ChBE 4310 Bioprocess Engineering (required course)

Credit: 3-0-3

Instructor: Rachel Chen

Textbook: *Bioprocessing Engineering*, Basic Concepts (2nd edition)
Michael Shuler and Filret Kargi, 2002

Catalog Description: Integrating several ChBE core concepts, bioprocess engineering applies the engineering principles to biological systems. Topics covered include enzyme kinetics, fermentation, downstream processing and integrated bioprocesses important to biotech industries.

Prerequisites: Biochemistry I (Chem 3511) or Biochemistry II (Chem 4511) minimum grade "D", and Kinetics and Reactor Design, minimum grade "C"

Objectives: Specifically, after completing the course, students should be able to:

1.) Apply engineering principles to address issues in bioprocesses

2.) Delineate problems associated biomolecules or biological cells from those associated with environmental conditions,

3.) Analyze and identify limiting factors in a bioprocess and Propose solutions to address biological and engineering problems

Learning Outcomes: By the end of this course, a student should be able to:

1. Use correct biological terms to describe and analyze phenomena/problems in bioprocesses (Student Outcomes: a, e)

2. Explain major differences between different cell types (such as Gram-negative/ Gram-positive bacteria, simple eukaryotes vs. mammalian cells) and their respective cell growth requirements in bioprocesses (Student Outcomes: a, c, e).

3. Explain how environmental conditions influence cell growth and means to achieve optimal cell growth in large scale (Student Outcomes: a, c, e).

4. Analyze kinetics of cell growth or enzyme-catalyzed reactions and identify limiting factors (Student Outcomes: a, c, e, k)

5. Design or Select appropriate bioreactor models based upon bioproducts and cell lines and other process criteria (Student Outcomes: a, c, e).

6. Design a suitable scheme of bioproduct separations based upon the molecular characteristics of the product and other process criteria (Student Outcomes: c, e, k).

7. Analyze major metabolic pathways and identify common regulatory mechanisms (Student Outcomes: a, e, j, k)

8. Analyze molecular biology elements used to construct recombinant cell lines and identify potential genetic instability in bioprocesses (Student Outcomes: a, k)

Topical Outline

1. Overview of biotechnology industry

2. Organisms of biotechnological importance

3. Enzymes and applications

4. Metabolic pathways

5. Microbial growth

6. Stoichiometry and application in bioprocesses

7. Expression of a gene in a heterologous host

8. Making recombinant protein

9. Regulation in gene expression and metabolism

10. Using genetically engineered organisms in bioprocesses

11. Bioreactors for enzymatic and microbial processes

12. Bioseparation and product purification

13. Mammalian cell culture and bioreactors

14. Plant cell culture

15. Industrai process analysis

16. Regulatory issues in biopharmaceutical industry