Downstream Process Technology A New Horizon In Biotechnology

This book will update the original edition published in 1997. Since the publication of the first edition, the biotechnology and biologics industries have gained extensive knowledge and experience in downstream processing using chromatography and other technologies associated with recovery and purification unit operations. This book will tie that experience together for the next generation of readers. Updates include: - sources and productivity - types of products made today - experiences in clinical and licensed products - economics - current status of validation - illustrations and tables - automated column packing - automated systems New topics include: - the use of disposables - multiproduct versus dedicated production - design principles for chromatography media and filters - ultrafiltration principles and optimization - risk assessments - characterization studies - design space - platform technologies - process analytical technologies (PATs) - biogenerics - comparability assessments Key Features: - new approaches to process optimiaztion - use of patform technologies - applying risk assessment to process design

The current book gives an excellent insight into downstream processing technology and explains how to establish a successful strategy for an efficient recovery, isolation and purification of biosynthetic products. In addition to the overview of purification steps and unit operations, the authors provide practical information on capital and operating costs related to downstream processing.

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 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.

High Value Processing is concerned with all the processes and activities of converting raw materials and commodity materials into valuable products required by manufacturers or the end consumer. Efficient processing of raw materials and commodity goods is of great significance for continuing economic welfare. There is a need to develop products that have high value in world markets, and therefore people must understand fully the properties of materials as diverse as food, wood, metals, plastics and fuel. Advanced technologies and knowledge are required to design, manufacture and process these materials into high-value products. It is also important to understand the properties of these high-value products and how they will interact with their environment, whether it be within the body or in the atmosphere. This book will serve industrial and other activities where material is undergoing a change, whether that change is chemical, biochemical or physical. Improving the understanding of how to prepare feed materials, how to make reactions occur, separating and purifying products, controlling wastes, minimizing energy usage, and ultimately adding value to the raw materials used to produce something useful to people is an essential aspect to this composition. This book reads more as a single authored book with fully integrated chapters than as one compiled by editors, having benefited directly from the discussions by true experts in their fields.

UPSTREAM AND DOWNSTREAM PROCESSING OF BIOPRODUCTS

Biopharmaceutical Processing

Design, Development and Application of High and Low-Resolution Methods

Downstream Process Technology: A New Horizon In Biotechnology

Natural Gas Processing from Midstream to Downstream

Innovative Technologies and Methods

The challenge of bioseparations is to isolate and purify identified products from the dilute product broth produced from cell culture. Innovation in bioseparations technology is increasingly driven by the requirements imposed by the growing importance of production on a process scale of injectable-grade products, and economic pressures to improve the efficiency of downstream processing. As in other areas of technical change, science does not necessarily precede new technology: progress results from a complex and messy mixture of advances in understanding, ingenious ideas, novel techniques and chance discoveries. What is certain is that close interaction between academics and practitioners, biological scientists and process engineers is needed to solve the problems of bioseparations. The Second International Conference on Separations for Biotechnology at Reading, UK, in September 1990 set out to provide a critical multidisciplinary forum for the discussion of bioseparations. This volume contains the papers presented at the meeting. The meeting was organised around six themes with oral and poster presentations on the science and practice of bioseparations technology, and the same structure has been kept for this book. We have also included the texts of the keynote review paper by Professor Alan Michaels and the introductory review papers specially commissioned for the conference. Within each part of this book the review paper is followed by the contributed papers grouped alphabetically by their first author. All the original papers published here were accepted for publication after scientific refereeing.

On July 30-31, 2018, the National Academies of Sciences, Engineering, and Medicine held a workshop titled Continuous Manufacturing for the Modernization of Pharmaceutical Production. This workshop discussed the business and regulatory concerns associated with adopting continuous manufacturing techniques to produce biologics such as enzymes, monoclonal antibodies, and vaccines. The participants also discussed specific challenges for integration across the manufacturing system, including upstream and downstream processes, analytical techniques, and drug product development. The workshop addressed these challenges broadly across the biologics domain but focused particularly on drug categories of greatest FDA and industrial interest such as monoclonal antibodies and vaccines. This publication summarizes the presentations and discussions from the workshop.

Since sterile filtration and purification steps are becoming more prevalent and critical within medicinal drug manufacturing, the third edition of Filtration and Purification in the Biopharmaceutical Industry greatly expands its focus with extensive new material on the critical role of purification and advances in filtration science and technology. It provides state-of-the-science information on all aspects of bioprocessing including the current methods, processes, technologies and equipment. It also covers industry standards and regulatory requirements for the pharmaceutical and biopharmaceutical industries. The book is an essential, comprehensive source for all involved in filtration and purification practices, training and compliance. It describes such technologies as viral retentive filters, membrane chromatography, downstream processing, cell harvesting, and sterile filtration. Features: Addresses recent biotechnology-related processes and advanced technologies such as viral retentive filters, membrane chromatography, downstream processing, cell harvesting, and sterile filtration of medium, buffer and end product Presents detailed updates on the latest FDA and EMA regulatory requirements involving filtration and purification practices, as well as discussions on best practises in filter integrity testing Describes current industry quality standards and validation requirements and provides guidance for compliance, not just from an end-user perspective, but also supplier requirement It discusses the advantages of single-use process technologies and the qualification needs Sterilizing grade filtration qualification and process validation is presented in detail to gain the understanding of the regulatory needs

The book has been compilated by highly experienced contributors in the field of pharmaceutical and biopharmaceutical processing. Each specific topic has been thoroughly examined by a subject matter expert.

This book review series presents current trends in modern biotechnology. The aim is to cover all aspects of this interdisciplinary technology where knowledge, methods and expertise are required from chemistry, biochemistry, microbiology, genetics, chemical engineering and computer science. Volumes are organized topically and provide a comprehensive discussion of developments in the respective field over the past 3-5 years. The series also discusses new discoveries and applications. Special volumes are dedicated to selected topics which focus on new biotechnological products and new processes for their synthesis and purification. In general, special volumes are edited by well-known guest editors. The series editor and publisher will however always be pleased to receive suggestions and supplementary information. Manuscripts are accepted in English.

Biochemical Engineering and Biotechnology

Process Scale Purification of Antibodies

Bioprocess Engineering

Downstream Processing of Proteins

New Bioprocessing Strategies: Development and Manufacturing of Recombinant Antibodies and Proteins

Process Development and Scale-Up

In Downstream Processing of Proteins: Methods and Protocols, Mohamed A. Desai and a team of experienced biotechnologists review both conventional and novel isolation techniques used in industrial applications for the downstream processing of protein molecules. These techniques include primary and secondary separations during the isolation of biomolecules, as well as unique laboratory-scale research methods with a potential for scale-up. Also treated are the various strands of the downstream biological process essential for a successful product license application, including both the validation of DSP stages, and the design and validation of viral clearance stages during the purification process. Downstream Processing of Proteins: Methods and Protocols provides scientists everywhere, but particularly in the biopharmaceutical and biotechnology industry, with a much-needed introduction to this critical technology. Every bioprocess scientist and engineer working to design and validate biological processes for novel proteins-and successfully apply for their new product licenses-will find this important book an eminently practical resource.

Microalgae can be future resource for industrial biotechnology In current energy crisis era, microalgae are under tremendous research focus for the production of biodiesel due to their high photosynthetic efficiency, growth rate and high lipid content compared to territorial plants. However, the large-scale production of algal biomass and downstream processing of harvested algae towards bio-fuels are facing several challenges from economic viability perspective. Apart from bio-fuels, the microalgae synthesize number of bio-molecules such as pigments (e.g., chlorophyll, carotenoid), protein (e.g., lectin, phycobiliprotein), and carbohydrates (e.g., agar, carrageenan, alginate, fucodian) which are available in the various forms of microalgal products. Therefore, developing a strategy for large-scale production and use of algal biomass for the co-production of these value-added macromolecules is thus imperative for the improvement of the economics of algal biorefinery. In the above context, this book covers three major areas (i) commercial-scale production of bio-molecules from microalgae, (ii) sustainable approach for industrial-scale operation, and (iii) optimization of downstream processes. Each of these sections is composed of several chapters written by the renowned academicians/industry experts. Furthermore, in this book, a significant weightage is given to the industry experts (around 50%) to enrich the industrial perspectives. We hope that amalgamate of fundamental knowledge from academicians and applied research information from industry experts will be useful for forthcoming implementation of a sustainable integrated microalgal biorefinery. This book highlights following. Explores biomolecules from microalgae and their applications Discusses microalgae cultivations and harvesting Examines downstream processing of biomolecules Explores sustainable integrated approaches for industrial scale operations Examines purification techniques specific for microalgal proteins, Omega 3 fatty Acids, carbohydrates, and pigments

Proteins are the most diverse group of biologically important substances. With the recent technological advances in the genomics area and the efforts in proteomics research, the rate of discovery for new proteins with unknown structure and function has increased. These proteins generated from genomic approaches present enormous opportunities for research and industrial application. Protein Downstream Processing: Design, Development and Application of High and Low-Resolution Methods is a compilation of chapters within the exciting area of protein purification designed to give the laboratory worker the information needed to design and implement a successful purification strategy. It presents reliable and robust protocols in a concise form, emphasizing the critical aspects on practical problems and questions encountered at the lab bench. Written in the successful Methods in Molecular Biology series format, chapters include introductions to their respective topics, lists of the necessary materials and reagents, step-by-step, readily reproducible protocols and notes on troubleshooting and avoiding known pitfalls. Authoritative and easily accessible, Protein Downstream Processing: Design, Development and Application of High and Low-Resolution Methods will be an ideal source of scientific information to advanced students, junior researchers, and scientists involved in health sciences, cellular and molecular biology, biochemistry, and biotechnology and other related areas in both academia and industry.

Authoritative guide to the principles, characteristics, engineering aspects, economics, and applications of disposables in the manufacture of biopharmaceuticals The revised and updated second edition of Single-Use Technology in Biopharmaceutical Manufacture offers a comprehensive examination of the most-commonly used disposables in the manufacture of biopharmaceuticals. The authors—noted experts on the topic—provide the essential information on the principles, characteristics, engineering aspects, economics, and applications. This authoritative guide contains the basic knowledge and information about disposable equipment. The author also discusses biopharmaceuticals' applications through the lens of case studies that clearly illustrate the role of manufacturing, quality assurance, and environmental influences. This updated second edition revises existing information with recent developments that have taken place since the first edition was published. The book also presents the latest advances in the field of single-use technology and explores topics including applying single-use devices for microorganisms, human mesenchymal stem cells, and T-cells. This important book: • Contains an updated and end-to-end view of the development and manufacturing of single-use biologics • Helps in the identification of appropriate disposables and relevant vendors • Offers illustrative case studies that examine manufacturing, quality assurance, and environmental influences • Includes updated coverage on cross-functional/transversal dependencies, significant improvements made by suppliers, and the successful application of the single-use technologies Written for biopharmaceutical manufacturers, process developers, and biological and chemical engineers, Single-Use Technology in Biopharmaceutical Manufacture, 2nd Edition provides the information needed for professionals to come to an easier decision for or against disposable alternatives and to choose the appropriate system.

In Biologics Production

Recovery and Purification

Protein Chromatography

Downstream Processing

Biomass and Biofuels from Microalgae

Methods and Protocols

This book has been assembled with the hope of being an authoritative, comprehensive, conceptually sound and highly informative compilation of recent advances describing the concepts of bioengineering in the field of microbiology. It comprises of seven chapters written by eminent authors in their respective fields. Topics included deal with the significant advancement of microbial technology with emphasis on drug delivery strategies for healthcare products, vaccine delivery, biotransformation approaches to generate new molecules, upstream/downstream processing of biopharmaceuticals. It serves as excellent reference material for researchers, students and academicians in the fields of biotechnology, microbiology and pharmaceutical sciences.

Biopharmaceutical Processing: Development, Design, and Implementation of Manufacturing Processes covers bioprocessing from cell line development to bulk drug substances. The methods and strategies described are essential learning for every scientist, engineer or manager in the biopharmaceutical and vaccines industry. The integrity of the bioprocess ultimately determines the quality of the product in the biotherapeutics arena, and this book covers every stage including all technologies related to downstream purification and upstream processing fields. Economic considerations are included throughout, with recommendations for lowering costs and improving efficiencies. Designed for quick reference and easy accessibility of facts, calculations and guidelines, this book is an essential tool for industrial scientists and managers in the biopharmaceutical industry. Offers a comprehensive, go-to reference for daily work decisions Covers both upstream and downstream processes Includes case studies that emphasize financial outcomes Presents summaries, decision grids, graphs and overviews for quick reference

The last two decades have seen a phenomenal growth of the field of genetic or biochemical engineering and have witnessed the development and ultimately marketing of a variety of products-typically through the manipulation and growth of different types of microorganisms, followed by the recovery and purification of the associated products. The engineers and biotechnologists who are involved in the full-scale process design of such facilities must be familiar with the variety of unit operations and equipment and the applicable regulatory requirements. This book describes current commercial practice and will be useful to those engineers working in this field in the design, construction and operation of pharmaceutical and biotechnology plants. It will be of help to the chemical or pharmaceutical engineer who is developing a plant design and who faces issues such as: Should the process be batch or continuous or a combination of batch and continuous? How should the optimum process design be developed? Should one employ a new revolutionary separation which could be potentially difficult to validate or use accepted technology which involves less risk? Should the process be run with ingredients formulated from water for injection, deionized water, or even filtered tap water? Should any of the separations be run in cold rooms or in glycol jacketed lines to minimize microbial growth where sterilization is not possible? Should the process equipment and lines be designed to be sterilized in-place, cleaned-in-place, or should every piece be broken down, cleaned and autoclaved after every turn?

DOWNSTREAM INDUSTRIAL BIOTECHNOLOGY An affordable, easily accessible desk reference on biomanufacturing, focused on downstream recovery and purification Advances in the fundamental knowledge surrounding biotechnology, novel materials, and advanced engineering approaches continue to be translated into bioprocesses that bring new products to market at a significantly faster pace than most other industries. Industrial scale biotechnology and new manufacturing methods are revolutionizing medicine, environmental monitoring and remediation, consumer products, food production, agriculture, and forestry, and continue to be a major area of research. The downstream stage in industrial biotechnology refers to recovery, isolation, and purification of the microbial products from cell debris, processing medium and contaminating biomolecules from the upstream process into a finished product such as biopharmaceuticals and vaccines. Downstream process design has the greatest impact on overall biomanufacturing cost because not only does the biochemistry of different products (e.g., peptides, proteins, hormones, antibiotics, and complex antigens) dictate different methods for the isolation and purification of these products, but contaminating byproducts can also reduce overall process yield, and may have serious consequences on clinical safety and efficacy. Therefore downstream separation scientists and engineers are continually seeking to eliminate, or combine, unit operations to minimize the number of process steps in order to maximize product recovery at a specified concentration and purity. Based on Wiley's Encyclopedia of Industrial Biotechnology: Bioprocess, Bioseparation, and Cell Technology, this volume features fifty articles that provide information on down- stream recovery of cells and protein capture; process development and facility design; equipment; PAT in downstream processes; downstream cGMP operations; and regulatory compliance. It covers: Cell wall disruption and lysis Cell recovery by centrifugation and filtration Large-scale protein chromatography Scale down of biopharmaceutical purification operations Lipopolysaccharide removal Porous media in biotechnology Equipment used in industrial protein purification Affinity chromatography Antibody purification, monoclonal and polyclonal Protein aggregation, precipitation and crystallization Freeze-drying of biopharmaceuticals Biopharmaceutical facility design and validation Pharmaceutical bioburden testing Regulatory requirements Ideal for graduate and advanced undergraduate courses on biomanufacturing, biochemical engineering, biopharmaceutical facility design, biochemistry, industrial microbiology, gene expression technology, and cell culture technology, Downstream Industrial Biotechnology is also a highly recommended resource for industry professionals and libraries.

Continuous Manufacturing for the Modernization of Pharmaceutical Production

Bioseparations

Process Intensification in the Manufacturing of Biotherapeutics

Principles of Downstream Techniques in Biological and Chemical Processes

Downstream Industrial Biotechnology

Biochemical Engineering Management

With contributions from biotechnologists and bioengineers, this ready reference describes the state of the art in industrial biopharmaceutical production, with a strong focus on continuous processes. Recent advances in single-use technology as well as application guidelines for all types of biopharmaceutical products, from vaccines to antibodies, and from bacterial to insect to mammalian cells are covered. The efficiency, robustness, and quality control of continuous production processes for biopharmaceuticals are reviewed and compared to traditional batch processes for a range of different production systems.

This book provides an extensive overview of the latest research in environmentally benign integrated bioprocess technology. The cutting edge bioprocess technologies highlighted in the book include bioenergy from lignocellulose materials, biomass gasification, ethanol, butanol, biodiesel from agro waste, enzymatic bioprocess technology, food fermentation with starter cultures, and intellectual property rights for bioprocesses. This book further addresses niche technologies in bioprocesses that broadens readers understanding of downstream processing for bio products and membrane technology for bioprocesses. The latest developments in biomass and bioenergy technology are reviewed exhaustively, including IPR rights, nanotechnology for bioenergy products, biomass gasification, and biomass combustion. This is an ideal book for scientists, engineers, students, as well as members of industry and policy-makers. This book also: Addresses

cutting-edge technologies in bioprocesses Broadens readers understanding of metabolic engineering, downstream processing for bioproducts, and membrane technology for bioprocesses Reviews exhaustively the latest developments in biomass and bioenergy technology, including nanotechnology for bioenergy products, biomass gasification, biomass combustion, and more

This book introduces fundamental principles and practical application of techniques used in the scalable production of biopharmaceuticals with animal cell cultures. A broad spectrum of subjects relevant to biologics production and manufacturing are reviewed, including the generation of robust cell lines, a survey of functional genomics for a better understanding of cell lines and processes, as well as advances in regulatory compliant upstream and downstream development. The book is an essential reference for all those interested in translational animal cell-based pharmaceutical biotechnology.

Microorganisms have been exploited for many centuries for the production of fermented foods and beverages and for bread-making. The production of alcoholic beverages using microbes was the first major industrialized process. The technology developed for large-scale brewing was adapted for other anaerobic processes such as acetone and butanol in the early 1900s. With the discovery of penicillins, rapid developments were made in the technology of submerged culture fermentation of aerobic microorganisms under controlled conditions. The advancements in microbiology and process biochemistry improved our ability to harness the potential of microorganisms through improved bioprocessing methods to manufacture new products with economic viability. Microbial derived bioproducts have been gaining importance in the food, pharmaceutical, textile, leather, cosmetic and chemical industries, and most important among them are therapeutic proteins and peptides, enzymes, antigens, vaccines, antibiotics, drugs, etc.Not all microbial production processes involve culture of the organism in liquid medium. Instead, the organism can be grown on the surface of a solid substrate. Solid substrate (or solid state) fermentation (SSF) is an established traditional technology in many countries, producing edible mushrooms, fungal- fermented foods and soy sauce. Before the development of processes in liquid culture, citric acid and some microbial enzymes were produced by SSF. Carbon composting is also a form of SSF.

Advances in Bioprocess Technology

Review of Unit Operations from R&D to Production: Impacts of Upstream and Downstream Process Decisions

Development of Sustainable Bioprocesses

Filtration and Purification in the Biopharmaceutical Industry, Third Edition

Continuous Biomanufacturing

Protein Downstream Processing

Bioprocess Engineering: Downstream Processing is the first book to present the principles of bioprocess engineering, focusing on downstream bioprocessing. It aims to provide the latest bioprocess technology and explain process analysis from an engineering point of view, using worked examples related to biological systems. This book introduces the commonly used technologies for downstream processing of biobased products. The covered topics include centrifugation, filtration, membrane separation, reverse osmosis, chromatography, biosorption, liquid-liquid separation, and drying. The basic principles and mechanism of separation are covered in each of the topics, wherein the engineering concept and design are emphasized. This book is aimed at bioprocess engineers and professionals who wish to perform downstream processing for their feedstock, as well as students.

Process Intensification in the Manufacturing of Biotherapeutics, Volume 59 in the Advances in Chemical Engineering series, highlights new advances in the field with this new volume presenting interesting chapters on topics such as Evolution and design of continuous bioreactors for the production of biologics, Continuous countercurrent chromatography for the downstream processing of bioproducts: A focus on flow-through technologies Application of multicolumn countercurrent solvent gradient purification to the polishing of therapeutic proteins, Continuous precipitation technologies for the recovery of bioproducts, Continuous Recovery and Purification of Bioproducts on the Basis of Adsorption Technology, General Platform for Development of Integrated Continuous Downstream Processes, and more Provides the authority and expertise of leading contributors from an international board of authors Presents the latest release in the Advances in Chemical Engineering serials " /li> Updated release includes the latest information on Process Intensification in the Manufacturing of Biotherapeutics

An all-in-one practical guide on how to efficiently use chromatographic separation methods Based on a training course that teaches the theoretical as well as practical aspects of protein bioseparation to bioprocess professionals, this fully updated and revised new edition offers comprehensive coverage of continuous chromatography and provides readers with many relevant examples from the biopharmaceutical industry. Divided into two large parts, Protein Chromatography: Process Development and Scale-Up, Second Edition presents all the necessary knowledge for effective process development in chromatographic bioseparation, both on small and large scale. The first part introduces chromatographic theory, including process design principles, to enable the reader to rationalize the set-up of a bioseparation process. The second part illustrates by way of case studies and sample protocols how the theory learned in the first part may be applied to real-life problems. Chapters look at: Downstream Processing of Biotechnology Products; Chromatography Media; Laboratory and Process Columns and Equipment; Adsorption Equilibrium; Rate Processes; and Dynamics of Chromatography Columns. The book closes with chapters on: Effects of Dispersion and Rate Processes on Column Performance; Gradient Elution Chromatography; and Chromatographic Column Design and Optimization. -Presents the most pertinent examples from the biopharmaceutical industry, including monoclonal antibodies -Provides an overview of the field along with design tools and examples illustrating the advantages of continuous processing in biopharmaceutical productions -Focuses on process development and large-scale bioseparation tasks, making it an ideal guide for the professional bioengineer in the biotech and pharma industries -Offers field-tested information based on decades of training courses for biotech and chemical engineers in Europe and the U.S. Protein Chromatography: Process Development and Scale-Up, Second Edition will appeal to biotechnologists, analytical chemists, chromatographers, chemical engineers, pharmaceutical industry, biotechnological industry, and biochemists.

Stem Cell Manufacturing discusses the required technologies that enable the transfer of the current laboratory-based practice of stem cell tissue culture to the clinic environment as therapeutics, while concurrently achieving control, reproducibility, automation, validation, and safety of the process and the product. The advent of stem cell research unveiled the therapeutic potential of stem cells and their derivatives and increased the awareness of the public and scientific community for the topic. The successful manufacturing of stem cells and their derivatives is expected to have a positive impact in the society since it will contribute to widen the offer of therapeutic solutions to the patients. Fully defined cellular products can be used to restore the structure and function of damaged tissues and organs and to develop stem cell-based cellular therapies for the treatment of cancer and hematological disorders, autoimmune and other inflammatory diseases and genetic disorders. Presents the first ' Flowchart ' of stem cell manufacturing enabling easy understanding of the various processes in a sequential and coherent manner Covers all bioprocess technologies required for the transfer of the bench findings to the clinic including the process components: cell signals, bioreactors, modeling, automation, safety, etc. Presents comprehensive coverage of a true multidisciplinary topic by bringing together specialists in their particular area Provides the basics of the processes and identifies the issues to be resolved for large scale cell culture by the bioengineer Addresses the critical need in bioprocessing for the successful delivery of stem cell technology to the market place by involving professional engineers in sections of the book

Integration and Optimization of Unit Operations

BIOSPERATIONS

Development, Design, and Implementation of Manufacturing Processes

Handbook of Process Chromatography

Downstream Processing for Biotechnology

We are all aware of opportunities created by advances in molecular biology. Living cells and their components can be used to produce a large number of useful compounds such as therapeutics and other products. But to obtain significant benefits as a commercial operation, molecular biology needs the support of biochemical engineering. The vital area of biotechnology that is concerned with practical application of biological agents (whole cell systems and biocatalysts) and the methodologies and processes associated with it on an industrial scale is biochemical engineering. Biochemical engineering is applicable in different areas of biotechnology such as biochemical reactions, enzyme technology, environmental biotechnology, microbial manipulations, bioseparation technology, plant and animal cell cultures, and food technology. It consists of the development of new process technology, designing bioreactors, developing efficient, and economically feasible extraction and purification procedures (downstream processing). Chapter 1 and 2 discuss about the basic concept of biotechnology and biochemical engineering. Chapter 3 tells about the concept of enzyme kinetics, their evolution and use in biochemical engineering. Chapter 4 and 5 describe immobilized enzyme and industrial applications of enzymes. Chapter 6 depicts about industrial microbiology. This chapter discuss different concepts about fermentation process, cell products and other modified compounds. Chapter 7 tells about different types of cell cultivations in microbial, animal, and plant. Chapter 8 discuss about the fermentation proce4ss and its control. Chapter 9 and 10 describe cell kinetics and fermenter design and also how the cell grows. Chapter 11 discuss about the bioreactor design. Chapter 12 depicts the downstream processing, centrifugration, sedimentation and other technology. Chapter 13 tells about the sterilization.

Offers a concise introduction to the separation and purification of biochemicals. Bridges two scientific cultures, providing an introduction to bioseparations for scientists with no background in engineering and for engineers with little grounding in biology. The authors supplement the ideas by simple worked examples, making the techniques of bioseparations easy to learn. Discusses removal of insolubles, product isolation, purification and polishing.

The chemical industry changes and becomes more and more integrated worldwide. This creates a need for information exchange that includes not only the principles of operation but also the transfer of practical knowledge. Integration and Optimization of Unit Operations provides up-to-date and practical information on chemical unit operations from the R&D stage to scale-up and demonstration to commercialization and optimization. A global collection of industry experts systematically discuss all innovation stages, complex processes with different unit operations, including solids processing and recycle flows, and the importance of integrated process validation. The book addresses the needs of engineers who want to increase their skill levels in various disciplines so that they are able to develop, commercialize and optimize processes. After reading this book, you will be able to acquire new skills and knowledge to collaborate across disciplines and develop creative solutions. Shows the impacts of upstream process decisions on downstream operations Provides troubleshooting strategies at each process stage Asks challenging questions to develop creative solutions to process problems

Promoting a continued and much-needed renaissance in biopharmaceutical manufacturing, this book covers the different strategies and assembles top-tier technology experts to address the challenges of antibody purification. • Updates existing topics and adds new ones that include purification of antibodies produced in novel production systems, novel separation technologies, novel antibody formats and alternative scaffolds, and strategies for ton-scale manufacturing • Presents new and updated discussions of different purification technologies, focusing on how they can address the capacity crunch in antibody purification • Emphasizes antibodies and innovative chromatography methods for processing

High Value Processing Technologies

PRINCIPLES AND TECHNIQUES

The Bioengineering Perspective

Handbook of Downstream Processing

Unit Operation Downstream Processing (Penerbit USM)

Single-Use Technology in Biopharmaceutical Manufacture

A comprehensive review of the current status and challenges for natural gas and shale gas production, treatment and monetization technologies Natural Gas Processing from Midstream to Downstream presents an international perspective on the production and monetization of shale gas and natural gas. The authors review techno-economic assessments of the midstream and downstream natural gas processing technologies. Comprehensive in scope, the text offers insight into the current status and the challenges facing the advancement of the midstream natural gas treatments. Treatments covered include gas sweeting processes, sulfur recovery units, gas dehydration and natural gas pipeline transportation. The authors highlight the downstream processes including physical treatment and chemical conversion of both direct and indirect conversion. The book also contains an important overview of natural gas monetization processes and the potential for shale gas to play a role in the future of the energy market, specifically for the production of ultra-clean fuels and value-added chemicals. This vital resource: Provides fundamental chemical engineering aspects of natural gas technologies Covers topics related to upstream, midstream and downstream natural gas treatment and processing Contains well-integrated coverage of several technologies and processes for treatment and production of natural gas Highlights the economic factors and risks facing the monetization technologies Discusses supply chain, environmental and safety issues associated with the emerging shale gas industry Identifies future trends in educational and research opportunities, directions and emerging opportunities in natural gas monetization Includes contributions from leading researchers in academia and industry Written for Industrial scientists, academic researchers and government agencies working on developing and sustaining state-of-the-art technologies in gas and fuels production and processing, Natural Gas Processing from Midstream to Downstream provides a broad overview of the current status and challenges for natural gas production, treatment and monetization technologies.

This book provides fundamental principles, terminology, mechanisms, methods, types and applications of unit operation in downstream processing of various fields, ranging from engineering, technology, pure sciences and applied sciences. The discussion revolves around the principle of unit operations such as filtration, coagulation and flocculation, centrifugation, cell disruption, adsorption, chromatography, distillation, crystallization and drying. This book is designed to serve as a reference book for students, researchers, professionals and others who work in the processing industries.

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.

Downstream processing is an essential practice in the production and purification of biosynthethic materials, which is especially important in the production of pharmaceutical products. This book covers the fundamentals and the design concepts of various downstream recovery and purification steps (unit operations) involved in biochemical and chemical processes. The book describes cell breakage and recovery of intracellular material, isolation of solids, product recovery, product enrichment, and product polishing and finishing. It also covers basic chemical engineering purification techniques such as distillation, absorption, adsorption, etc. Described in the book are several case studies that discuss the various unit operation in each of the processes. An important point to consider is the economics of the downstream operation, and this book provides practical information on capital costs and operating expenses in addition to other operating cost factors with respect to downstream processing. Green chemistry and safety issues are also addressed. Practicing chemical engineers in biotechnology and pharmaceutical chemistry and other areas will find this book valuable as a reference on downstream techniques used in biological processes. Students in chemical engineering would benefit from this book as well.

Continuous Processing in Pharmaceutical Manufacturing

Animal Cell Biotechnology

Downstream Processing in Biotechnology

Sustainable Downstream Processing of Microalgae for Industrial Application

Proceedings of a Workshop

Bioseparations Science and Engineering

This is the most comprehensive treatise of this topic available, providing invaluable information on the technological and economic benefits to be gained from implementing continuous processes in the biopharmaceutical industry. Top experts from industry and academia cover the latest technical developments in the field, describing the use of single-use technologies alongside perfusion production platforms and downstream operations. Special emphasis is given to process control and monitoring, including such topics as 'quality by design' and automation. The book is supplemented by case studies that highlight the enormous potential of continuous manufacturing for biopharmaceutical production facilities.

Downstream Process Technology: A New Horizon In BiotechnologyPHI Learning Pvt. Ltd.Downstream Processing in BiotechnologyWalter de Gruyter GmbH & Co KG

This is the first book to present the idea of Industry 5.0 in biomanufacturing and bioprocess engineering, both upstream and downstream. The Prospect of Industry 5.0 in Biomanufacturing details the latest technologies and how they can be used efficiently and explains process analysis from an engineering point of view. In addition, it covers applications and challenges. FEATURES Describes the previous Industrial Revolution, current Industry 4.0, and how new technologies will transition toward Industry 5.0 Explains how Industry 5.0 can be applied in biomanufacturing Demonstrates new technologies catered to Industry 5.0 Uses worked examples related to biological systems This book enables readers in industry and academia working in the biomanufacturing engineering sector to understand current trends and future directions in this field.

Biochemical Engineering and Biotechnology, 2nd Edition, outlines the principles of biochemical processes and explains their use in the manufacturing of every day products. The author uses a diirect approach that should be very useful for students in following the concepts and practical applications. This book is unique in having many solved problems, case studies, examples and demonstrations of detailed experiments, with simple design equations and required calculations. Covers major concepts of biochemical engineering and biotechnology, including applications in bioprocesses, fermentation technologies, enzymatic processes, and membrane separations, amongst others Accessible to chemical engineering students who need to both learn, and apply, biological knowledge in engineering principals Includes solved problems, examples, and demonstrations of detailed experiments with simple design equations and all required calculations Offers many graphs that present actual experimental data, figures, and tables, along with explanations

Pharmaceuticals from Microbes

The Prospect of Industry 5.0 in Biomanufacturing

Modeling and Assessment

Stem Cell Manufacturing

Separations for Biotechnology 2

Development, Manufacturing, Validation and Economics

Designed for undergraduates, graduate students, and industry practitioners, Bioseparations Science and Engineering fills a critical need in the field of bioseparations. Current, comprehensive, and concise, it covers bioseparations unit operations in unprecedented depth. In each of the chapters, the authors use a consistent method of explaining unit operations, starting with a qualitative description noting the significance and general application of the unit operation. They then illustrate the scientific application of the operation, develop the required mathematical theory, and finally, describe the applications of the theory in engineering practice, with an emphasis on design and scaleup. Unique to this text is a chapter dedicated to bioseparations process design and economics, in which a process simular, SuperPro Designer® is used to analyze and evaluate the production of three important biological products. New to this second edition are updated discussions of moment analysis, computer simulation, membrane chromatography, and evaporation, among others, as well as revised problem sets. Unique features include basic information about bioproducts and engineering analysis and a chapter with bioseparations laboratory exercises. Bioseparations Science and Engineering is ideal for students and professionals working in or studying bioseparations, and is the premier text in the field.

Expanded bed adsorption chromatography is a novel processing technique for the purification of biomolecules, combining clarification, concentration and initial purification in one step. By such an integration it is possible to reduce the number of steps in the purification process, to shorten the processing time and to improve the yields. The technology is new, and interesting developments have taken place concerning the adsorbents, the processing technology and potential applications. Both small-scale laboratory processes and larger industrial processes are being developed. Expanded bed chromatography is one of the most exciting new developments in downstream

processing in recent years. The technology will be a standard procedure when new biotechnological processes are being developed.
This comprehensive book details the most recent advances in the microalgae biological sciences and engineering technologies for biomass and biofuel production in order to meet the ongoing need for new and affordable sources of food, chemicals and energy for future generations. The chapters explore new microalgae cultivation techniques, including solid (biofilm) systems, and heterotrophic production methods, while also critically investigating topics such as combining wastewater as a source of nutrients, the effect of CO2 on growth, and converting biomass to methane through anaerobic digestion. The book highlights innovative bioproduct optimization and molecular genetic techniques, applications of genomics and metabolomics, and the genetic engineering of microalgae strains targeting biocrude production. The latest developments in microalgae harvesting and dewatering technologies, which combine biomass production with electricity generation, are presented, along with detailed techno-economic modeling. This extensive volume was written by respected experts in their fields and is intended for a wide audience of researchers and engineers.
Advances in Engineering and Biology
Expanded Bed Chromatography