

Bioprocess Technology

Course Outcome Summary

Course Information

Organization	MATC - Madison Area Technical College
Developers	Joy A. McMillan, Ph.D.
Development Date	2/13/2003
Course Number	10-007-105
Instructional Level	Associate Degree
Potential Hours of Instruction	126
Total Credits	3

Description

Covers basic techniques of fermentation technology, including the principles of isolation, identification, improvement, preservation and growth of industrial microorganisms. Emphasizes the use of fermentation equipment to obtain products.

Types of Instruction

Instruction Type	Contact Hours	Credits
Classroom Presentation	18	3
On-Campus Laboratory and Clinicals	108	

Textbooks

P.F. Stanbury and A. Whitaker. *Principles of Fermentation Technology*. Pergamon Press. **Edition:** 1094.

Arnold L. Demain and Nadine A. Solomon. *Manual of Industrial Microbiology and Biotechnology*. American Society for Microbiology. **Edition:** 1986.

Learner Supplies

Laboratory notebook.

Safety glasses.

Laboratory coat.

3-ring binder.

Prerequisites

Biotechnology Laboratory Skills for a Regulated Workplace (10-007-103)

Chemistry 1 (10-806-111)

Industrial and Applied Microbiology (10-806-174)

OR consent of instructor

Competencies

Unit 1. Introduction to Industrial Fermentations

A. Evaluate various fermentation and bioprocessing applications

You will demonstrate your competence:

1. by written analyses you prepare

Your performance will be successful when:

1. you explain the various product types to the class of fermentation or bioprocess
2. you identify various product types as to the class of fermentation or bioprocess

B. Explain the effects of specialized fermentation operations on the cell growth kinetics

You will demonstrate your competence:

1. by diagramming the fermentation process relative the cell growth kinetics

Your performance will be successful when:

1. you explain the advantages of each fermentation process
2. you explain the disadvantages of each fermentation process

Unit 2. Use of Aseptic Technique

A. Validate the principles and importance of sterility in industrial fermentations

You will demonstrate your competence:

1. by written explanation of sterility
2. by sterilizing equipment
3. by completing appropriate calculations and applying statistical methods to collected data

Your performance will be successful when:

1. you explain the important features of aseptic technique in terms of absolute sterility

B. Demonstrate aseptic technique and sterility control procedures

You will demonstrate your competence:

1. when only desired microorganisms grow

Your performance will be successful when:

1. you aseptically transfer microorganisms
2. you sterilize all materials to be used in the fermentation process

Unit 3. External Measurement of Fermentation Parameters

A. Measure microbial growth

You will demonstrate your competence:

1. by completion of laboratory activities
2. by completion of written explanation of laboratory observations and data
3. by completion of written assignments

Your performance will be successful when:

1. you remove samples and record growth parameters
2. you record growth parameters
3. you explain the results obtained in a growth experiment

B. Analyze fermentation samples

You will demonstrate your competence:

1. through completion of laboratory activities
2. through written analysis of laboratory observations and data
3. through the completion of written assignments

Your performance will be successful when:

1. you assemble needed supplies and materials
2. you complete analysis of fermentation samples

C. Measure substrate and/or product using standard methods

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through the written analysis of laboratory observations and data
3. through the completion of written assignments
4. through written examinations

Your performance will be successful when:

1. you select the standard methods to be used
2. you assemble the needed materials and supplies
3. you measure the substrate and/or product in question
4. you explain observations and data

Unit 4. Fermenter Principles and Operation

A. Summarize the theory of operation of a bench-top fermenter

You will demonstrate your competence:

1. through the completion of written assignments
2. through written examinations
3. through oral examinations

Your performance will be successful when:

1. you summarize the function of parts of a bench-top fermenter
2. you summarize the function of the parts of a bench-top fermenter

B. Prepare bench-top fermenter for use

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through written explanations of laboratory observations and data
3. through the completion of written assignments
4. through written examinations
5. through laboratory proficiency examinations

Your performance will be successful when:

1. you assemble needed materials and supplies
2. you sterilize media and equipment as needed
3. you employ safety precautions as needed

C. Recover spent fermentation broth

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through the written explanations of laboratory observations and data
3. through the completion of written assignments
4. through written examinations

Your performance will be successful when:

1. you assemble needed supplies and materials
2. you initiate the appropriate process for the fermentation system used
3. you recover the spent broth for reuse or analysis

D. Calculate the efficiency of a fermentation process

You will demonstrate your competence:

1. through the written evaluations of laboratory observations and data
2. through the completion of written assignments
3. through written examinations

Your performance will be successful when:

1. you identify the factors determining the efficiency of the process
2. you apply the appropriate mathematical functions to the calculations

Unit 5. Fermentation Aeration Measurement and Control

A. Explain the effects of oxygen tension on product and biomass formation

You will demonstrate your competence:

1. through the completion of written assignments
2. through written examinations
3. through written analyses of laboratory observations and data

Your performance will be successful when:

1. learner explains the effects of oxygen tension on product and biomass formation

B. Construct and test a galvanic dissolved oxygen probe

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through written explanation of laboratory observations and data
3. through written examinations

Your performance will be successful when:

1. your galvanic DO probe is completed
2. your galvanic DO probe measures dissolved oxygen

C. Calibrate polarographic and galvanic dissolved oxygen probes

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through written explanations of laboratory observations and data
3. through written examinations

Your performance will be successful when:

1. you calibrate the oxygen probes using standard industry protocols
2. your oxygen probes are within industry tolerance standards

D. Describe the relationship of oxygen transfer rates to mass transfer

You will demonstrate your competence:

1. through the completion of written assignments
2. through written examinations
3. through the analysis of laboratory data

Your performance will be successful when:

1. you summarize the factors promoting oxygen transfer
2. you summarize factors inhibiting oxygen transfer
3. you differentiate oxygen transfer rates and mass transfer

Unit 6. Preparation of Seed Inoculum

A. Recover a microorganism from a lyophilized preparation

You will demonstrate your competence:

1. through the completion of laboratory activities

2. through written analyses of laboratory observations and data
3. growth of microorganism with no contamination (pure culture)

Your performance will be successful when:

1. you rehydrate cell line
2. your microorganism grows in appropriate media

B. Determine the viability of stored cells

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through the written analyses of the laboratory observations and data

Your performance will be successful when:

1. you assemble the appropriate materials and supplies
2. you calculate the viability rates of stored cells
3. you grow cells on appropriate media

C. Explain the methods used to acquire and develop microbial strains for industrial uses

You will demonstrate your competence:

1. through the completion of written assignments
2. through written examinations
3. through the assessment of journal articles identifying novel strains for industrial use

Your performance will be successful when:

1. you identify the methods used to develop microbial strains for industrial use
2. you explain the properties of microorganisms useful to industry

D. Design various fermentation media for specific applications for determining media factors affecting production/biomass formation

You will demonstrate your competence:

1. through the completion of written assignments
2. through the written analysis of laboratory data
3. through written examinations

Your performance will be successful when:

1. you identify media components that affect production and biomass formation
2. you compare media formulations to yield data

Unit 7. Measurement of Fermentation Substrate Uptake and Product Formation

A. Prepare analytical standards and establish an analytical calibration curve

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through written analysis of laboratory observations and data
3. through the completion of written assignments
4. through written examinations
5. through laboratory proficiency examinations

Your performance will be successful when:

1. your standard curve is prepared
2. you assemble the needed materials and supplies
3. you identify the appropriate analytical test to complete

B. Aseptically withdraw and prepare a sample for analysis

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through laboratory proficiency examinations
3. through written analysis of laboratory observations and data

Your performance will be successful when:

1. you apply standard aseptic techniques
2. your sample is not contaminated

C. Operate a fermentation high performance liquid chromatography system

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through laboratory proficiency examinations
3. through written explanations of laboratory observations and data

Your performance will be successful when:

1. you assemble the needed supplies and materials
2. you obtain a separation of molecules in sample
3. HPLC operates within the parameters identified

Unit 8. Regulatory and Ecological Considerations in Industrial Fermentations

A. Comply with regulatory and ecological guidelines in the operation and design of fermentation processes

You will demonstrate your competence:

1. through the completion of laboratory activities
2. through written examination
3. through laboratory proficiency examinations

Your performance will be successful when:

1. you follow applicable guidelines