

Nuclear Science and Technology

3

Numerical Methods Of Reactor Analysis

Melville Jr. Clark



Numerical Methods Of Reactor Analysis:

Numerical Methods of Reactor Analysis Melville Jr. Clark, 2012-12-02 Nuclear Science and Technology Volume 3
Numerical Methods of Reactor Analysis presents the numerical analysis frequently used in the nuclear reactor field. This book discusses the numerical approximation for the multigroup diffusion method which results in simple algebraic equations. Organized into six chapters, this volume starts with an overview of the simplified formulation of linear algebra by defining the matrices and operations with matrices. This text then discusses the properties of special matrices and reviews the elementary properties of finite difference equations. Other chapters consider a variety of methods of obtaining numerical solutions to the approximating equations. The final chapter deals with the Monte Carlo method, which is a statistical method for solving statistical or deterministic problems. This book is a valuable resource for nuclear engineers. Students at the graduate level who had an introductory course in reactor physics and a basic course in differential equations will also find this book useful.

Introduction to Chemical Reactor Analysis R.E. Hayes, 2020-12-17 This book provides an introduction to the basic concepts of chemical reactor analysis and design. It is intended for both the senior level undergraduate student in chemical engineering and the working professional who may require an understanding of the basics of this subject. **Introduction to Chemical Reactor Analysis, Second Edition** R.E. Hayes, J.P. Mmbaga, 2012-10-05 Introduction to Chemical Reactor Analysis Second Edition introduces the basic concepts of chemical reactor analysis and design, an important foundation for understanding chemical reactors which play a central role in most industrial chemical plants. The scope of the second edition has been significantly enhanced and the content reorganized for improved pedagogical value, containing sufficient material to be used as a text for an undergraduate level two-term course. This edition also contains five new chapters on catalytic reaction engineering. Written so that newcomers to the field can easily progress through the topics, this text provides sufficient knowledge for readers to perform most of the common reaction engineering calculations required for a typical practicing engineer. The authors introduce kinetics, reactor types, and commonly used terms in the first chapter. Subsequent chapters cover a review of chemical engineering thermodynamics, mole balances in ideal reactors for three common reactor types, energy balances in ideal reactors, and chemical reaction kinetics. The text also presents an introduction to nonideal reactors and explores kinetics and reactors in catalytic systems. The book assumes that readers have some knowledge of thermodynamics, numerical methods, heat transfer, and fluid flow. The authors include an appendix for numerical methods which are essential to solving most realistic problems in chemical reaction engineering. They also provide numerous worked examples and additional problems in each chapter. Given the significant number of chemical engineers involved in chemical process plant operation at some point in their careers, this book offers essential training for interpreting chemical reactor performance and improving reactor operation. **What's New in This Edition** Five new chapters on catalytic reaction engineering, including various catalytic reactions and kinetics, transport processes, and experimental methods. Expanded

coverage of adsorption Additional worked problems Reorganized material **High Resolution Numerical Methods for Coupled Non-linear Multi-physics Simulations with Applications in Reactor Analysis** Vijay Subramaniam

Mahadevan,2011 The modeling of nuclear reactors involves the solution of a multi physics problem with widely varying time and length scales This translates mathematically to solving a system of coupled non linear and stiff partial differential equations PDEs Multi physics applications possess the added complexity that most of the solution fields participate in various physics components potentially yielding spatial and or temporal coupling errors This dissertation deals with the verification aspects associated with such a multi physics code i e the substantiation that the mathematical description of the multi physics equations are solved correctly both in time and space Conventional paradigms used in reactor analysis problems employed to couple various physics components are often non iterative and can be inconsistent in their treatment of the non linear terms This leads to the usage of smaller time steps to maintain stability and accuracy requirements thereby increasing the overall computational time for simulation The inconsistencies of these weakly coupled solution methods can be overcome using tighter coupling strategies and yield a better approximation to the coupled non linear operator by resolving the dominant spatial and temporal scales involved in the multi physics simulation A multi physics framework KARMA K c ode for Analysis of Reactor and other Multi physics Applications is presented KARMA uses tight coupling strategies for various physical models based on a Matrix free Nonlinear Krylov MFNK framework in order to attain high order spatio temporal accuracy for all solution fields in amenable wall clock times for various test problems The framework also utilizes traditional loosely coupled methods as lower order solvers which serve as efficient preconditioners for the tightly coupled solution Since the software platform employs both lower and higher order coupling strategies it can easily be used to test and evaluate different coupling strategies and numerical methods and to compare their efficiency for problems of interest Multi physics code verification efforts pertaining to reactor applications are described and associated numerical results obtained using the developed multi physics framework are provided The versatility of numerical methods used here for coupled problems and feasibility of general non linear solvers with appropriate physics based preconditioners in the KARMA framework offer significantly efficient techniques to solve multi physics problems in reactor analysis *Fractional-Order Models for Nuclear Reactor Analysis* Gilberto Espinosa Paredes,2020-10-22 Fractional Order Models for Nuclear Reactor Analysis presents fractional modeling issues in the context of anomalous diffusion processes in an accessible and practical way The book emphasizes the importance of non Fickian diffusion in heterogeneous systems as the core of the nuclear reactor as well as different variations of diffusion processes in nuclear reactors which are presented to establish the importance of nuclear and thermohydraulic phenomena and the physical side effects of feedback In addition the book analyzes core issues in fractional modeling in nuclear reactors surrounding phenomenological description and important analytical sub diffusive processes in the transport neutron Users will find the most innovative modeling techniques of nuclear reactors using operator differentials

of fractional order and applications in nuclear design and reactor dynamics Proposed methods are tested with Boltzmann equations and non linear order models alongside real data from nuclear power plants making this a valuable resource for nuclear professionals researchers and graduate students as well as those working in nuclear research centers with expertise in mathematical modeling physics and control Presents and analyzes a new paradigm of nuclear reactor phenomena with fractional modeling Considers principles of fractional calculation methods of solving differential equations of fractional order and their applications Includes methodologies of linear and nonlinear analysis along with design and dynamic analyses

Notes on Reactor Analysis David K. Holmes,Robert Vartan Meghreblian,1955 Chemical Reaction Engineering and Reactor Technology Tapio O. Salmi,Jyri-Pekka Mikkola,Johan P. Warna,2010-08-30 The role of the chemical reactor is crucial for the industrial conversion of raw materials into products and numerous factors must be considered when selecting an appropriate and efficient chemical reactor Chemical Reaction Engineering and Reactor Technology defines the qualitative aspects that affect the selection of an industrial chemical reactor , **Numerical Methods and Computational Sciences Applied to Nuclear Energy** Yue Jin,Jun Wang,Haomin Yuan,Fulvio Mascari,Shripad T. Revankar,2022-11-11

Elementary Chemical Reactor Analysis Rutherford Aris,2013-09-03 Elementary Chemical Reactor Analysis focuses on the processes reactions methodologies and approaches involved in chemical reactor analysis including stoichiometry adiabatic reactors external mass transfer and thermochemistry The publication first takes a look at stoichiometry and thermochemistry and chemical equilibrium Topics include heat of formation and reaction measurement of quantity and its change by reaction concentration changes with a single reaction rate of generation of heat by reaction and equilibrium of simultaneous and heterogeneous reactions The manuscript then offers information on reaction rates and the progress of reaction in time Discussions focus on systems of first order reactions concurrent reactions of low order general irreversible reaction variation of reaction rate with extent and temperature and heterogeneous reaction rate expressions The book examines the interaction of chemical and physical rate processes continuous flow stirred tank reactor and adiabatic reactors Concerns include multistage adiabatic reactors adiabatic stirred tank stability and control of the steady state mixing in the reactor effective reaction rate expressions and external mass transfer The publication is a dependable reference for readers interested in chemical reactor analysis Reactor Technology ,1969 **Energy Research Abstracts** ,1978 **Nuclear Reactor Physics** Weston M. Stacey,2018-02-07 The third revised edition of this popular textbook and reference which has been translated into Russian and Chinese expands the comprehensive and balanced coverage of nuclear reactor physics to include recent advances in understanding of this topic The first part of the book covers basic reactor physics including but not limited to nuclear reaction data neutron diffusion theory reactor criticality and dynamics neutron energy distribution fuel burnup reactor types and reactor safety The second part then deals with such physically and mathematically more advanced topics as neutron transport theory neutron slowing down resonance absorption neutron thermalization perturbation and

variational methods homogenization nodal and synthesis methods and space time neutron dynamics For ease of reference the detailed appendices contain nuclear data useful mathematical formulas an overview of special functions as well as introductions to matrix algebra and Laplace transforms With its focus on conveying the in depth knowledge needed by advanced student and professional nuclear engineers this text is ideal for use in numerous courses and for self study by professionals in basic nuclear reactor physics advanced nuclear reactor physics neutron transport theory nuclear reactor dynamics and stability nuclear reactor fuel cycle physics and other important topics in the field of nuclear reactor physics

Chemical Reactor Analysis and Applications for the Practicing Engineer Louis Theodore, 2012-09-11 This book's format follows an applications oriented text and serves as a training tool for individuals in education and industry involved directly or indirectly with chemical reactors It addresses both technical and calculational problems in this field While this text can be complimented with texts on chemical kinetics and or reactor design it also stands alone as a self teaching aid The first part serves as an introduction to the subject title and contains chapters dealing with history process variables basic operations kinetic principles and conversion variables The second part of the book addresses traditional reactor analysis chapter topics include batch CSTRs tubular flow reactors plus a comparison of these classes of reactors Part 3 keys on reactor applications that include non ideal reactors thermal effects interpretation of kinetic data and reactor design The book concludes with other reactor topics chapter titles include catalysis catalytic reactors other reactions and reactors and ABET related topics An extensive Appendix is also included

Principles of Chemical Reactor Analysis and Design Uzi Mann, 2009-03-30 An innovative approach that helps students move from the classroom to professional practice This text offers a comprehensive unified methodology to analyze and design chemical reactors using a reaction based design formulation rather than the common species based design formulation The book's acclaimed approach addresses the weaknesses of current pedagogy by giving readers the knowledge and tools needed to address the technical challenges they will face in practice Principles of Chemical Reactor Analysis and Design prepares readers to design and operate real chemical reactors and to troubleshoot any technical problems that may arise The text's unified methodology is applicable to both single and multiple chemical reactions to all reactor configurations and to all forms of rate expression This text also Describes reactor operations in terms of dimensionless design equations generating dimensionless operating curves that depict the progress of individual chemical reactions the composition of species and the temperature Combines all parameters that affect heat transfer into a single dimensionless number that can be estimated a priori Accounts for all variations in the heat capacity of the reacting fluid Develops a complete framework for economic based optimization of reactor operations Problems at the end of each chapter are categorized by their level of difficulty from one to four giving readers the opportunity to test and develop their skills Graduate and advanced undergraduate chemical engineering students will find that this text's unified approach better prepares them for professional practice by teaching them the actual skills needed to

design and analyze chemical reactors Nucleonics ,1965 *Computer Codes and Mathematical Models* ,1985
 Computer Codes and Mathematical Models U.S. Nuclear Regulatory Commission. Division of Technical Information and
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