BIOT 150: BIOTECHNOLOGY II: BIOMANUFACTURING AND QUALITY PRINCIPLES

Citrus College Course Outline of Record

Heading	Value
Effective Term:	Fall 2024
Credits:	4
Total Contact Hours:	144
Lecture Hours :	36
Lab Hours:	108
Hours Arranged:	0
Outside of Class Hours:	72
Total Student Learning Hours:	216
Prerequisite:	BIOT 110.
Strongly Recommended:	Intermediate algebra or higher; ENGL 101.
Transferable to CSU:	Yes
Transferable to UC:	No
Grading Method:	Standard Letter

Catalog Course Description

This course builds upon the concepts and laboratory techniques introduced in Biotechnology I: Basic Lab Skills and Documentation. Students will closely examine the biomanufacturing sector, including facility design, the production process, quality control, and quality assurance. Governmental regulation of the biomanufacturing industry will be highlighted as students explore Good Manufacturing Practice and Good Documentation Practice. This course includes a significant laboratory component focusing on large-scale protein production and purification, environmental monitoring, equipment validation, and clean room operations. Resume writing and job interview skills for biomanufacturing employment opportunities will be emphasized. 36 lecture hours, 108 lab hours.

Course Objectives

- Describe the role of large-scale cell culture and fermentation in biomanufacturing
- Demonstrate appropriate technique for performing tasks in a clean room
- Validate and safely operate an autoclave for sterilization of a variety of liquids, tubing, and laboratory instruments
- Clean tanks or vessels with chemical disinfectants and perform quality testing on rinse water
- Sterilize components (as necessary) for a bioreactor/fermenter, setup the apparatus, aseptically inoculate, and monitor for successful growth promotion
- Explain the importance of aseptic technique when performing large-scale chemical synthesis or cell culture for biomanufacturing
- Record all measurements and equipment parameters for large-scale culture on a batch record using Good Documentation Practices (GDP)
- Perform filter integrity tests and identify damaged filters for disposal
- Harvest and purify proteins from a large-scale culture
- Perform and analyze data from an ELISA assay to quantify protein
- Safely operate a vacuum pump to perform lyophilization
- Discuss the Code of Federal Regulations and how they apply to the biomanufacturing industry
- Aseptically fill bottles, adhere product labels, and inspect bottles for defects
- Assemble and package orders for customers, inspect for and quarantine defective product, and maintain an updated digital inventory
- Construct and follow an environmental monitoring plan for a facility
- Prepare, sterilize, assess for viability, and properly store bacteriological media
- Aseptically sample surfaces and water sources for microbial contamination using swabs, contact plates, and filtration units
- Operate particulate counters and air samplers for testing air quality
- Perform basic bacteriological identification using Gram stain and biochemical testing for microbial contaminants
- Perform and interpret the LAL assay for endotoxin detection
- Obtain samples from incoming materials for inspection, and store materials in compliance with safety regulations and Good Manufacturing Practice (cGMP) standards
- Assess a work area for cGMP and GDP compliance, identify safety and/or process improvement, and compose an oral and a type written report of the audit
- Explain the significance of Good Documentation Practice (GDP) and Good Manufacturing Practice (cGMP) for biomanufacturing operations and their role in maintaining FDA compliance
- Evaluate a variety of completed records, forms, and logs for errors in Good Documentation Practices (GDP)
- Validate and utilize word processing software to generate a standard operating procedure (SOP)
- Utilize document change control protocols for revisions to existing SOPs
- Compose emails and memos with correct spelling and grammar that are professional in tone and formatting
- Compose type written performance evaluations for self and team members with correct spelling and grammar
- Perform research on a local bioscience company and deliver an oral presentation about the company
- Communicate personal strengths and skills to a potential biomanufacturing employer in a mock interview
- Compose and/or revise a resume and cover letter for biomanufacturing employment opportunities
- Establish a professional social media presence
- Diagram the FDA drug approval process for pharmaceuticals and medical devices
- Distinguish between the various strategies available for sterilization and disinfection in a biomanufacturing facility
- Formulate an example that demonstrates the use of industrial utilities, water sources, such as water for injection (WFI), in a biomanufacturing setting
- Summarize the importance of and rating system for clean room environments
- Don/doff clean room garments in the correct sequence and with the appropriate technique necessary for work in a clean room

- Prepare disinfectant solutions of the correct concentration, and clean bench tops and floors in a manner appropriate for a clean room environment

Major Course Content

Introduction to Biomanufacturing

1. History of biomanufacturing
2. Drug discovery and patents
3. Clinical trials
4. Products isolated from human blood and milk
5. Large-scale production
6. Good Manufacturing Practice (cGMP)

Introduction to Regulation

1. History of the U.S. Food and Drug Administration (FDA)
2. Code of Federal Regulations

Biomanufacturing Facilities

1. Facility design
    a. Process considerations
    b. Utilities (water, nitrogen)
    c. Regulatory considerations
    d. Environmental health and safety
2. Classification system for clean rooms
3. Process equipment and control systems
4. Cleaning Processes
    a. Clean-in-place (CIP)
    b. Sterliize-in-place (SIP)
    c. Hold times
5. Utilities (such as water for injection)

Production

1. Review of metrology and calibration
2. Validation
3. Upstream processing
4. Downstream processing
5. Final fill and packaging

Quality Control

1. Raw material and product analysis
2. Environmental monitoring
3. Types of contamination
4. Strategies for reducing contamination

Quality Assurance

1. Quality systems
2. Data Integrity
3. Noncomformity investigation
4. Document change control
5. International regulatory bodies
    a. Inspections
    b. Warning letters

Workforce Preparation

1. Resume writing and revision
2. Interview skills
3. Establish professional social media profile(s)
4. Performance evaluation process
5. Local biomanufacturing companies

Lab Content

Laboratory Safety

1. Risk assessment
2. Review of personal protective equipment (PPE) and emergency safety equipment

Review of Good Laboratory Practice (GLP) and Good Documentation Practice (GDP)

1. Traceability
2. Accountability
3. Data Integrity

Production

1. Inventory of supplies and equipment
2. Proper handling and storage of materials
3. Review of metrology and solution preparation
4. Validation of autoclave
5. Preparation for and conduct in a clean room
6. Sterilization and assembly of a bioreactor
7. Conductivity testing for tanks and/or vessels
8. Aseptic inoculation and monitoring of bioreactor
9. Filter integrity testing
10. Harvesting and purification of protein product
11. ELISA assay for product quantitation
12. Aseptic fill
13. Lyophilization
14. Product packaging, labeling, and inspection

Quality Control

1. Design environmental monitoring (EM) plan
2. Air monitoring (viable and non-viable)
3. Microbial testing
    a. Surface sampling
    b. Water filtration
4. Endotoxin screening
5. Basic bacterial identification

Quality Assurance

1. Introduction to Good Manufacturing Practice (cGMP) standards
2. Internal audit process
3. Software validation
4. Document change control

Employment Skills

1. Resume revision
2. Mock interview
3. Performance evaluation

Suggested Reading Other Than Required Textbook

Students will read and complete supplemental handouts given in the laboratory.
Students will read technical articles, news items, and/or online resources relating to the biotechnology industry and specific course content.

Examples of Required Writing Assignments

Students will write a resume and cover letter targeted to entry-level positions in the bioscience industry.
Students will write a short report on a local biomanufacturing company in preparation for an oral presentation in class.
Students will write a performance evaluation for him/herself or a team member.

Examples of Outside Assignments

Students will prepare for exams covering principles of biomanufacturing, such as the rating systems used to classify clean room environments.
Students will complete homework assignments with questions, such as: (1) Provide one example for the use of WFI (water for injection) in a biomanufacturing setting. (2) Propose an environmental monitoring plan directed at the attached facility blueprint. (3) Explain the goal of each stage of testing in clinical trials.
Students will perform online research in preparation for class discussions. Topics to include: published FDA inspection reports and recent patent ligation regarding biotechnology products.

Instruction Type(s)

Lab, Lecture, Online Education Lab, Online Education Lecture