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## Bioprocess Engineering

### Basic Concepts

*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 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.*

## Solutions Manual

### Bioprocess Engineering Principles

### Bioprocess Engineering

### Basic Concepts

*The Leading Introduction to Biochemical and Bioprocess Engineering, Updated with Key Advances in Productivity, Innovation, and Safety Bioprocess Engineering, Third Edition, is an extensive update of the world's leading introductory textbook on biochemical and bioprocess engineering and reflects key advances in productivity, innovation, and safety. The authors review relevant fundamentals of biochemistry, microbiology, and molecular biology, including enzymes, cell functions and growth, major metabolic pathways, alteration of cellular information, and other key topics. They then introduce evolving biological tools for manipulating cell biology more effectively and to reduce costs of bioprocesses. This edition presents major advances in the production of biologicals; highly productive techniques for making heterologous proteins; new commercial applications for both animal and plant cell cultures; key improvements in recombinant DNA microbe engineering; techniques for more consistent authentic post-translational processing of proteins; and other advanced topics. It includes new, improved, or expanded coverage of The role of small RNAs as regulators Transcription, translation, regulation, and differences between prokaryotes and eukaryotes Cell-free processes, metabolic engineering, and protein engineering Biofuels and energy, including coordinated enzyme systems, mixed-inhibition and enzyme-activation kinetics, and two-phase enzymatic reactions Synthetic biology The growing role of genomics and epigenomics Population balances and the Gompertz equation for batch growth and product formation Microreactors for scale-up/scale-down, including rapid scale-up of vaccine production The development of single-use technology in bioprocesses Stem cell technology and utilization Use of microfabrication, nanobiotechnology, and 3D printing techniques Advances in animal and plant cell biotechnology The text makes extensive use of illustrations, examples,*

and problems, and contains references for further reading as well as a detailed appendix describing traditional bioprocesses.

## Bioprocess Engineering

### Kinetics, Sustainability, and Reactor Design

*Newnes Bioprocess Engineering involves the design and development of equipment and processes for the manufacturing of products such as food, feed, pharmaceuticals, nutraceuticals, chemicals, and polymers and paper from biological materials. It also deals with studying various biotechnological processes. "Bioprocess Kinetics and Systems Engineering" first of its kind contains systematic and comprehensive content on bioprocess kinetics, bioprocess systems, sustainability and reaction engineering. Dr. Shijie Liu reviews the relevant fundamentals of chemical kinetics-including batch and continuous reactors, biochemistry, microbiology, molecular biology, reaction engineering, and bioprocess systems engineering- introducing key principles that enable bioprocess engineers to engage in the analysis, optimization, design and consistent control over biological and chemical transformations. The quantitative treatment of bioprocesses is the central theme of this book, while more advanced techniques and applications are covered with some depth. Many theoretical derivations and simplifications are used to demonstrate how empirical kinetic models are applicable to complicated bioprocess systems. Contains extensive illustrative drawings which make the understanding of the subject easy Contains worked examples of the various process parameters, their significance and their specific practical use Provides the theory of bioprocess kinetics from simple concepts to complex metabolic pathways Incorporates sustainability concepts into the various bioprocesses*

### Bioprocess Engineering Principles

*Elsevier The emergence and refinement of techniques in molecular biology has changed our perceptions of medicine, agriculture and environmental management. Scientific breakthroughs in gene expression, protein engineering and cell fusion are being translated by a strengthening biotechnology industry into revolutionary new products and services. Many a student has been enticed by the promise of biotechnology and the excitement of being near the cutting edge of scientific advancement. However, graduates trained in molecular biology and cell manipulation soon realise that these techniques are only part of the picture. Reaping the full benefits of biotechnology requires manufacturing capability involving the large-scale processing of biological material. Increasingly, biotechnologists are being employed by companies to work in co-operation with chemical engineers to achieve pragmatic commercial goals. For many years aspects of biochemistry and molecular genetics have been included in chemical engineering curricula, yet there has been little attempt until recently to teach aspects of engineering applicable to process design to biotechnologists. This textbook is the first to present the principles of bioprocess engineering in a way that is accessible to biological scientists. Other texts on bioprocess engineering currently available assume that the reader already has engineering training. On the other hand, chemical engineering textbooks do not consider examples from bioprocessing, and are written almost exclusively with the petroleum and chemical industries in mind. This publication explains process analysis from an engineering point of view, but refers exclusively to the treatment of biological systems. Over 170 problems and worked examples encompass a wide range of applications, including recombinant cells, plant and animal cell cultures, immobilised catalysts as well as traditional fermentation systems. \* \* First book to present the principles of bioprocess engineering in a way that is accessible to biological scientists \* Explains process analysis from an engineering point of view, but uses worked examples relating to biological systems \* Comprehensive, single-authored \* 170 problems and worked examples encompass a wide range of applications, involving recombinant plant and animal cell cultures, immobilized catalysts, and traditional fermentation systems \* 13 chapters, organized according to engineering sub-disciplines, are grouped in four sections - Introduction, Material and Energy Balances, Physical Processes, and Reactions and Reactors \* Each chapter includes a set of problems and exercises for the student, key references, and a list of suggestions for further reading \* Includes useful appendices, detailing conversion factors, physical and chemical property data, steam tables, mathematical rules, and a list of symbols used \* Suitable for course adoption - follows closely curricula used on most bioprocessing and process biotechnology courses at senior undergraduate and graduate levels.*

### Biochemical Engineering Fundamentals

*McGraw-Hill Science, Engineering & Mathematics 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.*

## Chemical Process Design and Integration

John Wiley & Sons "The book provides a practical guide to chemical process design and integration for students and practicing process engineers in industry"--

## Chemical and Bioprocess Engineering

## Fundamental Concepts for First-Year Students

Springer Science & Business Media 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.

## Engineering Principles in Biotechnology

John Wiley & Sons This book is a short introduction to the engineering principles of harnessing the vast potential of microorganisms, and animal and plant cells in making biochemical products. It was written for scientists who have no background in engineering, and for engineers with minimal background in biology. The overall subject dealt with is process, but the coverage goes beyond the process of biomanufacturing in the bioreactor, and extends to the factory of cell's biosynthetic machinery. Starting with an overview of biotechnology and organism, engineers are eased into biochemical reactions and life scientists are exposed to the technology of production using cells. Subsequent chapters allow engineers to be acquainted with biochemical pathways, while life scientist learn about stoichiometric and kinetic principles of reactions and cell growth. This leads to the coverage of reactors, oxygen transfer and scale up. Following three chapters on biomanufacturing of current and future importance, i.e. cell culture, stem cells and synthetic biology, the topic switches to product purification, first with a conceptual coverage of operations used in bioseparation, and then a more detailed analysis to provide a conceptual understanding of chromatography, the modern workhorse of bioseparation. Drawing on principles from engineering and life sciences, this book is for practitioners in biotechnology and bioengineering. The author has used the material within this book for a course for advanced students in both engineering and life sciences. To this end, problems are provided at the end of each chapter.

## Sustainable Treatment and Reuse of Municipal Wastewater

## For Decision Makers and Practicing Engineers

IWA Publishing In many countries, especially developing countries, many people are lacking access to water and sanitation services and this inadequate service is the main cause of diseases in these countries. Application of appropriate wastewater treatment technologies, which are effective, low cost (in investment, operation, and maintenance), simple to operate, proven technologies, is a key component in any strategy aimed at increasing the coverage of wastewater treatment.

## Chemical Engineering Dynamics

### An Introduction to Modelling and Computer Simulation

John Wiley & Sons *In this book, the modelling of dynamic chemical engineering processes is presented in a highly understandable way using the unique combination of simplified fundamental theory and direct hands-on computer simulation. The mathematics is kept to a minimum, and yet the nearly 100 examples supplied on [www.wiley-vch.de](http://www.wiley-vch.de) illustrate almost every aspect of chemical engineering science. Each example is described in detail, including the model equations. They are written in the modern user-friendly simulation language Berkeley Madonna, which can be run on both Windows PC and Power-Macintosh computers. Madonna solves models comprising many ordinary differential equations using very simple programming, including arrays. It is so powerful that the model parameters may be defined as "sliders", which allow the effect of their change on the model behavior to be seen almost immediately. Data may be included for curve fitting, and sensitivity or multiple runs may be performed. The results can be seen simultaneously on multiple-graph windows or by using overlays. The resultant learning effect of this is tremendous. The examples can be varied to fit any real situation, and the suggested exercises provide practical guidance. The extensive experience of the authors, both in university teaching and international courses, is reflected in this well-balanced presentation, which is suitable for the teacher, the student, the chemist or the engineer. This book provides a greater understanding of the formulation and use of mass and energy balances for chemical engineering, in a most stimulating manner. This book is a third edition, which also includes biological, environmental and food process examples.*

## Chemical Engineering Thermodynamics

Universities Press

## Bioseparations Science and Engineering

Oxford University Press, USA *Preceded by: Bioprocess science and engineering / Roger G. Harrison ... [et al.]. c2003.*

## Solution Manual to Engineering Mathematics

Laxmi Publications, Ltd.

## Fundamentals of Biochemical Engineering

Springer *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.*

# Development of Sustainable Bioprocesses

## Modeling and Assessment

*John Wiley & Sons* Bioprocess technology involves the combination of living matter (whole organism or enzymes) with nutrients under laboratory conditions to make a desired product within the pharmaceutical, food, cosmetics, biotechnology, fine chemicals and bulk chemicals sectors. Industry is under increasing pressure to develop new processes that are both environmentally friendly and cost-effective, and this can be achieved by taking a fresh look at process development; - namely by combining modern process modeling techniques with sustainability assessment methods. *Development of Sustainable Bioprocesses: Modeling and Assessment* describes methodologies and supporting case studies for the evolution and implementation of sustainable bioprocesses. Practical and industry-focused, the book begins with an introduction to the bioprocess industries and development procedures. Bioprocesses and bioproducts are then introduced, together with a description of the unit operations involved. Modeling procedures, a key feature of the book, are covered in chapter 3 prior to an overview of the key sustainability assessment methods in use (environmental, economic and societal). The second part of the book is devoted to case studies, which cover the development of bioprocesses in the pharmaceutical, food, fine chemicals, cosmetics and bulk chemicals industries. Some selected case studies include: citric acid, biopolymers, antibiotics, biopharmaceuticals. Supplementary material provides hands-on materials so that the techniques can be put into practice. These materials include a demo version of SuperPro Designer software (used in process engineering) and models of all featured case studies, excel sheets of assessment methods, Monte Carlo simulations and exercises. Previously available on CD-ROM, the supplementary material can now be accessed via <http://booksupport.wiley.com> by entering the author name, book title or isbn and clicking on the desired entry. This will then give a listing of all the content available for download. Please read any text files before downloading material.

## Biological Reaction Engineering

### Principles, Applications and Modelling with PC Simulation

*Wiley-VCH* This book is the admirable result of ten years' experience in organizing and teaching courses in biological reaction engineering. It gives engineers and scientists the information they need to analyze the behavior of complex biological reactors using mathematical equations and a dynamic simulation computer language. Part I treats the fundamentals of modelling (mass balance equations, involving reaction kinetics and mass-transfer rates), making them readily understandable to those new in the field. Part II gives 45 example problems, complete with models and programs. This book is the first of its kind to include a diskette with a commercial simulation language. The diskette can be run on any DOS personal computer. Users will appreciate how the simulation runs can be interrupted for interactive parameter changes and instructive plotting.

## Separation Process Principles

### With Applications Using Process Simulators

*Wiley Global Education* *Separation Process Principles with Applications Using Process Simulator, 4th EMEA Edition* is the most comprehensive and up-to-date treatment of the major separation operations in the chemical industry. The 4th edition focuses on using process simulators to design separation processes and prepares readers for professional practice.

## Advances in Bioprocess Engineering

## Volume II

*Springer Science & Business Media* Bioprocess engineering has played a key role in biotechnology, contributing towards bringing the exciting new discoveries of molecular and cellular biology into the applied sphere, and in maintaining established processes, some centuries-old, efficient and essential for today's industry. Novel developments and new application areas of biotechnology, along with increasing constraints in costs, product quality, regulatory and environmental considerations, have placed the biochemical engineer at the forefront of new challenges. This second volume of *Advances in Bioprocess Engineering* reflects precisely the multidisciplinary nature of the field, where new and traditional areas of application are nurtured by a better understanding of fundamental phenomena and by the utilization of novel techniques and methodologies. The chapters in this book were written by the invited speakers to the 2nd International Symposium on Bioprocess Engineering, Mazatlan, Mexico, September 1997.

## Bioreactors

### Animal Cell Culture Control for Bioprocess Engineering

*CRC Press* *Bioreactors: Animal Cell Culture Control for Bioprocess Engineering* presents the design, fabrication, and control of a new type of bioreactor meant especially for animal cell line culture. The new bioreactor, called the "see-saw bioreactor," is ideal for the growth of cells with a sensitive membrane. The see-saw bioreactor derives its name from its principle of operation in which liquid columns in either limb of the reactor alternately go up and down. The working volume of the reactor is small, to within 15 L. However, it can easily be scaled up for large production in volume of cell mass in the drug and pharmaceutical industries. The authors describe the principle of operation of the see-saw bioreactor and how to automatically control the bioprocess. They discuss different control strategies as well as the thorough experimental research they conducted on this prototype bioreactor in which they applied a time delay control for yield maximization. To give you a complete understanding of the design and development of the see-saw bioreactor, the authors cover the mathematical model they use to describe the kinetics of fermentation, the genetic algorithms used for deriving the optimal time trajectories of the bioprocess variables, and the corresponding control inputs for maximizing the product yield. One chapter is devoted to the application of time delay control. Following a description of the bioreactor's working setup in the laboratory, the authors sum up their investigation and define the future scope of work in terms of design, control, and software sensors.

### Animal Cell Bioreactors

*Butterworth-Heinemann* *Animal Cell Bioreactors* provides an introduction to the underlying principles and strategies in the in vitro cell culture biotechnology. It addresses engineering aspects such as mass transfer, instrumentation, and control ensuring successful design and operation of animal cell bioreactors. The goal is to provide a comprehensive analysis and review in the advancement of the bioreactor systems for large-scale animal cell cultures. The book is organized into four parts. Part I traces the historical development of animal cell biotechnology. It presents examples of work in progress that seeks to make animal cell biotechnology processes as productive on a cost per unit of product basis as that achieved by other microbial systems. Part II includes chapters dealing with the implications of cell biology in animal cell biotechnology; protein-bound oligosaccharides and their structures; the development of serum-free media and its use in the production of biologically active substances; and the metabolism of mammalian cells. Part III focuses on animal cell cultivation, covering topics such as the fixed bed immobilized culture; three-dimensional microcarriers; and hydrodynamic phenomena in microcarrier cultures. Part IV discusses the design, operation, and control of animal cell bioreactors.

## Bioprocess Technology

### Kinetics and Reactors

*Springer Science & Business Media* This book is based on a 1981 German language edition published by Springer Verlag, Vienna, under the title *Bioprozesstechnik*. Philip Manor has done the translation, for which I am deeply grateful. This book differs from the German edition in many ways besides language. It is substantially enlarged and updated, and examples of computer simulations have been added together with other appendices to make the work both more comprehensive and more practical. This book is the result of over 15 years of experience in teaching and research. It stems from lectures that I

began in 1970 at the Technical University of Graz, Austria, and continued at the University of Western Ontario in London, Canada, 1980; at the Free University of Brussels, 1981; at Chalmers Technical University in G6teborg, Sweden; at the Academy of Sciences in Iena, East Germany; at the "Haus der Technik" in Essen, West Germany, 1982; at the Academy of Science in Sofia, Bulgaria; and at the Technical University of Delft, Netherlands, 1986. The main goals of this book are, first, to bridge the gap that always exists between basic principles and applied engineering practice, second, to enhance the integration between biological and physical phenomena, and, third, to contribute to the internal development of the field of biotechnology by describing the process-oriented field of bioprocess technology.

## Process Scale Bioseparations for the Biopharmaceutical Industry

CRC Press The biopharmaceutical industry has become an increasingly important player in the global economy, and the success of these products depends on the development and implementation of cost-effective, robust and scalable production processes. Bioseparations-also called downstream processing- can be a key source of competitive advantage to biopharmaceutical developers. Process Scale Bioseparations for the Biopharmaceutical Industry brings together scientific principles, empirical approaches, and practical considerations for designing industrial downstream bioprocesses for various classes of biomolecules. Using clear language along with numerous case studies, examples, tables, flow charts, and schematics, the book presents perspectives from experienced professionals involved in purification processes and industrial downstream unit operations. The authors provide useful experimental design strategies and guidelines for developing application-specific process scale bioseparations. Chapter topics include harvest by centrifugation and filtration, expanded bed chromatography, protein refolding, modes of preparative chromatography, methodologies for resin screening, membrane chromatography, protein crystallization, viral filtration, ultrafiltration/diafiltration, implementing post-approval downstream process changes for an antibody product, and future trends. Ideal for both new and experienced scientists in the biopharmaceutical industry and students, Process Scale Bioseparations for the Biopharmaceutical Industry is a comprehensive resource for all topics relevant to industrial process development.

## Bioprocess Technology

MJP Publisher Overview of BioprocessingTypes of FermentationStructure and Anatomy of FermenterTypes of FermenterIsolation and Screening of Industrially Important MicrobesMedia for Industrial FermentationProcess Control in FermentationDownstream ProcessingMicrobial Contamination and Spoilage of FoodGeneral Methods of Preserving FoodProduction of Milk ProductsProduction of Bakery ProductsProduction of Fermented BeveragesSingle Cell ProteinsMushroomVaccinesAntibiotic ProductionIndustrial EnzymesImmobilizationEnzyme KineticsOrganic AcidsVitaminsMicrobial PolysaccharidesBiofertilizersBiopesticidesBioremediation and TransformationBiological Waste TreatmentBiogas ProductionBiofuelsEthanolBiodieselGlossaryReferencesIndex

## Principles of Bioseparations Engineering

World Scientific Publishing Company Bioseparations engineering deals with the scientific and engineering principles involved in large-scale separation and purification of biological products. It is a key component of most chemical engineering/biotechnology/bioprocess engineering programmes. This book discusses the underlying principles of bioseparations engineering written from the perspective of an undergraduate course. It covers membrane based bioseparations in much more detail than some of the other books on bioseparations engineering. Based largely on the lecture notes the author developed to teach the course, this book is especially suitable for use as an undergraduate level textbook, as most other textbooks are targeted at graduate students.

## Encyclopedia of Industrial Biotechnology

Wiley The Encyclopedia of Industrial Biotechnology combines Wiley's acclaimed Encyclopedia of Bioprocess Technology and the Encyclopedia of Cell Technology in order to create a single resource and gateway to the many areas of industrial biotechnology for students, researchers, and technologists. In addition to revising and updating existing articles, the new Encyclopedia of Industrial Biotechnology has been greatly expanded to cover important areas of pharmaceutical and biologics bioprocess technology, including: Production of vaccines Biopharmaceuticals and methods for manufacturing biomaterials Biofabrication for the production of microfluidics Tissue engineering Biosensors Bioelectronics Bioarrays Bio-nanotechnology IDEAL STARTING POINT FOR ANY RESEARCH PROJECT The Encyclopedia of Industrial Biotechnology was published in order to help readers make sense of the vast amounts of information that have been published around the world across a broad array of journals, books, and websites. With its comprehensive coverage, Encyclopedia of Industrial Biotechnology is the ideal starting point for research projects involving any aspect of industrial biological processes, including fermentation, biocatalysis, bioseparation, and biofabrication.

## Discovering Statistics Using IBM SPSS Statistics

*SAGE* With an exciting new look, new characters to meet, and its unique combination of humour and step-by-step instruction, this award-winning book is the statistics lifesaver for everyone. From initial theory through to regression, factor analysis and multilevel modelling, Andy Field animates statistics and SPSS software with his famously bizarre examples and activities. What's brand new: A radical new design with original illustrations and even more colour A maths diagnostic tool to help students establish what areas they need to revise and improve on. A revamped online resource that uses video, case studies, datasets, testbanks and more to help students negotiate project work, master data management techniques, and apply key writing and employability skills New sections on replication, open science and Bayesian thinking Now fully up to date with latest versions of IBM SPSS Statistics©. All the online resources above (video, case studies, datasets, testbanks) can be easily integrated into your institution's virtual learning environment or learning management system. This allows you to customize and curate content for use in module preparation, delivery and assessment. For instructions on how to upload the resources you want, please visit the Instructors' page or alternatively, contact your local SAGE sales representative. Please note that ISBN: 9781526445780 comprises the paperback edition of the Fifth Edition and the student version of IBM SPSS Statistics. More information on this version of the software's features can be found [here](#).

## Putting Biotechnology to Work

### Bioprocess Engineering

*National Academies Press* The ability of the United States to sustain a dominant global position in biotechnology lies in maintaining its primacy in basic life-science research and developing a strong resource base for bioprocess engineering and bioproduct manufacturing. This book examines the status of bioprocessing and biotechnology in the United States; current bioprocess technology, products, and opportunities; and challenges of the future and what must be done to meet those challenges. It gives recommendations for action to provide suitable incentives to establish a national program in bioprocess-engineering research, development, education, and technology transfer.

### Process Control

### Modeling, Design, and Simulation

*Prentice Hall Professional* Process Control: Modeling, Design, and Simulation is the first complete introduction to process control that fully integrates software tools-helping you master critical techniques hands-on, using MATLAB-based computer simulations. Author B. Wayne Bequette includes process control diagrams, dynamic modeling, feedback control, frequency response analysis techniques, control loop tuning, and start-to-finish chemical process control case studies.

## Principles and Applications of Environmental Biotechnology for a Sustainable Future

*Springer* This textbook on Environmental Biotechnology not only presents an unbiased overview of the practical biological approaches currently employed to address environmental problems, but also equips readers with a working knowledge of the science that underpins them. Starting with the fundamentals of biotechnology, it subsequently provides detailed discussions of global environmental problems including microbes and their interaction with the environment, xenobiotics and their remediation, solid waste management, waste water treatment, bioreactors, biosensors, biomining and biopesticides. This book also covers renewable and non-renewable bioenergy resources, biodiversity and its conservation, and approaches to monitoring biotechnological industries, genetically modified microorganism and foods so as to increase awareness. All chapters are written in a highly accessible style, and each also includes a short bibliography for further research. In summary this textbook offers a valuable asset, allowing students, young researchers and professionals in the biotechnology industry to grasp the basics of environmental biotechnology.

# Fluid Mechanics for Chemical Engineers with Microfluidics and CFD

## FLUID MECH CHEM ENGS \_c2

Prentice Hall *The Chemical Engineer's Practical Guide to Contemporary Fluid Mechanics* Since most chemical processing applications are conducted either partially or totally in the fluid phase, chemical engineers need a strong understanding of fluid mechanics. Such knowledge is especially valuable for solving problems in the biochemical, chemical, energy, fermentation, materials, mining, petroleum, pharmaceuticals, polymer, and waste-processing industries. *Fluid Mechanics for Chemical Engineers, Second Edition, with Microfluidics and CFD*, systematically introduces fluid mechanics from the perspective of the chemical engineer who must understand actual physical behavior and solve real-world problems. Building on a first edition that earned Choice Magazine's Outstanding Academic Title award, this edition has been thoroughly updated to reflect the field's latest advances. This second edition contains extensive new coverage of both microfluidics and computational fluid dynamics, systematically demonstrating CFD through detailed examples using FlowLab and COMSOL Multiphysics. The chapter on turbulence has been extensively revised to address more complex and realistic challenges, including turbulent mixing and recirculating flows. Part I offers a clear, succinct, easy-to-follow introduction to macroscopic fluid mechanics, including physical properties; hydrostatics; basic rate laws for mass, energy, and momentum; and the fundamental principles of flow through pumps, pipes, and other equipment. Part II turns to microscopic fluid mechanics, which covers Differential equations of fluid mechanics Viscous-flow problems, some including polymer processing Laplace's equation, irrotational, and porous-media flows Nearly unidirectional flows, from boundary layers to lubrication, calendring, and thin-film applications Turbulent flows, showing how the  $k/\epsilon$  method extends conventional mixing-length theory Bubble motion, two-phase flow, and fluidization Non-Newtonian fluids, including inelastic and viscoelastic fluids Microfluidics and electrokinetic flow effects including electroosmosis, electrophoresis, streaming potentials, and electroosmotic switching Computational fluid mechanics with FlowLab and COMSOL Multiphysics *Fluid Mechanics for Chemical Engineers, Second Edition, with Microfluidics and CFD*, includes 83 completely worked practical examples, several of which involve FlowLab and COMSOL Multiphysics. There are also 330 end-of-chapter problems of varying complexity, including several from the University of Cambridge chemical engineering examinations. The author covers all the material needed for the fluid mechanics portion of the Professional Engineer's examination. The author's Web site, [www.engin.umich.edu/~fmche/](http://www.engin.umich.edu/~fmche/), provides additional notes on individual chapters, problem-solving tips, errata, and more.

## Cell and Tissue Reaction Engineering

Springer Science & Business Media The completion of the Human Genome Project and the rapid progress in cell biology and biochemical engineering, are major forces driving the steady increase of approved biotech products, especially biopharmaceuticals, in the market. Today mammalian cell products ("products from cells"), primarily monoclonals, cytokines, recombinant glycoproteins, and, increasingly, vaccines, dominate the biopharmaceutical industry. Moreover, a small number of products consisting of in vitro cultivated cells ("cells as product") for regenerative medicine have also been introduced in the market. Their efficient production requires comprehensive knowledge of biological as well as biochemical mammalian cell culture fundamentals (e.g., cell characteristics and metabolism, cell line establishment, culture medium optimization) and related engineering principles (e.g., bioreactor design, process scale-up and optimization). In addition, new developments focusing on cell line development, animal-free culture media, disposables and the implications of changing processes (multi-purpose facilities) have to be taken into account. While a number of excellent books treating the basic methods and applications of mammalian cell culture technology have been published, only little attention has been afforded to their engineering aspects. The aim of this book is to make a contribution to closing this gap; it particularly focuses on the interactions between biological and biochemical and engineering principles in processes derived from cell cultures. It is not intended to give a comprehensive overview of the literature. This has been done extensively elsewhere.

## Principles of Fermentation Technology

Elsevier This second edition has been thoroughly updated to include recent advances and developments in the field of fermentation technology, focusing on industrial applications. The book now covers new aspects such as recombinant DNA techniques in the improvement of industrial micro-organisms, as well as including comprehensive information on fermentation media, sterilization procedures, inocula, and fermenter design. Chapters on effluent treatment and fermentation economics are also incorporated. The text is supported by plenty of clear, informative diagrams. This book is of great interest to final year and post-graduate students of applied biology, biotechnology, microbiology, biochemical and chemical engineering.

## Recent Advances in Biotechnology

Springer Science & Business Media In last decades rapid scientific and engineering developments have been occurring within the context of Biotechnology. If the World Economy is to benefit fully from the advances in biosciences and biochemical engineering, it must be able to focus new knowledge on commercially appropriate targets. Modern Biotechnology is a mixture of far reaching innovation superimposed on an industrial background and it represents a means of production with bright prospects, challenging problems and stimulating competition. This NATO Advanced Study Institute on "RECENT ADVANCES IN INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY" held between September 16-27, 1991 in KuşEtdasI was the first ASI on Biotechnology :Ln Turkey. It was aiming to provide an updated overview of the fundamental principles, novel application areas and impact of Biotechnology on international economy. Recent developments in the field of Biotechnology have been thoroughly discussed, concentrating on various interdisciplinary aspects. The illain lectures presented at the Institute covered both scientific and commercial aspects of new developments in biotechnology and discussed the possible ways of meeting the challenges of the industry. The main lectures were supplemented by Oral 2nd Poster Presentations. Thus, this volume is comprised of three sections. Part I contains the i~vited lectures and Part II oral presentations. Exte~ded abstracts of poster presentations have been included in Part III to provide a more comprehensive coverage of the ASI.

## Techniques of Model-based Control

Prentice Hall Professional Annotation In this book, two of the field's leading experts bring together powerful advances in model-based control for chemical process engineering. From start to finish, Coleman Brosilow and Babu Joseph introduce practical approaches designed to solve real-world problems -- not just theory. The book contains extensive examples and exercises, and an accompanying CD-ROM contains hands-on MATLAB files that supplement the examples and help readers solve the exercises -- a feature found in no other book on the topic.

## Kinetics of Chemical Processes

## Butterworth-Heinemann Series in Chemical Engineering

Elsevier Kinetics of Chemical Processes details the concepts associated with the kinetic study of the chemical processes. The book is comprised of 10 chapters that present information relevant to applied research. The text first covers the elementary chemical kinetics of elementary steps, and then proceeds to discussing catalysis. The next chapter tackles simplified kinetics of sequences at the steady state. Chapter 5 deals with coupled sequences in reaction networks, while Chapter 6 talks about autocatalysis and inhibition. The seventh chapter describes the irreducible transport phenomena in chemical kinetics. The next two chapters discuss the correlations in homogenous kinetics and heterogeneous catalysis, respectively. The last chapter covers the analysis of reaction networks. The book will be of great use to students, researchers, and practitioners of scientific disciplines that deal with chemical reaction, particularly chemistry and chemical engineering.

## Engineering Ethics: Concepts and Cases

Cengage Learning Bridging the gap between theory and practice, ENGINEERING ETHICS, Fifth Edition, will help you quickly understand the importance of your conduct as a professional and how your actions can affect the health, safety, and welfare of the public. ENGINEERING ETHICS, Fifth Edition, provides dozens of diverse engineering cases and a proven and structured method for analyzing them; practical application of the Engineering Code of Ethics; focus on critical moral reasoning as well as effective organizational communication; and in-depth treatment of issues such as sustainability, acceptable risk, whistle-blowing, and globalized standards for engineering. Additionally, a new companion website offers study questions, self-tests, and additional case studies. Available with InfoTrac Student Collections <http://gocengage.com/infotrac>. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

## Solid-State Fermentation Bioreactors

## Fundamentals of Design and Operation

*Springer Science & Business Media* This concise professional reference provides a fundamental framework for the design and operation of solid-state fermentation bioreactors, enabling researchers currently working at laboratory scale to scale up their processes. The authors survey bioreactor types in common use, and describe in depth how to plan a project, and model heat transfer phenomena. The book includes case studies, and a review of practical issues involved in bioreactor performance.

## Introduction to Biotechnology

Thoroughly updated for currency and with exciting new practical examples throughout, this popular text provides the tools, practice, and basic knowledge for success in the biotech workforce. With its balanced coverage of basic cell and molecular biology, fundamental techniques, historical accounts, new advances, and hands-on applications, the Third Edition emphasizes the future of biotechnology and the biotechnology student's role in that future. Two new features-Forecasting the Future, and Making a Difference-along with several returning hallmark features, support the new focus.

## Basic Principles and Calculations in Chemical Engineering

*FT Press* 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.