

## Solved Examples In Chemical Engineering Roy

Focusing on the application of mathematics to chemical engineering, *Applied Mathematical Methods for Chemical Engineers, Second Edition* addresses the setup and verification of mathematical models using experimental or other independently derived data. An expanded and updated version of its well-respected predecessor, this book uses worked examples to illustrate several mathematical methods that are essential in successfully solving process engineering problems. The book first provides an introduction to differential equations that are common to chemical engineering, followed by examples of first-order and linear second-order ordinary differential equations (ODEs). Later chapters examine Sturm–Liouville problems, Fourier series, integrals, linear partial differential equations (PDEs), and regular perturbation. The author also focuses on examples of PDE applications as they relate to the various conservation laws practiced in chemical engineering. The book concludes with discussions of dimensional analysis and the scaling of boundary value problems and presents selected numerical methods and available software packages. New to the Second Edition · Two popular approaches to model development: shell balance and conservation law balance · One-dimensional rod model and a planar model of heat conduction in one direction · Systems of first-order ODEs · Numerical method of lines, using MATLAB® and Mathematica where appropriate This invaluable resource provides a crucial introduction to mathematical methods for engineering and helps in choosing a suitable software package for computer-based algebraic applications.

"A companion book including interactive software for students and professional engineers who want to utilize problem-solving software to effectively and efficiently obtain solutions to realistic and complex problems. An Invaluable reference book that discusses and Illustrates practical numerical problem solving in the core subject areas of Chemical Engineering. Problem Solving in Chemical Engineering with Numerical Methods provides an extensive selection of problems that require numerical solutions from throughout the core subject areas of chemical engineering. Many are completely solved or partially solved using POLYMATH as the representative mathematical problem-solving software, Ten representative problems are also solved by Excel, Maple, Mathcad, MATLAB, and Mathematica. All problems are clearly organized and all necessary data are provided. Key equations are presented or derived. Practical aspects of efficient and effective numerical problem solving are emphasized. Many complete solutions are provided within the text and on the CD-ROM for use in problem-solving exercises."--BOOK JACKET. Title Summary field provided by Blackwell North America, Inc. All Rights Reserved

Solved Examples in Chemical Engineering Numerical Solutions to Important Examination Questions Chemical Engineering: Solutions to the Problems in Volume 1 Elsevier

Issues in Chemical Engineering and other Chemistry Specialties: 2011 Edition is a ScholarlyEditions™ eBook that delivers timely, authoritative, and comprehensive information about Chemical Engineering and other Chemistry Specialties. The editors have built Issues in Chemical Engineering and other Chemistry Specialties: 2011 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Chemical Engineering and other Chemistry Specialties in this eBook to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Issues in Chemical Engineering and other Chemistry Specialties: 2011 Edition has been produced by the world's leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at <http://www.ScholarlyEditions.com/>. This book presents Maple solutions to a wide range of problems relevant to chemical engineers and others. Many of these solutions use Maple's symbolic capability to help bridge the gap between analytical and numerical solutions. The readers are strongly encouraged to refer to the references included in the book for a better understanding of the physics involved, and for the mathematical analysis. This book was written for a senior undergraduate or a first year graduate student course in chemical engineering. Most of the examples in this book were done in Maple 10. However, the codes should run in the most recent version of Maple. We strongly encourage the readers to use the classic worksheet (\*. mws) option in Maple as we believe it is more user-friendly and robust. In chapter one you will find an introduction to Maple which includes simple basics as a convenience for the reader such as plotting, solving linear and nonlinear equations, Laplace transformations, matrix operations, 'do loop,' and 'while loop.' Chapter two presents linear ordinary differential equations in section 1 to include homogeneous and nonhomogeneous ODEs, solving systems of ODEs using the matrix exponential and Laplace transform method. In section two of chapter two, nonlinear ordinary differential equations are presented and include simultaneous series reactions, solving nonlinear ODEs with Maple's 'dsolve' command, stop conditions, differential algebraic equations, and steady state solutions. Chapter three addresses boundary value problems.

Although most realistic process engineering models require numerical solution, it is important for chemical engineering students to have an understanding of the gross tendencies of the particular model they are using. This understanding most naturally arises from deriving analytical solutions of a modified version of the problem being considered. Analytical models also allow for easier process optimizations. Emphasizing these analytical methods, *Applied Mathematical Methods for Chemical Engineers* introduces several techniques essential to solving real problems. The author's presentation shows students how to translate a problem from prose to mathematical symbolism and allows them to inductively build on previous experience. Designed for senior undergraduates and first-year graduates, the text provides detailed examples that allow students to experience how to actually use the methods presented. It contains an entire chapter of fully worked examples involving traditional mass, heat, and momentum applications along with cutting edge technologies, such as membrane separation and chemical vapor deposition. Another chapter acquaints readers with selected numerical methods and available software packages. Favoring clear, practical exposition over strict mathematical rigor, *Applied Mathematical Methods for Chemical Engineers* removes the mathematics phobia that often exists among chemical engineering students. It allows them to learn by example the techniques they will need to solve problems in practice.

Numerical, analytical and statistical computations are routine affairs for chemical engineers. They usually prefer a single software to solve their computational problems, and at present, MATLAB has emerged as a powerful computational language, which is preferably used for this purpose, due to its built-in functions and toolboxes. Considering the needs and convenience of the students, the author has made an attempt to write this book, which explains the various concepts of MATLAB in a systematic way and makes its readers proficient in using MATLAB for computing. It mainly focuses on the applications of MATLAB, rather than its

use in programming basic numerical algorithms. Commencing with the introduction to MATLAB, the text covers vector and matrix computations, solution of linear and non-linear equations, differentiation and integration, and solution of ordinary and partial differential equations. Next, analytical computations using the Symbolic Math Toolbox and statistical computations using the Statistics and Machine Learning Toolbox are explained. Finally, the book describes various curve fitting techniques using the Curve Fitting Toolbox. Inclusion of all these advanced-level topics in the book stands it out from the rest. **KEY FEATURES ?** Numerous worked-out examples to enable the readers understand the steps involved in solving the chemical engineering problems ? MATLAB codes to explain the computational techniques ? Several snapshots to help the readers understand the step-by-step procedures of using the toolboxes ? Chapter-end exercises, including short-answer questions and numerical problems ? Appendix comprising the definitions of some important and special matrices ? Supplemented with Solutions Manual containing complete detailed solutions to the unsolved analytical problems ? Accessibility of selected colour figures (including screenshots and results/outputs of the programs) cited in the text at [www.phindia.com/Pallab\\_Ghosh](http://www.phindia.com/Pallab_Ghosh). **TARGET AUDIENCE •** BE/B.Tech (Chemical Engineering) • ME/M.Tech (Chemical Engineering)

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

Richardson et al provide the student of chemical engineering with full worked solutions to the problems posed in Chemical Engineering Volume 2 "Particle Technology and Separation Processes" 5th Edition, and Chemical Engineering Volume 3 "Chemical and Biochemical Reactors & Process Control" 3rd Edition. Whilst the main volumes contains illustrative worked examples throughout the text, this book contains answers to the more challenging questions posed at the end of each chapter of the main texts. These questions are of both a standard and non-standard nature, and so will prove to be of interest to both academic staff teaching courses in this area and to the keen student. Chemical engineers in industry who are looking for a standard solution to a real-life problem will also find the book of considerable interest. \* Contains fully worked solutions to the problems posed in Chemical Engineering Volumes 2 and 3 \* Enables the reader to get the maximum benefit from using Volumes 2 and 3 \* An extremely effective method of learning

Keeping the importance of basic tools of process calculations—material balance and energy balance—in mind, the text prepares the students to formulate material and energy balance theory on chemical process systems. It also demonstrates how to solve the main process-related problems that crop up in chemical engineering practice. The chapters are organized in a way that enables the students to acquire an in-depth understanding of the subject. The emphasis is given to the units and conversions, basic concepts of calculations, material balance with/without chemical reactions, and combustion of fuels and energy balances. Apart from numerous illustrations, the book contains numerous solved problems and exercises which bridge the gap between theoretical learning and practical implementation. All the numerical problems are solved with block diagrams to reinforce the understanding of the concepts. Primarily intended as a text for the undergraduate students of chemical engineering, it will also be useful for other allied branches of chemical engineering such as polymer science and engineering and petroleum engineering. **KEY FEATURES •** Methods of calculation for stoichiometric proportions with practical examples from the Industry • Simplified method of solving numerical problems under material balance with and without chemical reactions • Conversions of chemical engineering equations from one unit to another • Solution of fuel and combustion, and energy balance problems using tabular column This book contains the solved problems in fluid flow usually required by practicing engineers in chemical and petrochemical, power plants. The problems solved in this book are as per the course content for chemical and mechanical engineers

This book is a very useful reference that contains worked-out solutions for all the exercise problems in the book Chemical Engineering Thermodynamics by the same author. Step-by-step solutions to all exercise problems are provided and solutions are explained with detailed and extensive illustrations. It will come in handy for all teachers and users of Chemical Engineering Thermodynamics.

This is a unique book with nearly 1000 problems and 50 case studies on open-ended problems in every key topic in chemical engineering that helps to better prepare chemical engineers for the future. The term "open-ended problem" basically describes an approach to the solution of a problem and/or situation for which there is not a unique solution. The Introduction to the general subject of open-ended problems is followed by 22 chapters, each of which addresses a traditional chemical engineering or chemical engineering-related topic. Each of these chapters contain a brief overview of

the subject matter of concern, e.g., thermodynamics, which is followed by sample open-ended problems that have been solved (by the authors) employing one of the many possible approaches to the solutions. This is then followed by approximately 40-45 open-ended problems with no solutions (although many of the authors' solutions are available for those who adopt the book for classroom or training purposes). A reference section is included with the chapter's contents. Term projects, comprised of 12 additional chapter topics, complement the presentation. This book provides academic, industrial, and research personnel with the material that covers the principles and applications of open-ended chemical engineering problems in a thorough and clear manner. Upon completion of the text, the reader should have acquired not only a working knowledge of the principles of chemical engineering, but also (and more importantly) experience in solving open-ended problems. What many educators have learned is that the applications and implications of open-ended problems are not only changing professions, but also are moving so fast that many have not yet grasped their tremendous impact. The book drives home that the open-ended approach will revolutionize the way chemical engineers will need to operate in the future.

This book starts from the fundamentals to the professional level, academic, practical and industrial classification and understanding of the many types and mechanisms of chemical reactions before illustrating the generalised kinetics and stoichiometry which may be applied to them. Several typical and numerical problems are solved in chemical kinetics, stoichiometry, material and energy balances relevant to the chemical engineering aspects of chemical reactor design. This volume in the Coulson and Richardson series in chemical engineering contains full worked solutions to the problems posed in volume 1. Whilst the main volume contains illustrative worked examples throughout the text, this book contains answers to the more challenging questions posed at the end of each chapter of the main text. These questions are of both a standard and non-standard nature, and so will prove to be of interest to both academic staff teaching courses in this area and to the keen student. Chemical engineers in industry who are looking for a standard solution to a real-life problem will also find the book of considerable interest. \* An invaluable source of information for the student studying the material contained in Chemical Engineering Volume 1 \*

A helpful method of learning - answers are explained in full

This Second Edition of the go-to reference combines the classical analysis and modern applications of applied mathematics for chemical engineers. The book introduces traditional techniques for solving ordinary differential equations (ODEs), adding new material on approximate solution methods such as perturbation techniques and elementary numerical solutions. It also includes analytical methods to deal with important classes of finite-difference equations. The last half discusses numerical solution techniques and partial differential equations (PDEs). The reader will then be equipped to apply mathematics in the formulation of problems in chemical engineering. Like the first edition, there are many examples provided as homework and worked examples. The field of chemical engineering is in constant evolution, and access to information technology is changing the way chemical engineering problems are addressed. Inspired by the need for a user-friendly chemical engineering text that demonstrates the real-world applicability of different computer programs, *Introduction to Software for Chemical Engineers* acquaints readers with the capabilities of various general purpose, mathematical, process modeling and simulation, optimization, and specialized software packages, while explaining how to use the software to solve typical problems in fluid mechanics, heat and mass transfer, mass and energy balances, unit operations, reactor engineering, and process and equipment design and control. Employing nitric acid production, methanol and ammonia recycle loops, and SO<sub>2</sub> oxidation reactor case studies and other practical examples, *Introduction to Software for Chemical Engineers* shows how computer packages such as Excel, MATLAB®, Mathcad, CHEMCAD, Aspen HYSYS®, gPROMS, CFD, DEM, GAMS, and AIMMS are used in the design and operation of chemical reactors, distillation columns, cooling towers, and more. Make *Introduction to Software for Chemical Engineers* your go-to guide and quick reference for the use of computer software in chemical engineering applications.

Engineers and other applied scientists are frequently faced with models of complex systems for which no rigorous mathematical solution can be calculated. To predict and calculate the behaviour of such systems, numerical approximations are frequently used, either based on measurements of real life systems or on the behaviour of simpler models. This is essential work for example for the process engineer implementing simulation, control and optimization of chemical processes for design and operational purposes. This fourth in a suite of five practical guides is an engineer's companion to using numerical methods for the solution of complex mathematical problems. It explains the theory behind current numerical methods and shows in a step-by-step fashion how to use them. The volume focuses on differential and differential-algebraic systems, providing numerous real-life industrial case studies to illustrate this complex topic. It describes the methods, innovative techniques and strategies that are all implemented in a freely available toolbox called BzzMath, which is developed and maintained by the authors and provides up-to-date software tools for all the methods described in the book. Numerous examples, sample codes, programs and applications are taken from a wide range of scientific and engineering fields, such as chemical engineering, electrical engineering, physics, medicine, and environmental science. As a result, engineers and scientists learn how to optimize processes even before entering the laboratory. With additional online material including the latest version of BzzMath Library, installation tutorial, all examples and sample codes used in the book and a host of further examples.

*Mathcad for Chemical Engineers* demonstrates the use of Mathcad 13, which is the latest version of one of the most powerful and popular computational software packages in the world, for solving various chemical engineering problems. The book serves as a must-to-have guide and quick reference for chemical engineers and those who would like to learn and use Mathcad as their computational tool. This book can also be used as a textbook for chemical engineering education on computing using Mathcad. The book contains many real-life chemical engineering examples from various areas: material and energy balance, thermodynamics, transport phenomena, kinetics and reactor design, unit operations, engineering economics, and operations management. Unlike other books of similar theme, concise, but comprehensive, explanations are given in each chapter and step-by-step procedures of solving mathematical problems are also given for quick reference. Many examples allow readers to experience the power of Mathcad in solving chemical engineering problems. The book has chapters on Mathcad fundamentals, solving a single algebraic equation and a system of algebraic equations, curve fitting, integration and differentiation, solving a single ordinary differential equation (ODE) and a system of ODEs, solving a single partial differential equation (PDE) and a system of PDEs, and programming in Mathcad. There are a number of exercise problems at the end of each chapter that allow readers to

further expose themselves to various chemical engineering problems. Although Mathcad 13 is the software package chosen by the authors and used throughout the book, most of the features discussed can also be applied using earlier versions of Mathcad. Furthermore, although Mathcad will always evolve into a newer version, most of the contents in this book will be applicable for any subsequent version of Mathcad.

Avoid wasting time and money on recurring plant process problems by applying the practical, five-step solution in Process Engineering Problem Solving: Avoiding "The Problem Went Away, but it Came Back" Syndrome. Combine cause and effect problem solving with the formulation of theoretically correct working hypotheses and find a structural and pragmatic way to solve real-world issues that tend to be chronic or that require an engineering analysis. Utilize the fundamentals of chemical engineering to develop technically correct working hypotheses that are key to successful problem solving.

Contains Fluid Flow Topics Relevant to Every Engineer Based on the principle that many students learn more effectively by using solved problems, Solved Practical Problems in Fluid Mechanics presents a series of worked examples relating fluid flow concepts to a range of engineering applications. This text integrates simple mathematical approaches that clarify key concepts as well as the significance of their solutions, and fosters an understanding of the fundamentals encountered in engineering. Comprised of nine chapters, this book grapples with a number of relevant problems and asks two pertinent questions to extend understanding and appreciation: What should we look out for? and What else is interesting? This text can be used for exam preparation and addresses problems that include two-phase and multi-component flow, viscometry and the use of rheometers, non-Newtonian fluids, and applications of classical fluid flow principles. While the author incorporates terminology recognized by all students of engineering and provides a full understanding of the basics, the book is written for engineers who already have a rudimentary understanding and familiarity of fluid flow phenomena. It includes engineering concepts such as dimensionless numbers and requires a fluency in basic mathematical skills, such as differential calculus and the associated application of boundary conditions to reach solutions. Solved Practical Problems in Fluid Mechanics thoroughly explains the concepts and principles of fluid flow by highlighting various problems frequently encountered by engineers with accompanying solutions. This text can therefore help you gain a complete understanding of fluid mechanics and draw on your own practical experiences to tackle equally tricky problems. This volume in the Coulson and Richardson series in chemical engineering contains full worked solutions to the problems in volume 1. Whilst the main volume contains illustrative worked examples throughout the text, this book, and its companion in the series (Volume 5 - which performs the same role with respect to Volumes 2 and 3), contains the answers to the more challenging questions posed at the end of each chapter of the main text. These questions are of both a standard and non-standard nature, and so will prove to be of interest to both academic staff teaching courses in this area and to the keen student. Chemical engineers in industry who are looking for a standard solution to a real-life problem will also find the book of considerable interest.

This book teaches readers what chemical engineering is and why it's so important in our daily lives, such as enabling solar panels to promote green energy and the creation of consumer products such as Post-It notes. Readers also learn how chemical engineering has helped in medicine, such as by advancing prosthetics.

A practical engineer's companion to using numerical methods for the solution of complex mathematical problems. It thus enables readers to use and implement standard numerical tools in their work, explaining the theory behind the various functions and problem solvers, while showcasing applications in diverse scientific and engineering fields. The material is based on several tried-and-tested courses for scientists and engineers taught by the authors, and all the exercises and problems are classroom-tested. The required software is freeware developed and maintained by the authors, included on the accompanying CD-ROM, together with an installation tutorial, all the examples and sample codes described in the book, as well as a host of additional examples.

Problem Solving in Chemical and Biochemical Engineering with POLYMATH<sup>®</sup>, Excel, and MATLAB<sup>®</sup>, Second Edition, is a valuable resource and companion that integrates the use of numerical problem solving in the three most widely used software packages: POLYMATH, Microsoft Excel, and MATLAB. Recently developed POLYMATH capabilities allow the automatic creation of Excel spreadsheets and the generation of MATLAB code for problem solutions. Students and professional engineers will appreciate the ease with which problems can be entered into POLYMATH and then solved independently in all three software packages, while taking full advantage of the unique capabilities within each package. The book includes more than 170 problems requiring numerical solutions. This greatly expanded and revised second edition includes new chapters on getting started with and using Excel and MATLAB. It also places special emphasis on biochemical engineering with a major chapter on the subject and with the integration of biochemical problems throughout the book. General Topics and Subject Areas, Organized by Chapter Introduction to Problem Solving with Mathematical Software Packages Basic Principles and Calculations Regression and Correlation of Data Introduction to Problem Solving with Excel Introduction to Problem Solving with MATLAB Advanced Problem-Solving Techniques Thermodynamics Fluid Mechanics Heat Transfer Mass Transfer Chemical Reaction Engineering Phase Equilibrium and Distillation Process Dynamics and Control Biochemical Engineering Practical Aspects of Problem-Solving Capabilities Simultaneous Linear Equations Simultaneous Nonlinear Equations Linear, Multiple Linear, and Nonlinear Regressions with Statistical Analyses Partial Differential Equations (Using the Numerical Method of Lines) Curve Fitting by Polynomials with Statistical Analysis Simultaneous Ordinary Differential Equations (Including Problems Involving Stiff Systems, Differential-Algebraic Equations, and Parameter Estimation in Systems of Ordinary Differential Equations) The Book's Web Site (<http://www.problemsolvingbook.com>) Provides solved and partially solved problem files for all three software packages, plus additional materials Describes discounted purchase options for educational version of POLYMATH available to book purchasers Includes detailed, selected problem solutions in Maple<sup>®</sup>, Mathcad<sup>®</sup>, and Mathematica<sup>®</sup>

Chemical Engineering Sample Exams offers the most complete set of sample exams available with step-by-step solutions to every problem in the book. It is a superb reference guide, and it provides ample practice for the exams, including the new breadth/depth exams.

Material balance Calculations is a textbook intended to help students overcome the challenges associated with solving problems in material balance. This book contains numerous solved problems in important areas of chemical engineering material balance. These worked examples will really improve students understanding in the area of mass balance. This book will be useful to students in colleges and other higher institutions of learning. It will also be a useful guide for students of chemistry. The detailed explanations given in this book have been done in order to improve students' material balance calculation skills which is required for proper understanding of chemical engineering calculations. The worked examples in this textbook are presented in a simple, logical and self-explanatory manner that will impart students with the required numerical skills for excelling in chemistry and chemical engineering calculations. Exercises are presented at the end of each topic in order for students to attempt and assess themselves. The topics covered in this book include: MATERIAL BALANCE: INTRODUCTION BALANCES INVOLVING DRYING/EVAPORATIVE PROCESSES BALANCES INVOLVING MIXING OF SOLUTIONS BALANCES ON SEPARATION PROCESSES BALANCES ON SOLVENT EXTRACTION PRESSURE IN LIQUID HUMIDITY AND WATER VAPOUR IN THE AIR These topics are well simplified with the numerous worked examples explained in a step-by-step order. A thorough study of this textbook will definitely improve your calculation skills in chemical engineering material balance calculations

Best-selling introductory chemical engineering book - now updated with far more coverage of biotech, nanotech, and green engineering •

- Thoroughly covers material balances, gases, liquids, and energy balances.
- Contains new biotech and bioengineering problems throughout.
- Adds new examples and homework on nanotechnology, environmental engineering, and green engineering.
- All-new student projects chapter.
- Self-assessment tests, discussion problems, homework, and glossaries in each chapter.

Basic Principles and Calculations in Chemical Engineering, 8/e, provides a complete, practical, and student-friendly introduction to the principles and techniques of modern chemical, petroleum, and environmental engineering. The authors introduce efficient and consistent methods for solving problems, analyzing data, and conceptually understanding a wide variety of processes. This edition has been revised to reflect growing interest in the life sciences, adding biotechnology and bioengineering problems and examples throughout. It also adds many new examples and homework assignments on nanotechnology, environmental, and green engineering, plus many updates to existing examples. A new chapter presents multiple student projects, and several chapters from the previous edition have been condensed for greater focus. This text's features include:

- Thorough introductory coverage, including unit conversions, basis selection, and process measurements.
- Short chapters supporting flexible, modular learning.
- Consistent, sound strategies for solving material and energy balance problems.
- Key concepts ranging from stoichiometry to enthalpy.
- Behavior of gases, liquids, and solids.
- Many tables, charts, and reference appendices.
- Self-assessment tests, thought/discussion problems, homework problems, and glossaries in each chapter.

This book offers a full account of thermodynamic systems in chemical engineering. It provides a solid understanding of the basic concepts of the laws of thermodynamics as well as their applications with a thorough discussion of phase and chemical reaction equilibria. At the outset the text explains the various key terms of thermodynamics with suitable examples and then thoroughly deals with the virial and cubic equations of state by showing the P-V-T (pressure, molar volume and temperature) relation of fluids. It elaborates on the first and second laws of thermodynamics and their applications with the help of numerous engineering examples. The text further discusses the concepts of exergy, standard property changes of chemical reactions, thermodynamic property relations and fugacity. The book also includes detailed discussions on residual and excess properties of mixtures, various activity coefficient models, local composition models, and group contribution methods. In addition, the text focuses on vapour-liquid and other phase equilibrium calculations, and analyzes chemical reaction equilibria and adiabatic reaction temperature for systems with complete and incomplete conversion of reactants.

key Features ? Includes a large number of fully worked-out examples to help students master the concepts discussed. ? Provides well-graded problems with answers at the end of each chapter to test and foster students' conceptual understanding of the subject. The total number of solved examples and end-chapter exercises in the book are over 600. ? Contains chapter summaries that review the major concepts covered. The book is primarily designed for the undergraduate students of chemical engineering and its related disciplines such as petroleum engineering and polymer engineering. It can also be useful to professionals. The Solution Manual containing the complete worked-out solutions to chapter-end exercises and problems is available for instructors.

For reasons both financial and environmental, there is a perpetual need to optimize the design and operating conditions of industrial process systems in order to improve their performance, energy efficiency, profitability, safety and reliability. However, with most chemical engineering application problems having many variables with complex inter-relationships, meeting these optimization objectives can be challenging. This is where Multi-Objective Optimization (MOO) is useful to find the optimal trade-offs among two or more conflicting objectives. This book provides an overview of the recent developments and applications of MOO for modeling, design and operation of chemical, petrochemical, pharmaceutical, energy and related processes. It then covers important theoretical and computational developments as well as specific applications such as metabolic reaction networks, chromatographic systems, CO<sub>2</sub> emissions targeting for petroleum refining units, ecodesign of chemical processes, ethanol purification and cumene process design.

Multi-Objective Optimization in Chemical Engineering: Developments and Applications is an invaluable resource for researchers and graduate students in chemical engineering as well as industrial practitioners and engineers involved in process design, modeling and optimization.

A brand new book, FUNDAMENTALS OF CHEMICAL ENGINEERING THERMODYNAMICS makes the abstract subject of chemical engineering thermodynamics more accessible to undergraduate students. The subject is presented through a problem-solving inductive (from specific to general) learning approach, written in a conversational and approachable manner. Suitable for either a one-semester course or two-semester sequence in the subject, this book covers thermodynamics in a complete and mathematically rigorous manner, with an emphasis on solving practical engineering problems. The approach taken stresses problem-solving, and draws from best practice engineering teaching strategies. FUNDAMENTALS OF CHEMICAL ENGINEERING THERMODYNAMICS uses examples to frame the importance of the material. Each topic begins with a motivational example that is investigated in context to that topic. This framing of the material is helpful to all readers, particularly to global learners who require big picture insights, and hands-on learners who struggle with abstractions. Each worked example is fully annotated with sketches and comments on the thought process behind the solved problems. Common errors are presented and explained. Extensive margin notes add to the book accessibility as well as presenting opportunities for investigation. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

This book is an exhaustive presentation of the applications of numerical methods in chemical engineering. Intended primarily as a textbook for B.E./B.Tech and M.Tech students of chemical engineering, the book will also be useful for research and development/process professionals in the fields of chemical, biochemical, mechanical and biomedical engineering. The book, now, in its second edition, comprises three parts. Part I on General Chemical Engineering is same as given in the first edition of the book. It explains solving linear and non-linear algebraic equations, chemical engineering thermodynamics problems, initial value problems, boundary value problems and topics related to chemical reaction, dispersion and diffusion as well as steady and transient heat conduction. Whereas, Part II and Part III comprising two chapters and six chapters, respectively, are newly introduced in the present edition. Besides, three appendices covering computer programs have been included. For practice, the book provides students with numerous worked-out examples and chapter-end exercises including their answers.

NEW TO THE SECOND EDITION

- Part II on Fixed Bed Catalytic Reactor consists of solving multiple gas phase reactions in a PFR, diffusion and multiple reactions in a catalytic pellet, and fixed bed catalytic reactor with multiple reactions.
- Part III on Multicomponent Distillation consists of solving vapour-liquid-liquid isothermal flash using NRTL model, adiabatic flash using Wilson model, bubble point method, theta method and Naphtali-Sandholm method for distillation using modified Raoult's law with Wilson activity coefficient model.

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