ChE 446 – BIOCHEMICAL ENGINEERING

Type: Required for Biochemical Engineering Track

2005-2006 Catalog Data: CHE 446. Biochemical Engineering. Extension of chemical engineering fundamentals to biological systems. The topics will include principles of bioreaction engineering and bioseparation. Laboratory experiments will support the concepts introduced in the lecture. Prerequisites: CHEM 312 and MATH 231. Offered in the Spring semester. *One semester; three credit.*

Prerequisites: ChE 312, Math 231, ChE 443
Corequisites: None

Textbook: Michael L. Shuler and Fikret Kargi, *Bioprocess Engineering Basic Concepts*, 2nd Edition, Prentice Hall, 2002.

Other References: Harvey W. Blanch and Douglas S. Clark, *Biochemical Engineering*, Marcel Dekkar, 1996.

Instructor: Dr. Asit K. Ray, Professor of Chemical Engineering

Course Objectives:

1. Students will receive a quick review of biology from an engineer's perspective including biology basics, enzymes, how cells work, metabolic pathways and how cells are altered. (ABET: a)
2. Students will learn how to combine this information with conventional reaction engineering concepts to design, operate, control and scale-up of biochemical reactors. (ABET: a, c, e, k)
3. Students will be introduced to unconventional biological systems where they will learn to use bioprocess considerations using animal and plant cell cultures. (ABET: a, e, k)
4. Finally students will venture into medical applications of bioprocess engineering including tissue engineering, gene therapy and bioreactors. (ABET: a, e, f, j, k)

Prerequisites by Topics:

1. Solution of first order differential equations.
2. Analysis of mass and energy balances.
3. Chemistry and metabolism of biologically important systems including amino acids, proteins, carbohydrates, enzymes, etc.
4. Theories of chemical kinetics of homogeneous and heterogeneous systems, isothermal and nonisothermal and applications to analyze and design batch and flow reactors.

Topics:

1. Review of biology basics from an engineer's viewpoint.
2. Cell growth and stoichiometry of microbial growth and product formation.
3. Operating considerations for bioreactors for suspension and immobilized cultures.
4. Selection, scale-up, operation and control of bioreactors.
5. Recovery and purification of products.
6. Bioprocess considerations in using animal cell cultures.
7. Bioprocess considerations in using plant cell cultures.
8. Medical applications of bioprocess engineering
9. Examinations

Class Schedule: Three 50-minute sessions per week

Prepared by: Asit K. Ray, Ph.D. **Date:** October 2005

Professional Component:
ChE 446 – Biochemical Engineering

Category (check one)	____ Math/Basic Science __X__ Engineering ____ General Education ____ Other
Design (check one)	__X__ Significant ____ Some ____ None
Realistic Constraints (check all that apply)	__X__ Economic __X__ Environmental ____ Sustainability __X__ Manufacturability __X__ Ethical __X__ Health & Safety ____ Social ____ Political

Relationship to Program Outcomes:

Check all that apply:

__X__ (a) an ability to apply knowledge of mathematics, science, and engineering
____ (b) an ability to design and conduct experiments, as well as to analyze and interpret data
__X__ (c) an ability to design a system, component, or process to meet desired needs
____ (d) an ability to function on multi-disciplinary teams
__X__ (e) an ability to identify, formulate, and solve engineering problems
__X__ (f) an understanding of professional and ethical responsibility
____ (g) an ability to communicate effectively
____ (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
__X__ (i) a recognition of the need for and an ability to engage in life-long learning
____ (j) a knowledge of contemporary issues
__X__ (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice