

Biochemical Engineering Fundamentals By James Lee

The biology, biotechnology, chemistry, pharmacy and chemical engineering students at various university and engineering institutions are required to take the Biochemical Engineering course either as an elective or compulsory subject. This book is written keeping in mind the need for a text book on afore subject for students from both engineering and biology backgrounds. The main feature of this book is that it contains the solved problems, which help the students to understand the subject better. The book is divided into three sections: Enzyme mediated bioprocess, whole cell mediated bioprocess and the engineering principle in bioprocess. Dr. Rajiv Dutta is Professor in Biotechnology and Director, Amity Institute of Biotechnology, Lucknow. He earned his M. Tech. in Biotechnology and Engineering from the Department of Chemical Engineering, IIT, Kharagpur and Ph.D. in Bioelectronics from BITS, Pilani. He has taught Biochemical Engineering and Biophysics to B.E., M.E. and M.Sc. level student carried out advanced research in the area of Ion channels at the Department of Botany at Oklahoma State University, Stillwater and Department of Biological Sciences at Purdue University, West Lafayette, IN. He also holds the position of Nanion Technologies Adjunct Research Professor at Research Triangle Institute, RTP, NC. He had received various awards including JCI Outstanding Young Person of India and ISBEM Dr. Ramesh Gulrajani Memorial Award 2006 for outstanding research in electro

physiology.

Biochemical Engineering Fundamentals McGraw-Hill Science, Engineering & Mathematics

Building up gradually from first principles, this unique introduction to modern thermodynamics integrates classical, statistical and molecular approaches and is especially designed to support students studying chemical and biochemical engineering. In addition to covering traditional problems in engineering thermodynamics in the context of biology and materials chemistry, students are also introduced to the thermodynamics of DNA, proteins, polymers and surfaces. It includes over 80 detailed worked examples, covering a broad range of scenarios such as fuel cell efficiency, DNA/protein binding, semiconductor manufacturing and polymer foaming, emphasizing the practical real-world applications of thermodynamic principles; more than 300 carefully tailored homework problems, designed to stretch and extend students' understanding of key topics, accompanied by an online solution manual for instructors; and all the necessary mathematical background, plus resources summarizing commonly used symbols, useful equations of state, microscopic balances for open systems, and links to useful online tools and datasets.

For Senior-level and graduate courses in Biochemical Engineering, and for programs in Agricultural and Biological Engineering or Bioengineering. This concise yet comprehensive text introduces the essential concepts of bioprocessing-internal

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structure and functions of different types of microorganisms, major metabolic pathways, enzymes, microbial genetics, kinetics and stoichiometry of growth and product information-to traditional chemical engineers and those in related disciplines. It explores the engineering principles necessary for bioprocess synthesis and design, and illustrates the application of these principles to modern biotechnology for production of pharmaceuticals and biologics, solution of environmental problems, production of commodities, and medical applications.

The latest volume in the Advanced Biotechnology series provides an overview of the main product classes and platform chemicals produced by biotechnological processes today, with applications in the food, healthcare and fine chemical industries. Alongside the production of drugs and flavors as well as amino acids, bio-based monomers and polymers and biofuels, basic insights are also given as to the biotechnological processes yielding such products and how large-scale production may be enabled and improved. Of interest to biotechnologists, bio and chemical engineers, as well as those working in the biotechnological, chemical, and food industries.

Comprehensive and practical guide to the selection and design of a wide range of chemical process equipment. Emphasis is placed on real-world process design and performance of equipment. Provides examples of successful applications, with numerous drawings, graphs, and tables to show the functioning and performance of the equipment. Equipment rating forms and manufacturers' questionnaires are collected to

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illustrate the data essential to process design. Includes a chapter on equipment cost and addresses economic concerns. * Practical guide to the selection and design of a wide range of chemical process equipment. Examples of successful, real-world applications are provided. * Fully revised and updated with valuable shortcut methods, rules of thumb, and equipment rating forms and manufacturers' questionnaires have been collected to demonstrate the design process. Many line drawings, graphs, and tables illustrate performance data. * Chapter 19 has been expanded to cover new information on membrane separation. Approximately 100 worked examples are included. End of chapter references also are provided.

This updated edition of an Artech House classic introduces readers to the importance of engineering in medicine. Bioelectrical phenomena, principles of mass and momentum transport to the analysis of physiological systems, the importance of mechanical analysis in biological tissues/ organs and biomaterial selection are discussed in detail. Readers learn about the concepts of using living cells in various therapeutics and diagnostics, compartmental modeling, and biomedical instrumentation. The book explores fluid mechanics, strength of materials, statics and dynamics, basic thermodynamics, electrical circuits, and material science. A significant number of numerical problems have been generated using data from recent literature and are given as examples as well as exercise problems. These problems provide an opportunity for comprehensive understanding of the basic concepts, cutting edge

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technologies and emerging challenges. Describing the role of engineering in medicine today, this comprehensive volume covers a wide range of the most important topics in this burgeoning field. Moreover, you find a thorough treatment of the concept of using living cells in various therapeutics and diagnostics. Structured as a complete text for students with some engineering background, the book also makes a valuable reference for professionals new to the bioengineering field. This authoritative textbook features numerous exercises and problems in each chapter to help ensure a solid understanding of the material.

Gives students of automotive engineering a basic understanding of the principles involved with designing a vehicle and includes details of engines and transmissions, vehicle aerodynamics and computer modelling.

Environmental Engineering: Fundamentals, Sustainability, Design presents civil engineers with an introduction to chemistry and biology, through a mass and energy balance approach. ABET required topics of emerging importance, such as sustainable and global engineering are also covered. Problems, similar to those on the FE and PE exams, are integrated at the end of each chapter. Aligned with the National Academy of Engineering's focus on managing carbon and nitrogen, the 2nd edition now includes a section on advanced technologies to more effectively reclaim nitrogen and phosphorous. Additionally, readers have immediate access to web modules, which address a specific topic, such as water and wastewater treatment. These modules

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include media rich content such as animations, audio, video and interactive problem solving, as well as links to explorations. Civil engineers will gain a global perspective, developing into innovative leaders in sustainable development.

The Maritime Engineering Reference Book is a one-stop source for engineers involved in marine engineering and naval architecture. In this essential reference, Anthony F. Molland has brought together the work of a number of the world's leading writers in the field to create an inclusive volume for a wide audience of marine engineers, naval architects and those involved in marine operations, insurance and other related fields. Coverage ranges from the basics to more advanced topics in ship design, construction and operation. All the key areas are covered, including ship flotation and stability, ship structures, propulsion, seakeeping and maneuvering. The marine environment and maritime safety are explored as well as new technologies, such as computer aided ship design and remotely operated vehicles (ROVs). Facts, figures and data from world-leading experts makes this an invaluable ready-reference for those involved in the field of maritime engineering. Professor A.F. Molland, BSc, MSc, PhD, CEng, FRINA. is Emeritus Professor of Ship Design at the University of Southampton, UK. He has lectured ship design and operation for many years. He has carried out extensive research and published widely on ship design and various aspects of ship hydrodynamics. * A comprehensive overview from best-selling authors including Bryan Barrass, Rawson and Tupper, and David Eyres * Covers basic and advanced material

on marine engineering and Naval Architecture topics * Have key facts, figures and data to hand in one complete reference book

Since the introduction of recombinant human growth hormone and insulin a quarter century ago, protein therapeutics has greatly broadened the horizon of health care. Many patients suffering with life-threatening diseases or chronic dysfunctions, which were medically untreatable not long ago, can attest to the wonder these drugs have achieved. Although the first generation of protein therapeutics was produced in recombinant *Escherichia coli*, most recent products use mammalian cells as production hosts. Not long after the first production of recombinant proteins in *E. coli*, it was realized that the complex tasks of most post-translational modifications on proteins could only be efficiently carried out in mammalian cells. In the 1990s, we witnessed a rapid expansion of mammalian-cell-derived protein therapeutics, chiefly antibodies. In fact, it has been nearly a decade since the market value of mammalian-cell-derived protein therapeutics surpassed that of those produced from *E. coli*. A common characteristic of recent antibody products is the relatively large dose required for effective therapy, demanding larger quantities for the treatment of a given disease. This, coupled with the broadening repertoire of protein drugs, has rapidly expanded the quantity needed for clinical applications. The increasing demand for protein therapeutics has not been met exclusively by construction of new manufacturing plants and increasing total volume capacity. More importantly the productivity of cell culture

processes has been driven upward by an order of magnitude in the past decade. From the bestselling authors of *The Leadership Challenge* and over a dozen award winning leadership books, James M. Kouzes and Barry Z. Posner have written a new book that examines a fundamental question: How do people learn leadership? How do they learn to become leaders? *Learning Leadership: The Five Fundamentals of Becoming an Exemplary Leader* (ISBN: 978-1-119-14428-1; Wiley; May 2016) is a comprehensive guide to unleashing the inner-leader in us all and to building a solid foundation for a lifetime of leadership growth and mastery. The book offers a concrete framework to help individuals of all levels, functions, and backgrounds take charge of their own leadership development and become the best leaders they can be. Arguing that all individuals are born with the capacity to lead, Kouzes and Posner provide readers with a practical series of actions and specific coaching tips for harnessing that capacity and creating a context in which they can excel. Supported by over 30 years of research, from over seventy countries, and with examples from real-world leaders, *Learning Leadership* is a clarion call to unleash the leadership potential that is already present in today's society. According to Kouzes and Posner, "Leadership makes a significant difference in levels of engagement and commitment and is perhaps the most important asset in every organization, yet recent research points to a shortage of leaders. It is a serious global concern. The world needs more exemplary leaders in order to promote high-performing workplaces and inspire feelings of greater self-worth

and meaningfulness. The shortage, however, is not because of the lack of potential talent. The people are out there, the eagerness is out there, and the capability is out there. The shortage results from prevailing myths—myths about talent, strengths, position, self-reliance, and effort—that inhibit the vast majority of leaders from shining and organizations from realizing the full benefits of the talent they already have.” Learning Leadership provides readers with evidence-based strategies to ignite the habit of continuous improvement and the mindset of becoming the best leaders they can be. Emerging leaders, as well as leadership developers, internal and external coaches and trainers, and other human resource professionals will learn from first-hand stories and practical examples so that they can deeply understand and apply the fundamental for becoming the best leaders they can be. Learning Leadership: The Five Fundamentals of Becoming an Exemplary Leader is divided into digestible bite-sized chapters that encourage daily actions to becoming a better leader. Key takeaways from the book include: Believe in Yourself. Believing in oneself is the essential first step in developing leadership competencies. The best leaders are learners, and they can’t achieve mastery until and unless they truly decide that inside them there is a person who can make and difference and learn to be a better leader than they are right now. Aspire to Excel. To become an exemplary leader, people have to determine what they care most about and why they want to lead. Leaders with values-based motivations are the most likely to excel. They also must have a clear image of the kind of leader they want to be

in the future—and the legacy they want to leave for others. **Challenge Yourself.** Challenging oneself is critical to learning leadership. Leaders have to seek new experiences and test themselves. There will be inevitable setbacks and failures along the way that require curiosity, grit, courage, and resilience in order to persist in learning and becoming the best. **Engage Support.** One can't lead alone, and one can't learn alone. It is essential to get support and coaching on the path to achieving excellence. Whether it's family, managers at work, or professional coaches, leaders need the advice, feedback, care, and support of others. **Practice Deliberately.** No one gets better at anything without continuous practice. Exemplary leaders spend more time practicing than ordinary leaders. Simply being in the role of a leader is insufficient. To achieve mastery, leaders must set improvement goals, participate in designed learning experiences, ask for feedback, and get coaching. They also put in the time every day and make learning leadership a daily habit. Kouzes and Posner offer unrivaled insights into what it means to become an exemplary leader in today's world with their original research and over 30 years of experience studying the practices of extraordinary leadership. They show that anyone can become a better leader if they believe in themselves, aspire to excel, challenge themselves, to grow, engage the support of others, and practice deliberately. *Learning Leadership* challenges readers to do the meaningful and disciplined work necessary to becoming the best they can, using a new mindset and toolkit that can make extraordinary things happen. It's not the once-in-a-

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while transformational acts that demonstrate leadership. It's the little things that one does day in and day out that pave the path to greatness.

Part I: Process design -- Introduction to design -- Process flowsheet development -- Utilities and energy efficient design -- Process simulation -- Instrumentation and process control -- Materials of construction -- Capital cost estimating -- Estimating revenues and production costs -- Economic evaluation of projects -- Safety and loss prevention -- General site considerations -- Optimization in design -- Part II: Plant design -- Equipment selection, specification and design -- Design of pressure vessels -- Design of reactors and mixers -- Separation of fluids -- Separation columns (distillation, absorption and extraction) -- Specification and design of solids-handling equipment -- Heat transfer equipment -- Transport and storage of fluids.

Rang & Dale's Pharmacology provides you with all the knowledge you need to get through your pharmacology course and beyond. Drs. Humphrey P. Rang, Maureen M. Dale, James M. Ritter, Rod Flower, and Graeme Henderson present a clear and accessible approach to the analysis of therapeutic agents at the cellular and molecular level through detailed diagrams, full-color illustrations, and pedagogical features. Find and cross-reference information quickly using a color-coded layout that makes navigation easy. Effectively understand and review key concepts through detailed diagrams and full-color illustrations that clarify even the most complex concepts. Reinforce your learning with key points boxes and clinical uses boxes that highlight

crucial information and clinical applications. Apply current best practices and clinical applications through thoroughly updated and revised drug information. Stay current with the latest developments in the field thanks to major updates in chapters such as How Drugs Act; Amino Acid Transmitters; Analgesic Drugs; Antidepressant Drugs; and Drug Addiction, Dependence & Abuse. Tap into comprehensive content tailored to your courses with new and reorganized chapters on Host Defense; Inflammatory Mediators; Pharmacogenetics, Pharmacogenomics & Personalized Medicine; Hydroxytryptamine & The Pharmacy of Migraine; and Purines.

Digital Signal Processing, Second Edition enables electrical engineers and technicians in the fields of biomedical, computer, and electronics engineering to master the essential fundamentals of DSP principles and practice. Many instructive worked examples are used to illustrate the material, and the use of mathematics is minimized for easier grasp of concepts. As such, this title is also useful to undergraduates in electrical engineering, and as a reference for science students and practicing engineers. The book goes beyond DSP theory, to show implementation of algorithms in hardware and software. Additional topics covered include adaptive filtering with noise reduction and echo cancellations, speech compression, signal sampling, digital filter realizations, filter design, multimedia applications, over-sampling, etc. More advanced topics are also covered, such as

adaptive filters, speech compression such as PCM, u-law, ADPCM, and multi-rate DSP and over-sampling ADC. New to this edition: MATLAB projects dealing with practical applications added throughout the book New chapter (chapter 13) covering sub-band coding and wavelet transforms, methods that have become popular in the DSP field New applications included in many chapters, including applications of DFT to seismic signals, electrocardiography data, and vibration signals All real-time C programs revised for the TMS320C6713 DSK Covers DSP principles with emphasis on communications and control applications Chapter objectives, worked examples, and end-of-chapter exercises aid the reader in grasping key concepts and solving related problems Website with MATLAB programs for simulation and C programs for real-time DSP

Methanol: Science and Engineering provides a comprehensive review of the chemistry, properties, and current and potential uses and applications of methanol. Divided into four parts, the book begins with a detailed account of current production methods and their economics. The second part deals with the applications of methanol, providing useful insights into future applications.

Modeling of the various reactor systems is covered in the next section, with final discussions in the book focusing on the economic and environmental impact of this chemical. Users will find this to be a must-have resource for all researchers

and engineers studying alternative energy sources. Provides the latest developments on methanol research Reviews methanol production methods and their economics Outlines the use of methanol as an alternative green transportation fuel Includes new technologies and many new applications of methanol

Treats the battle with Custer from the Indians' point of view, showing how their "victory" was merely a last hurrah for a landless people stripped of their rights. This is a well-rounded handbook of fermentation and biochemical engineering presenting techniques for the commercial production of chemicals and pharmaceuticals via fermentation. Emphasis is given to unit operations fermentation, separation, purification, and recovery. Principles, process design, and equipment are detailed. Environment aspects are covered. The practical aspects of development, design, and operation are stressed. Theory is included to provide the necessary insight for a particular operation. Problems addressed are the collection of pilot data, choice of scale-up parameters, selection of the right piece of equipment, pinpointing of likely trouble spots, and methods of troubleshooting. The text, written from a practical and operating viewpoint, will assist development, design, engineering and production personnel in the fermentation industry. Contributors were selected based on their industrial

background and orientation. The book is illustrated with numerous figures, photographs and schematic diagrams.

Biochemistry: The Molecular Basis of Life is the ideal text for students who do not specialize in biochemistry but who require a strong grasp of biochemical principles. The goal of this edition has been to enrich the coverage of chemistry while better highlighting the biological context. Once concepts and problem-solving skills have been mastered, students are prepared to tackle the complexities of science, modern life, and their chosen professions. Key features

- A review of basic principles
- Chemical and biological principles in lanace
- Real-world relevance
- The most robust problem-solving program available
- Simple, clear illustrations
- Currency
- New to this edition
- 258 additional end-of-chapter revision questions
- New chemistry primer
- New chapter-opening vignettes
- New 'Biochemistry in Perspective' boxes
- Expanded coverage throughout
- In-chapter 'key concept' lists

Process integration has been one of the most active research fields in Biochemical Engineering over the last decade and it will continue to be so if bioprocessing is to become more rational, efficient and productive. This volume outlines what has been achieved in recent years. Written by experts who have made important contributions to the European Science, Foundation Program on

Process Integration in Biochemical Engineering, the volume focuses on the progress made and the major opportunities, and in addition on the limitations and the challenges in bioprocess integration that lie ahead. The concept of bioprocess integration is treated at various levels, including integration at the molecular, biological, bioreactor and plant levels, but also accounting for the integration of separation and mass transfer operations and biology, fluid dynamics and physiology, as well as basic science and process technology. Coulson and Richardson's Chemical Engineering: Volume 3A: Chemical and Biochemical Reactors and Reaction Engineering, Fourth Edition, covers reactor design, flow modelling, gas-liquid and gas-solid reactions and reactors. Captures content converted from textbooks into fully revised reference material Includes content ranging from foundational through technical Features emerging applications, numerical methods and computational tools

This is the 20th Volume in the series Memorial Tributes compiled by the National Academy of Engineering as a personal remembrance of the lives and outstanding achievements of its members and foreign associates. These volumes are intended to stand as an enduring record of the many contributions of engineers and engineering to the benefit of humankind. In most cases, the authors of the tributes are contemporaries or colleagues who had personal

knowledge of the interests and the engineering accomplishments of the deceased. Through its members and foreign associates, the Academy carries out the responsibilities for which it was established in 1964. Under the charter of the National Academy of Sciences, the National Academy of Engineering was formed as a parallel organization of outstanding engineers. Members are elected on the basis of significant contributions to engineering theory and practice and to the literature of engineering or on the basis of demonstrated unusual accomplishments in the pioneering of new and developing fields of technology. The National Academies share a responsibility to advise the federal government on matters of science and technology. The expertise and credibility that the National Academy of Engineering brings to that task stem directly from the abilities, interests, and achievements of our members and foreign associates, our colleagues and friends, whose special gifts we remember in this book.

This book covers trends in modern biotechnology. All aspects of this interdisciplinary technology, where knowledge, methods and expertise are required from Chemistry, Biochemistry, Microbiology, Genetics, Chemical Engineering and Computer Science, are treated. More information as well as the electronic version available at springeronline.com

Analysts, policymakers, scholars, and general readers need to understand the

world's response to Yugoslavia's bloody collapse to build effective policies and prevent future wars in the Balkans. At a time when the failure of cooperation among Western powers shatters faith in the UN, NATO, and the EC to deal with such crises, this book's accessible, balanced perspective provides essential guidance.

Receptors: Models for Binding, Trafficking, and Signaling bridges the gap between chemical engineering and cell biology by lucidly and practically demonstrating how a mathematical modeling approach combined with quantitative experiments can provide enhanced understanding of cell phenomena involving receptor/ligand interactions. In stressing the need for a quantitative understanding of how receptor-mediated cell functions depend on receptor and ligand properties, the book offers comprehensive treatments of both basic and state-of-the-art model frameworks that span the entire spectrum of receptor processes--from fundamental cell surface binding, intracellular trafficking, and signal transduction events to the cell behavioral functions they govern, including proliferation, adhesion, and migration. The book emphasizes mechanistic models that are accessible to experimental testing and includes detailed examples of important contemporary issues. This much-needed book introduces chemical engineers and bioengineers to important problems in receptor biology and

familiarizes cell biologists with the insights that can be gained from engineering analysis and synthesis. As such, chemical engineers, researchers, and advanced students in the fields of biotechnology, biomedical sciences, bioengineering, and molecular cell biology will find this book to be conceptually rich, timely, and useful.

A revised edition of the well-received thermodynamics text, this work retains the thorough coverage and excellent organization that made the first edition so popular. Now incorporates industrially relevant microcomputer programs, with which readers can perform sophisticated thermodynamic calculations, including calculations of the type they will encounter in the lab and in industry. Also provides a unified treatment of phase equilibria. Emphasis is on analysis and prediction of liquid-liquid and vapor-liquid equilibria, solubility of gases and solids in liquids, solubility of liquids and solids in gases and supercritical fluids, freezing point depressions and osmotic equilibria, as well as traditional vapor-liquid and chemical reaction equilibria. Contains many new illustrations and exercises.

The goal of this textbook is to provide first-year engineering students with a firm grounding in the fundamentals of chemical and bioprocess engineering.

However, instead of being a general overview of the two topics, Fundamentals of Chemical and Bioprocess Engineering will identify and focus on specific areas in

which attaining a solid competency is desired. This strategy is the direct result of studies showing that broad-based courses at the freshman level often leave students grappling with a lot of material, which results in a low rate of retention. Specifically, strong emphasis will be placed on the topic of material balances, with the intent that students exiting a course based upon this textbook will be significantly higher on Bloom's Taxonomy (knowledge, comprehension, application, analysis and synthesis, evaluation, creation) relating to material balances. In addition, this book also provides students with a highly developed ability to analyze problems from the material balances perspective, which leaves them with important skills for the future. The textbook consists of numerous exercises and their solutions. Problems are classified by their level of difficulty. Each chapter has references and selected web pages to vividly illustrate each example. In addition, to engage students and increase their comprehension and rate of retention, many examples involve real-world situations. Biochemical Engineering Fundamentals, 2/e, combines contemporary engineering science with relevant biological concepts in a comprehensive introduction to biochemical engineering. The biological background provided enables students to comprehend the major problems in biochemical engineering and formulate effective solutions.

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In the new edition of this highly successful book, Malcolm Hunter and new co-author James Gibbs offer a thorough introduction to the fascinating and important field of conservation biology, focusing on what can be done to maintain biodiversity through management of ecosystems and populations. Starting with a succinct look at conservation and biodiversity, this book progresses to contend with some of the subject's most complex topics, such as mass extinctions, ecosystem degradation, and over exploitation. Discusses social, political, and economic aspects of conservation biology. Thoroughly revised with over six hundred new references and web links to many of the organizations involved in conservation biology, striking photographs and maps. Artwork from the book is available to instructors online at www.blackwellpublishing.com/hunter and by request on CD-ROM.

Phased-Array Radar Design is a text-reference designed for electrical engineering graduate students in colleges and universities as well as for corporate in-house training programs for radar design engineers, especially systems engineers and analysts who would like to gain hands-on, practical knowledge and skills in radar design fundamentals, advanced radar concepts, trade-offs for radar design and radar performance analysis.

"Designed for an introductory course on Biochemical Engineering, this book interweaves bioprocessing with chemical reaction engineering concepts"--Back cover.

This systematically organized and well-balanced book compresses within the covers of a single volume the theoretical principles and techniques involved in bio-separations, also called downstream processing. These techniques are derived from a range of subjects, for example, physical chemistry, analytical chemistry, bio-chemistry, biological science and chemical engineering. Organized in its 15 chapters, the text covers in the first few chapters topics

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related to chemical engineering unit operations such as filtration, centrifugation, adsorption, extraction and membrane separation as applied to bioseparations. The use of chromatography as practiced at laboratory as well as industrial scale operation and related techniques such as gel filtration, affinity and pseudoaffinity chromatography, ion-exchange chromatography, electrophoresis and related methods have been discussed. The important applications of these techniques have also been highlighted.

Key features: Industrially relevant approach to chemical and bio-process control Fully revised edition with substantial enhancements to the theoretical coverage of the subject Increased number and variety of examples Extensively revised homework problems with degree-of-difficulty rating added Expanded and enhanced chapter on model predictive control Self-assessment questions and problems at the end of most sections with answers listed in the appendix Bio-process control coverage: Background and history of bio-processing and bio-process control added to the introductory chapter Discussion and analysis of the primary biosensors used in bio-tech industries added to the chapter on control loop hardware Significant proportion of examples and homework problems in the text deal with bio-processes Section on troubleshooting bio-process control systems included Bio-related process models added to the modeling chapter Supplemental material: Visual basic simulator of process models developed in text Solutions manual Set of PowerPoint lecture slides Collection of process control exams All supplemental material can be found at www.che.ttu.edu/pcoc/software

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