

126:410 Process Biotechnology (index 56987)

Spring 2013

Professor Henrik Pedersen

C-005 (SoE, Busch)

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required text for this course - BIOPROCESS ENGINEERING PRINCIPLES, 2nd Edition, Pauline M. Doran, Academic Press (Elsevier), 2013 ISBN 978-0-12-220851-5; handouts will also be provided

Lectures MW6, 5³⁵-6⁵⁵, Foran Hall 138b

This course introduces quantitative methods used in modern biochemical engineering practice to students with a biological sciences background. The basic principles of mass and energy balances are discussed and their application to a variety of biological systems from cells to production facilities is presented. Analysis of metabolism at the cellular level is introduced and rational design of new industrial organisms is described. The design principles and approaches used for large-scale production are developed. A basic background in microbiology is assumed along with some mathematics, including linear algebra and calculus. Not open to students in chemical engineering.

OUTLINE

1	1/23	Introduction, overview, course schedule/requirements, engineering calculations	Chapter 1.
2	1/28, 30	Presentation and analysis of data, linear models, nonlinear models,	Chapter 2.1-6, 3.1-3 HW1
3	2/4, 2/6	Growth stoichiometry, product formation, reductance balance, yield, maintenance	Chapter 2.7, 4.6, 12.1, 12.3, 12.7
4	2/11, 13	Reaction rates and biological systems,	Chapter 12.8, 12.10-14 HW2
5	2/18, 20	Metabolic flux analysis	Chapter 12.16
6	2/25, 27	Mass balances, species mass, continuous systems	Chapter 4 HW3
7	3/4, 3/6	Energy balance, enthalpy calculations, unsteady state mass and energy balances	Chapter 5, 6
8	3/11, 13	Exam 1 ; Pilot plant visit	Chapters 1-6, 12
9	3/18, 20	<i>Spring Break, no class</i>	
10	3/25, 27	Chemostats, batch reactors, fed-batch reactors	Chapter 14.5
11	4/1, 3*	Mass transfer, oxygen transfer rate, scale-up,	Chapter 10.5-12, 8.5, 8.6, 8.11 HW4
12	4/8, 10	Unit operations, downstream processing	Chapter 11.1-2
13	4/15, 17	Filtration, centrifugation, chromatography,	Chapter 11.3-4, 11.11 HW5

14	4/23, 25	Bioprocess design	handout
15	4/30	Review	HW6
16	5/2	Exam 2	Chapters 8, 10, 11, 14

Course objectives (Learning Goals): Students will learn to

1. Employ the general of mass and energy conservation principles to problems not previously seen.
2. Formulate models for quantitative understanding of biological growth and metabolism
3. Perform data analysis and parameter estimation for algebraic models, including nonlinear models
4. Know how to build flux analysis models from genomic-derived pathway data
5. Analyze journal papers that employ conservation models and flux analysis in biological systems
6. Summarize the major unit operations used downstream in bioprocess systems
7. Diagram a process flow sheet for large-scale industrial synthesis of biological products

Assessments

Homeworks (40%), exams (50%), class participation (10%)

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- properly acknowledge and cite all use of the ideas, results, or words of others.
- properly acknowledge all contributors to a given piece of work.
- make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of impermissible materials or impermissible collaboration.
- obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Adherence to these principles is necessary in order to ensure that

- everyone is given proper credit for his or her ideas, words, results, and other scholarly accomplishments.
- all student work is fairly evaluated and no student has an inappropriate advantage over others.
- the academic and ethical development of all students is fostered.

- the reputation of the University for integrity in its teaching, research, and scholarship is maintained and enhanced.

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