BIOE 3000: Bioprocess Engineering Systems

This course is required for all Engineering majors pursuing the bioprocess engineering concentration.

Course Coordinator:
Loren Limberis

Catalog Description:
Engineering concepts for biological conversion of raw materials to food, pharmaceuticals, fuels, and chemicals. Includes enzyme kinetics and technology, bioreaction kinetics, design, analysis, and control of bioreactors and fermenters, and downstream processing of bioreaction products.

Course Structure:
Three 50-minute lectures (three credits)

Prerequisites:
BIOL 2110; CHEM 2650, 2651; and consent of instructor.

Required Materials:
Bioprocess Engineering—Basic Concepts, 2nd Ed. By Shuler and Kargi, Prentice Hall 2002 (0130819085)

Course Objectives:
Upon completion of this course, students shall be able to:

- Apply concepts of cell biology and biochemistry toward the design and implementation of a bioprocess system
- Describe basic concepts of bioprocess engineering and how they are used in common biotechnological processes
- Apply basic concepts of material and energy balances, reaction kinetics, and mass transfer to biological systems
- Identify the main issues associated with the design, implementation, and operation of bioprocessing technology
- Quantitatively analyze enzyme systems
- Quantitatively describe the growth of microorganisms
- Determine the reaction stoichiometry for bioreactors
- Select, scale up, and understand the operation of bioreactors
- Design bioreactors for the production of various products
- Select recovery and purification processes for bioproducts
- Describe the regulatory processes and issues associated with bioprocess engineering
- Engage in the current literature in the bioprocessing field and pursue further understanding of the material
- Analyze, understand, and present the impact of bioprocess engineering solutions in appropriate global, economic, environmental, and societal contexts
- Understand the professional opportunities in the field including professional societies, workshops and conferences, contemporary issues, where the field is heading, and identify future opportunities
- Document and present bioprocess engineering technical information and analyses in a professional manner.

Lecture Topics:
Topics covered in this course include:

- Biotechnology overview (1 class)

- Beginning of semester concept map (1 class)
- Regulatory constraints (1 class)
- Microorganisms and biomolecules (2 classes)
- Enzymes kinetics (3 classes)
- Immobilized enzyme systems (1 class)
- Large-scale production and medical and industrial utilization of enzymes (2 classes)
- DNA replication, transcription, translation, metabolic regulation (2 classes)
- Metabolic pathways (3 classes)
- Microbial and cellular growth kinetics (5 classes)
- Stoichiometry of microbial growth and product formation (2 classes)
- Genetic engineering (1 class)
- Batch and continuous bioreactors, and immobilized cell systems (5 classes)
- Selection, scale-up, and operation of bioreactors (2 classes)
- Bioreactor instrumentation and control (3 classes)
- Recovery and purification of products (1 class)
- End of semester concept map (1 class)
- Tests (4 classes)
- Presentations (2 classes)

Relevant Program Outcomes:
Graduates of the BS in Engineering Program in the Bioprocess Engineering Concentration will demonstrate:

h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
i) a recognition of the need for, and an ability to engage in life-long learning.
j) a knowledge of contemporary issues.

Professional Component Content:
Math/Sciene: 0; Engineering: 3 cr; General Education: 0

Assessment Requirements:
Student Work Samples:

- Paper and presentation on a current subject in bioprocess engineering (outcome h and j)
- Homework assignment on the professional opportunities in the field including professional societies, workshops and conferences, contemporary issues, where the field is heading, and future opportunities (outcome i)

Student Course Survey

Last Review:
May 13, 2008 by Loren Limberis