can be rigorously identified in the infinite space of chemical reactors, independently of the network's internals (chapter 2). For the case of isothermal/isobaric chemical reactor networks where both endothermic and exothermic reactors participate in delivering the desired outlet product composition, entropy generation minimization is synonymous with an objective function of minimum hot/cold utility cost, with the cost coefficient of hot (cold) streams being the inverse of the temperature of the

cold (hot) reservoir to which it adds (removes) energy. For this scenario, the network's internal structure plays a key role in determining the optimal reactor network, which is determined using the IDEAS framework (chapter 3). A novel method to identify the sequence of isothermal mixed flow reactors (CSTR's) which globally minimizes a reactor residence time dependent objective function (able to represent such objectives as capital cost, volume, or total annualized cost), subject to a constraint dependent on the reactor sequence's exit concentrations, is presented in chapter 4. Finally, chapter 5 discusses a novel, heat-integrated, pressure-temperature-swing-adsorption (PTSA) process for the capture of CO2 from the flue gas of fossil-fueled power plants using MgO sorbents.

This book is a new contribution aiming to give some last research findings in the field of optimization and computing. This work is in the same field target than our two previous books published: Recent Developments in Metaheuristics and Metaheuristics for Production Systems, books in Springer Series in Operations Research/Computer Science Interfaces. The challenge with this work is to gather the main contribution in three fields, optimization technique for production decision, general development for optimization and computing method and wider spread applications. The number of researches dealing with decision maker tool and optimization method grows very quickly these last years and in a large number of fields. We may be able to read nice and worthy works from research developed in chemical, mechanical, computing, automotive and many other fields.

Selecting and bringing together matter provided by specialists, this project offers comprehensive information on particular cases of heat exchangers. The selection was guided by actual and future demands of applied research and industry, mainly focusing on the efficient

use and conversion energy in changing environment. Beside the questions of thermodynamic basics, the book addresses several important issues, such as conceptions, design, operations, fouling and cleaning of heat exchangers. It includes also storage of thermal energy and geothermal energy use, directly or by application of heat pumps. The contributions are thematically grouped in sections and the content of each section is introduced by summarising the main objectives of the encompassed chapters. The book is not necessarily intended to be an elementary source of the knowledge in the area it covers, but rather a mentor while pursuing detailed solutions of specific technical problems which face engineers and technicians engaged in research and development in the fields of heat transfer and heat exchangers.

Applications of Heat, Mass and Fluid Boundary Layers brings together the latest research on boundary layers where there has been remarkable advancements in recent years. This book highlights relevant concepts and solutions to energy issues and environmental sustainability by combining fundamental theory on boundary layers with real-world industrial applications from, among others, the thermal, nuclear and chemical industries. The book's editors and their team of expert contributors discuss many core themes, including advanced heat transfer fluids and boundary layer analysis, physics of fluid motion and viscous flow, thermodynamics and transport phenomena, alongside key methods of analysis such as the Merk-Chao-Fagbenle method. This book's multidisciplinary coverage will give engineers, scientists, researchers and graduate students in the areas of heat, mass, fluid flow and transfer a thorough understanding of the technicalities, methods and applications of boundary layers, with a unified approach to energy, climate change and a sustainable future. Presents up-to-date research on boundary

layers with very practical applications across a diverse mix of industries Includes mathematical analysis to provide detailed explanation and clarity Provides solutions to global energy issues and environmental sustainability

Entropy Generation MinimizationThe Method of Thermodynamic Optimization of Finite-Size Systems and Finite-Time ProcessesCRC Press

In this monograph Prof. Pramanick explicates the law of motive force, a fundamental law of nature that can be observed and appreciated as an addition to the existing laws of thermodynamics. This unmistakable and remarkable tendency of nature is equally applicable to all other branches of studies. He first conceptualized the law of motive force in 1989, when he was an undergraduate student. Here he reports various applications of the law in the area of thermodynamics, heat transfer, fluid mechanics and solid mechanics, and shows how it is possible to solve analytically century-old unsolved problems through its application. This book offers a comprehensive account of the law and its relation to other laws and principles, such as the generalized conservation principle, variational formulation, Fermat's principle, Bejan's constructal law, entropy generation minimization, Bejan's method of intersecting asymptotes and equipartition principle. Furthermore, the author addresses some interrelated fundamental problems of contemporary interest, especially to thermodynamicists, by combining analytical methods, physical reasoning and the proposed law of motive force. This foundational work is a valuable reading for both students and researchers in exact as well as non-exact sciences and, at the same time, a pleasant learning experience for the novice.

Constructal theory has been extensively used to analyze and optimize many different shapes and structures in both living and non-living systems. It is generally considered to be a law that

could govern the evolutions of shapes and structures in biology, physics, technology, and social organization. Accordingly, it seems that the constructal method is suitable for designing and analyzing all kinds of shapes and structures in the world. However, in most cases, the details for its applications were not carefully checked, meaning that it was often incorrectly applied, and that many unreasonable or inaccurate results were provided. This book systematically reviews and checks the applications of constructal theory in street design, economics, heat transfer optimization, flow systems, and explanations of natural structures and social phenomena. Every detail of the models, methods, optimizations, applications, results and conclusions is analysed, with careful consideration of theoretical derivations and typical examples. Accordingly, the problems and mistakes in the applications of the theory are directly pointed out and discussed in detail. The abuse and limitation of the constructal approach are also discussed. In many cases, it is shown that the theory has significant flaws and is even not applicable in certain circumstances. As constructal theory is widely used in the analysis and design of shapes and structures, this book will be essential for scientists, researchers, engineers, teachers, postgraduates and undergraduates in the fields of structure analysis, design and optimization in physics, biology, flow dynamics, heat transfer and thermodynamics. Heat Transfer XIII: Simulation and Experiments in Heat and Mass Transfer contains the proceedings of the thirteenth conference in the well established series on Simulation and Experiments in Heat Transfer and its applications. Advances in computational methods for solving and understanding heat transfer problems continue to be important because heat transfer topics and related phenomena are commonly of a complex nature and different mechanisms like heat conduction, convection, turbulence, thermal radiation and phase change

as well as chemical reactions may occur simultaneously. Typically, applications are found in heat exchangers, gas turbine cooling, turbulent combustion and fires, fuel cells, batteries, micro- and mini- channels, electronics cooling, melting and solidification, chemical processing etc. Heat Transfer might be regarded as an established and mature scientific discipline, but it has played a major role in new emerging areas such as sustainable development and reduction of greenhouse gases as well as for micro- and nano- scale structures and bioengineering. Non-linear phenomena other than momentum transfer may occur due to temperature-dependent thermophysical properties. In engineering design and development, reliable and accurate computational methods are requested to replace or complement expensive and time consuming experimental trial an error work. Tremendous advancements have been achieved during recent years due to improved numerical solution methods for non-linear partial differential equations, turbulence modelling advancements and developments of computers and computing algorithms to achieve efficient and rapid simulations. Nevertheless, to further progress in computational methods requires developments in theoretical and predictive procedures – both basic and innovative – and in applied research. Accurate experimental investigations are needed to validate the numerical calculations. Topics covered include: Heat transfer in energy producing devices; Heat transfer enhancements; Heat exchangers; Natural and forced convection and radiation; Multiphase flow heat transfer; Modelling and experiments; Heat recovery; Heat and mass transfer problems; Environmental heat transfer; Experimental and measuring technologies; Thermal convert studies.

This book describes the Exergy-based Input – Output (ExIO) framework, a comprehensive methodology for assessing the primary fossil fuels requirements for the production of goods

and services within a given economy from a lifecycle perspective. In the ExIO approach, exergy is assumed to be the best suited thermodynamic metric for characterizing fossil fuels. The mathematical formulation of ExIO is based on Input-Output analysis, which defines boundaries in time and space for any system or product analyzed, encompassing its entire lifecycle. The Hybrid-ExIO approach has been developed to increase the accuracy of results and to analyze energy systems in detail, leading to the definition of criteria and indicators for identifying and optimizing the primary fossil fuels requirements of system products. Lastly, the Bioeconomic ExIO model has been proposed to account for the side effects that the working hours required for producing goods and services have on the total primary fossil fuels consumption. As such, the book will be of considerable interest to both researchers and engineers in industry, offering them essential guidelines on the utilization of exergy and thermoeconomic analysis.

Good,No Highlights,No Markup,all pages are intact, Slight Shelfwear,may have the corners slightly dented, may have slight color changes/slightly damaged spine.

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In this book, the fundamentals of chemical engineering are presented with respect to applications in micro system technology, microfluidics, and transport processes within microstructures. Special features of the book include the state-of-the-art in micro process engineering, a detailed treatment of transport phenomena for engineers, and a design methodology from transport effects to economic considerations.

This book results from a Special Issue related to the latest progress in the thermodynamics of machines systems and processes since the premonitory work of Carnot. Carnot invented his

famous cycle and generalized the efficiency concept for thermo-mechanical engines. Since that time, research progressed from the equilibrium approach to the irreversible situation that represents the general case. This book illustrates the present state-of-the-art advances after one or two centuries of consideration regarding applications and fundamental aspects. The research is moving fast in the direction of economic and environmental aspects. This will probably continue during the coming years. This book mainly highlights the recent focus on the maximum power of engines, as well as the corresponding first law efficiency upper bounds.