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ABE 572

BIOPROCESS ENGINEERING

Course Syllabus

Spring 2013

Instructor

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Office Hours: by appointment

Class time

Monday, Wednesday, Friday

2.30 – 3.20 pm

124 Ag Eng. Bldg

Credits: 3.0

Course Description

Bioprocess Engineering includes the principles of microbiology, biochemistry, mathematics and biotechnology. It deals with the design and development of equipment and processes for the manufacturing of products such as food, feed, pharmaceuticals, polymers, and a multitude of value-added biomaterials found in and used by all industries. This course presents all steps in bioprocessing such as basic biology, microbial kinetics, aeration, agitation for bioreactor design, and various recovery methods for fermentation and downstream processing.

Prerequisites of this course are basic microbiology and chemistry.

Course Objectives

The main purpose of this course is to provide an understanding of conversions of raw materials into value-added products via microbial fermentation. After this course each student will be able to:

- Learn fundamentals of cell growth microbial kinetics.
- Focus on the application of the principles of these disciplines to processes based on using living cells.
- Design a project for large scale production of value added product.

What other than lectures?

The lectures are supplemented with lab exercises to demonstrate the scientific concepts taught in class. A project to design a plant to produce a value added product through microbial fermentation will be carried out. The course also includes an industrial visit in which some of the equipment used in the bioprocessing industries will be exhibited.

Course policies

- Students are expected to attend classes and lab sessions regularly.
- All homework is due in class every Wednesday. Late submissions are accepted with 10% deduction in score per day.
- In the event of a missed exam, see your instructor/professor as soon as possible.
- No cell phone or social networking (facebook, twitter, etc.) during class.

Required Text

- Michael L. Shuler and Fikret Kargi. 2002. Bioprocess Engineering: Basic Concepts. 2nd Edition. Prentice Hall, Englewood Cliffs, N.J.
- Pauline M. Doran. 1995. Bioprocess Engineering Principles. 4th Edition. Academic Press Limited, Oval Road, London.

Grading

The final grade will be based on the weighted average of homework and exams:

Homework	20%
Midterm exams	25%
Project reports/presentations	45%
Final exam	10%

Course syllabus

Week	Topic	Assignment / Exam
1	Introduction to course Biological basics • Cell construction • DNA, RNA, central dogma • Translation, Transcription	
2	Major metabolic pathways • Glucose metabolism • Nitrogen fixation • Anaerobic and aerobic metabolism	Homework 1 (uploaded online)
3	Enzyme kinetics • Michaelis-Menten type kinteics • Competitive, non-competitive, uncompetitive, and substrate inhibition • Immobilized Enzyme Systems	Homework 2
4	Cell growth • Stirred Tank Reactors • Sterilization, medium and inoculum preparation • Batch fermentation Lab 1– Fermentation growth of *Lactobacillus aceti*	Homework 3 Design project proposal presentations on Friday
5	Continuous fermentation • Kinetics • Optimization	Lab report 1 Project Report 1[microbial and medium characteristics]
6	• Operating considerations • Two-vessel fermenters	Homework 4 **First midterm exam:** 2/9/13
7	Chemostat • With recycle • Multistatge chemostat Fed-Batch Systems Immobilized Cell Systems	Homework 5
8	Aeration Oxygen transfer Oxygen uptake rate	Homework 6 Project Report 2 [bioreactor design]
9	**Spring Break**	
10	Agitation • Reactor types • Baffle • Spargers Lab 2- Aeration Lab	
11	Recovery and purification	Homework 7

	• Separation of insoluble products • Filtration, centrifugation, coagulation	Lab report 2
12	Cell disruption • mechanical and non-mechanical methods	Project Report 3 [aeration and agitation] Homework 8
13	Separation of soluble products • Liquid-liquid extraction • Precipitation • Adsorption and dialysis	**Second midterm exam:** 4/3/13 Homework 9 (due Friday because of midterm on Wednesday)
14	Reverse osmosis, ultra filtration, cross flow ultra-filtration Chromatography, electrophoresis, electro dialysis	Homework 10 Project Report 4 [Separation]
15	Finishing steps of purification • Crystallization, drying Wrap up session Field Trip	Homework 10
16	Final Design project reports and presentations	
17	Final Exam Week	

Academic integrity

As defined by University Faculty Senate Policy 49-20, is the pursuit of scholarly activity free from fraud and deception and is an educational objective of this institution. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students.