126:410 Process Biotechnology (index 56987) **Spring 2013**

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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, 5^{35}-6^{55}, 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	*Spring Break, no class*	
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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- 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.

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