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BIOPROCESS

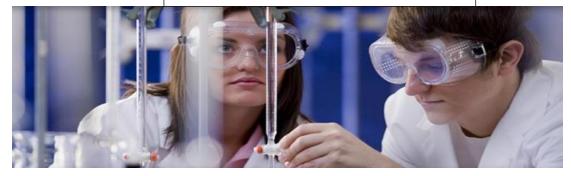
ABE 572

ENGINEERING

Course Syllabus

Spring 2013





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Office Hours: by appointment

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.

Class time

Monday, Wednesday, Friday 2.30 – 3.20 pm 124 Ag Eng. Bldg

Credits: 3.0

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

	• Separation of insoluble products	Lab report 2
	• Filtration, centrifugation, coagulation	
12	Cell disruptionmechanical and non-mechanical methods	Project Report 3 [aeration and agitation] Homework 8
13	Separation of soluble productsLiquid-liquid extraction	Second midterm exam: 4/3/13
	 Precipitation Adsorption and dialysis	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 purificationCrystallization, dryingWrap up sessionField 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.