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In recent years, NASA space exploration has achieved new feats due to advancement in aerodynamics, propulsion, and other related technologies. Future missions, including but not limited to manned mission to Mars, deep space exploratory missions, and orbit transfer vehicles, require advanced thermal management system. Current state-of-the-art for spacecrafts is a mechanically pumped single phase cooling loop that are not enough to meet thermal-related challenges for future space missions. Loop heat pipes (LHP) are the solution for the required thermal management system that is compact, light-weight, reliable, precise, and energy efficient. These are two-phase systems that employ capillary forces instead of pumps to circulate the coolant. In these devices, the coolant evaporates and condenses in the evaporator and condenser, respectively. The condensed coolant liquid is driven toward the evaporator by capillary action in a wick structure located inside the evaporator. A mechanical pump is added to the liquid line of the loop to reach the distributed heat loads while controlling the temperature to produce an isothermal surface. In this work, flow patterns and heat transfer in the LHP evaporator wick is studied for various flow rates of the working fluid, wick thermal conductivity, porosity and permeability of wick, heat flux, and gravity condition. A CFD model has been developed to predict the performance of LHP due to the change in these parameters. The Volume of Fluid (VOF) model in ANSYS Fluent was modified using a User Defined Function (UDF) to calculate mass transfer between the liquid and vapor phases at the interface. The Lee phase change model was used to calculate the mass flux due to evaporation and condensation.

Abstract: NASA's missions in space depend on the storage of

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cryogenic fluids for fuel and for life support. During long-term storage, heat can leak into the cryogenic fluid tanks. Heat leaks can cause evaporation of the liquid, which pressurizes the tank. However, when the tanks are in a microgravity environment, with reduced natural convection, heat leaks can also create superheated regions in the liquid. This may lead to boiling, resulting in much greater pressure rises than evaporation at the interface between the liquid and vapor phases. Models for predicting the pressure rise are needed to aid in developing methods to control the pressure rise, so that the safety of the storage tank is ensured for microgravity operations. In this work, a CFD model for predicting the pressure rise in a tank due to boiling has been developed and validated against experimental data. The tank was modeled as 2D axisymmetric. The Volume of Fluid (VOF) model in ANSYS Fluent version 15 was modified using a User Defined Function (UDF) to calculate mass transfer between the liquid and vapor phases. A kinetic based Schrage equation was used to calculate the mass flux for evaporation and condensation at the interface. The Schrage equation and the Lee model were compared for calculating the evaporation due to boiling that occurred in the bulk liquid. The results of this model were validated against microgravity data provided by the Tank Pressure Control Experiment, a tank pressurization and pressure control experiment performed aboard the Space Shuttle Mission STS-52 that experienced boiling. During this experiment, the tank pressure rose from about 43400 Pa to about 47200Pa, a difference of about 3800 Pa. The heater temperature rose from about 296K to about 303K, a difference of about 7K. The tank pressure predicted by the CFD model compared well with the experimental pressure data for self-pressurization and boiling in the tank. The validated CFD model uses the Schrage equation to calculate the mass transfer. Three different

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accommodation coefficients were used, one for evaporation at the interface, one for condensation at the interface, and one for boiling in the bulk liquid. The implicit VOF model with bounded second order time discretization was used.

The book covers selected problems in free surface flows. The topics range from linear and nonlinear gravity and capillary waves, thin film dynamics, equilibrium shape, stability, and dynamics of capillary surfaces to thermal Marangoni effects in several geometries. The fluid dynamical problems are supplemented by a review Eulerian based computational methods.

This book comprises select proceedings of the International Conference on Future Learning Aspects of Mechanical Engineering (FLAME 2018). The book gives an overview of recent developments in the field of thermal and fluid engineering, and covers theoretical and experimental fluid dynamics, numerical methods in heat transfer and fluid mechanics, different modes of heat transfer, multiphase transport and phase change, fluid machinery, turbo machinery, and fluid power. The book is primarily intended for researchers and professionals working in the field of fluid dynamics and thermal engineering.

Buoyancy is one of the main forces driving flows on our planet, especially in the oceans and atmosphere. These flows range from buoyant coastal currents to dense overflows in the ocean, and from avalanches to volcanic pyroclastic flows on the Earth's surface. This book brings together contributions by leading world scientists to summarize our present theoretical, observational, experimental and modeling understanding of buoyancy-driven flows. Buoyancy-driven currents play a key role in the global ocean circulation and in climate variability through their impact on deep-water formation. Buoyancy-driven currents are also primarily responsible for the redistribution of fresh water throughout the

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world's oceans. This book is an invaluable resource for advanced students and researchers in oceanography, geophysical fluid dynamics, atmospheric science and the wider Earth sciences who need a state-of-the-art reference on buoyancy-driven flows.

Our responses to our thermal environment have a considerable effect on our performance and behavior, not least in the realm of work. There has been considerable scientific investigation of these responses and formal methods have been developed for environmental evaluation and design. In recent years these have been developed to the extent that detailed national and international standards of practice have now become feasible. This new edition of Ken Parson's definitive text brings us back up to date. He covers hot, moderate and cold environments, and defines these in terms of six basic parameters: air temperature, radiate temperature, humidity, air velocity, clothing worn, and the person's activity. There is a focus on the principles and practice of human response, which incorporates psychology, physiology and environmental physics with applied ergonomics. Water requirements, computer modeling and computer-aided design are brought in, as are current standards. Special populations, such as the aged or disabled and specialist environments such as those found in vehicles are also considered. This book continues to be the standard text for the design of environments for humans to live and work safely, comfortably and effectively, and for the design of materials which help the same people cope with their environments.

Mixed or multiphase flows of solid/liquid or solid/gas are commonly found in many industrial fields, and their behavior is complex and difficult to predict in many cases. The use of computational fluid dynamics (CFD) has emerged as a powerful tool for the understanding of fluid mechanics in

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multiphase reactors, which are widely used in the chemical, petroleum, mining, food, beverage and pharmaceutical industries. Computational Techniques for Multiphase Flows enables scientists and engineers to understand the basis and application of CFD in multiphase flow, explains how to use the technique, when to use it and how to interpret the results and apply them to improving applications in process engineering and other multiphase application areas including the pumping, automotive and energy sectors. Understandable guide to a complex subject Important in many industries Ideal for potential users of CFD

This brief gives a summary of the soluble bio-based substances (SBO) field. Urban bio-wastes of differing compositions and ageing conditions represent a promising source of soluble bio-based substances (SBO), potentially able to perform as chemical auxiliaries for applications in the chemical industry and in environmental remediation. In particular, SBO process development, characterization and scale-up is described and bioassay studies discussed. This brief also discusses the use of SBOs in wastewater treatment in the context of 'green' processes, their role as humic-like substances, and their potential use as photocatalysts for the degradation of pollutants present in aqueous solutions (dyes, pharmaceuticals, chlorophenols). Furthermore, the role of SBOs as complexing agents for iron ions in the implementation of the photo-Fenton processes under mild pH conditions is also explored. Finally, SBOs are showcased in their capacity as organic component alternatives to petrochemical products for the synthesis of new materials. This book is the second edition of Numerical methods for diffusion phenomena in building physics: a practical introduction originally published by PUCPRESS (2016). It intends to stimulate research in simulation of diffusion problems in building physics, by providing an overview of

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mathematical models and numerical techniques such as the finite difference and finite-element methods traditionally used in building simulation tools. Nonconventional methods such as reduced order models, boundary integral approaches and spectral methods are presented, which might be considered in the next generation of building-energy-simulation tools. In this reviewed edition, an innovative way to simulate energy and hydrothermal performance are presented, bringing some light on innovative approaches in the field.

This book consists of select proceedings of the International Conference on Functional Material, Manufacturing and Performances (ICFMMP) 2019, and presents latest research on using the combined intelligence of people, processes, and machines to impact the overall economics of manufacturing. The book focuses on optimizing manufacturing resources, improving business value and safety, and reducing waste – both on the floor and in back-office operations. It highlights the applications of the latest manufacturing execution system (MES), intelligent devices, machine-to-machine communication, and data analysis for the production lines and facilities. This book will be useful to manufacturers of finished goods and of sub-assemblies in the automotive, agriculture, and construction equipment sector. It will also provide solutions to make production strategies exceptional and can be a useful reference for beginners, researchers, and professionals interested in intelligent manufacturing technologies.

This book gathers the proceedings of the 8th International Symposium on Coal Combustion. The contributions reflect the latest research on coal quality and combustion, techniques for pulverized coal combustion and fluidized bed combustion, special issues regarding CO₂ capture (CCS), industrial applications, etc. – aspects that are of great importance in promoting academic communications between

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related areas and the technical development of coal-related fields. The International Symposium on Coal Combustion (ISCC), sponsored and organized by Tsinghua University since 1987, has established itself as an important platform allowing scientists and engineers to exchange information and ideas on the science and technology of coal combustion and related issues, and to forge new partnerships in the growing Chinese market. Researchers in the fields of clean coal combustion, carbon dioxide capture and storage, coal chemical engineering, energy engineering, etc. will greatly benefit from this book. Guangxi Yue, professor of the Department of Thermal Engineering in Tsinghua University, Beijing, China, and a member of Chinese Academy of Engineering(CAE). Shuiqing Li, professor of the Department of Thermal Engineering in Tsinghua University, Beijing, China.

This book is open access under a CC BY 4.0 license. It relates to the III Annual Conference hosted by The Ministry of Education and Science of the Russian Federation in December 2016. This event has summarized, analyzed and discussed the interim results, academic outputs and scientific achievements of the Russian Federal Targeted Programme “Research and Development in Priority Areas of Development of the Russian Scientific and Technological Complex for 2014–2020.” It contains 75 selected papers from 6 areas considered priority by the Federal Targeted Programme: computer science, ecology & environment sciences; energy and energy efficiency; lifesciences; nanoscience & nanotechnology and transport & communications. The chapters report the results of the 3-years research projects supported by the Programme and finalized in 2016.

This book contains the proceedings of the thirteenth conference in the well established series on Simulation and

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Experiments in Heat Transfer and its applications

Heat-transfer equipment, typically represented by, for example, heat exchangers, process furnaces, and steam boilers, is among the essential equipment used for production processes in a number of industries (e.g., chemical and petrochemical, food, pharmaceutical, power, aviation and space) as well as for processes and applications in the communal sphere (e.g., waste incineration plants, heating plants, laundries, hospitals, server rooms, agriculture applications). Increasing demands for economical and efficient heat energy management can only be met when not only the layout of the whole system but also the individual heat-transfer equipment and its details are designed according to state-of-the-art knowledge. The purpose of this Special Issue is to present the latest advances in designing, modeling, testing, and operating heat-transfer equipment, including unconventional and innovative designs of heat-transfer equipment and their applications.

Heat Transfer and Fluid Flow in Biological Processes covers emerging areas in fluid flow and heat transfer relevant to biosystems and medical technology. This book uses an interdisciplinary approach to provide a comprehensive prospective on biofluid mechanics and heat transfer advances and includes reviews of the most recent methods in modeling of flows in biological media, such as CFD. Written by internationally recognized researchers in the field, each chapter provides a strong introductory section that is useful to both readers currently in the field and readers interested in learning more about these areas. Heat Transfer and Fluid Flow in Biological Processes is an indispensable reference for professors, graduate students, professionals, and clinical researchers in the fields of biology, biomedical engineering, chemistry and medicine working on applications of fluid flow, heat transfer, and transport phenomena in biomedical

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technology. Provides a wide range of biological and clinical applications of fluid flow and heat transfer in biomedical technology Covers topics such as electrokinetic transport, electroporation of cells and tissue dialysis, inert solute transport (insulin), thermal ablation of cancerous tissue, respiratory therapies, and associated medical technologies Reviews the most recent advances in modeling techniques This introduction reviews why combustion and radiation are important, as well as the technical challenges posed by radiation. Emphasis is on interactions among turbulence, chemistry and radiation (turbulence-chemistry-radiation interactions – TCRI) in Reynolds-averaged and large-eddy simulations. Subsequent chapters cover: chemically reacting turbulent flows; radiation properties, Reynolds transport equation (RTE) solution methods, and TCRI; radiation effects in laminar flames; TCRI in turbulent flames; and high-pressure combustion systems. This Brief presents integrated approach that includes radiation at the outset, rather than as an afterthought. It stands as the most recent developments in physical modeling, numerical algorithms, and applications collected in one monograph.

This book presents selected peer-reviewed papers from the International Conference on Recent Advancements in Air Conditioning and Refrigeration (RAAR) 2019. The focus is on current research in a very topical area of HVAC technology, which has wide-ranging applications. The topics covered include modern air conditioning and refrigeration practices, environment-friendly refrigerants, high-performance components, computer-assisted design, manufacture, operations and data management, energy-efficient buildings, and application of solar energy to heating and air conditioning. This book is useful for researchers and industry professionals working in the field of heating, air conditioning and refrigeration.

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Heat pipes are considered as an effective thermal solution, particularly in high heat flux applications and in situations where there is a combination of nonuniform heat loading, limited airflow over the heat-generating components, and space or weight constraints. This book is intended to explore some of the recent advances in heat pipes and their applications in thermal systems. The first chapter is an introductory chapter about the recent advances in heat pipes in general. The second chapter is about thermosyphon heat pipe technology; working principles, advantages, and disadvantages; application ranges; and using computational fluid dynamics in modeling thermosyphons. The third chapter is about recent research into loop heat pipes (LHPs). The last chapter presents a novel liquid-vapor separator-incorporated gravitational LHP.

This book consists of selected peer-reviewed papers presented at the NAFEMS India Regional Conference (NIRC 2018). It covers current topics related to advances in computer aided design and manufacturing. The book focuses on the latest developments in engineering modelling and simulation, and its application to various complex engineering systems. Finite element method/finite element analysis, computational fluid dynamics, and additive manufacturing are some of the key topics covered in this book. The book aims to provide a better understanding of contemporary product design and analyses, and hence will be useful for researchers, academicians, and professionals.

Over 90 papers presented, from turbulence structure to computation of complex flows, and heat and mass transfer. This book presents in a unified way the mathematical theory of well-posedness in optimization. The basic concepts of well-posedness and the links among them are studied, in particular Hadamard and Tykhonov well-posedness. Abstract optimization problems as well as applications to optimal

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control, calculus of variations and mathematical programming are considered. Both the pure and applied side of these topics are presented. The main subject is often introduced by heuristics, particular cases and examples. Complete proofs are provided. The expected knowledge of the reader does not extend beyond textbook (real and functional) analysis, some topology and differential equations and basic optimization. References are provided for more advanced topics. The book is addressed to mathematicians interested in optimization and related topics, and also to engineers, control theorists, economists and applied scientists who can find here a mathematical justification of practical procedures they encounter.

The book covers innovative research and its applications in infrastructure development and related areas. This book discusses the state-of-art development, challenges and unsolved problems in the field of infrastructure/smart development, control engineering, power system infrastructure, smart infrastructure, waste management and renewable energy. The solutions discussed in this book encourage the researchers and IT professionals to put the methods into their practice.

This reference book presents mathematical models of melting and solidification processes that are the key to the effective performance of latent heat thermal energy storage systems (LHTES), utilized in a wide range of heat transfer and industrial applications. This topic has spurred a growth in research into LHTES applications in energy conservation and utilization, space station power

systems, and thermal protection of electronic equipment in hostile environments. Further, interest in mathematical modeling has increased with the spread of high powered computers used in most industrial and academic settings. In two sections, the book first describes modeling of phase change processes and then describes applications for LHTES. It is aimed at graduate students, researchers, and practicing engineers in heat transfer, materials processing, multiphase systems, energy conservation, metallurgy, microelectronics, and cryosurgery.

This book provides essential information on and case studies in the fields of energy technology, clean energy, energy efficiency, sustainability and the environment relevant to academics, researchers, practicing engineers, technologists and students. The individual chapters present cutting-edge research on key issues and recent developments in thermo-fluid processes, including but not limited to: energy technologies in process industries, applications of thermo-fluid processes in mining industries, applications of electrostatic precipitators in thermal power plants, biofuels, energy efficiency in building systems, etc. Helping readers develop an intuitive understanding of the relevant concepts in and solutions for achieving sustainability in medium and large-scale industries, the book offers a valuable resource for undergraduate, honors and

postgraduate research students in the field of thermo-fluid engineering.

Computational Study of Heat and Mass Transfer with Phase Change Condensation and Evaporation in a Developing, Two-dimensional Wall Jet Velocity and Temperature FieldsHeat Transfer XIII Simulation and Experiments in Heat and Mass TransferWIT Press "Engineering Fluid Dynamics 2018". The topic of engineering fluid dynamics includes both experimental as well as computational studies. Of special interest were submissions from the fields of mechanical, chemical, marine, safety, and energy engineering. We welcomed both original research articles as well as review articles. After one year, 28 papers were submitted and 14 were accepted for publication. The average processing time was 37.91 days. The authors had the following geographical distribution: China (9); Korea (3); Spain (1); and India (1). Papers covered a wide range of topics, including analysis of fans, turbines, fires in tunnels, vortex generators, deep sea mining, as well as pumps.

This book is the result of a careful selection of contributors in the field of CFD. It is divided into three sections according to the purpose and approaches used in the development of the contributions. The first section describes the "high-performance computing" (HPC) tools and their impact on CFD modeling. The second section is

dedicated to "CFD models for local and large-scale industrial phenomena." Two types of approaches are basically contained here: one concerns the adaptation from global to local scale, - e.g., the applications of CFD to study the climate changes and the adaptations to local scale. The second approach, very challenging, is the multiscale analysis. The third section is devoted to "CFD in numerical modeling approach for experimental cases." Its chapters emphasize on the numerical approach of the mathematical models associated to few experimental (industrial) cases. Here, the impact and the importance of the mathematical modeling in CFD are focused on. It is expected that the collection of these chapters will enrich the state of the art in the CFD domain and its applications in a lot of fields. This collection proves that CFD is a highly interdisciplinary research area, which lies at the interface of physics, engineering, applied mathematics, and computer science. This book contains steam tables for practical industrial use calculated by using the international standard IAPWS-IF97 for the thermodynamic properties of water and steam and the IAPWS industrial standards for transport and other properties. The complete set of equations of IAPWS-IF97 is presented including all supplementary backward equations adopted by IAPWS for fast calculations of heat cycles, boilers, and steam

turbines. The calculation of the properties is not only shown for the usual input parameter pairs pressure and temperature, but also for the parameters pressure and enthalpy, pressure and entropy, enthalpy and entropy. It is for the first time that such a description is given. For designing advanced energy conversion processes, tables and property calculation algorithms of steam up to 2000 °C are given. In addition, these steam tables contain the following features:

- Formulas to calculate arbitrary partial derivatives of the eight most important properties from IAPWS-IF97, which are very helpful in non-stationary process modelling, are shown.
- The uncertainty values of IAPWS-IF97 regarding the most important properties are included.
- Pressure-temperature diagrams with isolines of 26 thermodynamic, transport and other properties are added.

Heat and mass transfer is the core science for many industrial processes as well as technical and scientific devices. Automotive, aerospace, power generation (both by conventional and renewable energies), industrial equipment and rotating machinery, materials and chemical processing, and many other industries are requiring heat and mass transfer processes. Since the early studies in the seventeenth and eighteenth centuries, there has been tremendous technical progress and scientific advances in the knowledge of heat and mass transfer, where modeling and simulation developments are increasingly contributing to the current

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state of the art. Heat and Mass Transfer - Advances in Science and Technology Applications aims at providing researchers and practitioners with a valuable compendium of significant advances in the field.

This book presents selected papers from the 11th International Symposium on Heating, Ventilation and Air Conditioning (ISHVAC 2019), with a focus on HVAC techniques for improving indoor environment quality and the energy efficiency of heating and cooling systems. Presenting inspiration for implementing more efficient and safer HVAC systems, the book is a valuable resource for academic researchers, engineers in industry, and government regulators.

* Third edition of a well-known and well established text both in industry and for teaching * Fully up-to-date and includes extra problems This book is an aid to heat exchanger design written primarily for design and development engineers in the chemical process, power generation, and refrigeration industries. It provides a comprehensive reference on two-phase flows, boiling, and condensation. The text covers all the latest advances like flows over tube bundles and two-phase heat transfer regarding refrigerants and petrochemicals. Another feature of this third edition is many new problems at chapter ends to enhance its use as a teaching text for graduate and post-graduate courses on two-phase flow and heat transfer. - ;This book is written for practising engineers as a comprehensive reference on two-phase flows, boiling, and condensation. It deals with methods for estimating two-phase flow pressure drops and heat transfer rates. It is a well-known

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reference book in its third edition and is also used as a text for advanced university courses. Both authors write from practical experience as both are professional engineers. -

Computational fluid dynamics, CFD, has become an indispensable tool for many engineers. This book gives an introduction to CFD simulations of turbulence, mixing, reaction, combustion and multiphase flows. The emphasis on understanding the physics of these flows helps the engineer to select appropriate models to obtain reliable simulations. Besides presenting the equations involved, the basics and limitations of the models are explained and discussed. The book combined with tutorials, project and power-point lecture notes (all available for download) forms a complete course. The reader is given hands-on experience of drawing, meshing and simulation. The tutorials cover flow and reactions inside a porous catalyst, combustion in turbulent non-premixed flow, and multiphase simulation of evaporation spray respectively. The project deals with design of an industrial-scale selective catalytic reduction process and allows the reader to explore various design improvements and apply best practice guidelines in the CFD simulations.

"Since the emergence of climate and global warming onto the international agenda, research in sustainability has been underpinned by the development in energy and environmental science. Highlighted 30 years ago by the Brundtland Commission, "sustainable development" was defined as: meeting the needs of the present without compromising the ability of future generations to meet

their own needs. This has very much defined the scope and aims of this conference. This conference proceedings book contains the selected papers presented in the 2015 International Conference on Sustainable Development (ICSD2015) held in September 25-27, 2015, in Wuhan, Hubei, China. The conference positions itself as an international forum for researchers all over the world to come together to share and discuss their findings and contributions in all aspects of sustainability; including theory, methodology and applications covering a wide spectrum of topics and issues. The conference proceedings put together a total of 119 papers in sustainable development, covering issues in environmental, energy, and economical aspects of the subjects."--Provided by publisher.

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.

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