

UNIVERSITY OF GUELPH  
SCHOOL OF ENGINEERING  
**ENGG\*4380 Bioreactor Design**  
**Winter 2013**

**Instructor:** Ping Wu, *P.Eng.*  
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**Calendar Description:**

Topics in this course include: modeling and design of batch and continuous bioreactors based on biological growth kinetics and mass balances; gas-liquid mass transfer for aeration and agitation; instrumentation; and control.

Prerequisite: ENGG\*3160 Biological Engineering Systems II

**Class Schedule:**

Lectures: Tuesday and Thursday, 1130 hr – 1250 hr  
MACK Room 317

Lab: Friday, 1130 hr – 1320 hr  
THRN Room 1002/1004

**Course Objectives:**

After successfully completing the course, students will be able to:

1. Describe and specify reactors used in industrial bioprocesses
2. Develop mathematical models for bioreactors, analyze their behaviour (dynamic and steady state) and specify operating parameters
3. Design complete bioreactor systems integrated with upstream and downstream processing operations
4. Use modelling and simulation tools to evaluate costs and environmental impact of a complete bio-process

**Topics (tentative):**

1. Introduction to bioreactor design
2. Modelling reaction kinetics (quick review of basics + more complex models)
  - kinetics of cell growth
  - enzyme kinetics
  - estimating kinetic parameters
3. Ideal bioreactors
  - stirred tank reactors
  - batch operation
  - continuous (reactors in series, reactors with recycle)
4. Industrial operations
  - process design & scale-up
  - large-scale reactors

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- sterilization & containment – sanitary design
- energetics and gas transfer
- instrumentation & control
- economics
- GMP and process validation

5. Case studies

**Textbook:**

*Modern Biotechnology: Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals.*  
N.S. Mosier and M.R. Ladisch. John Wiley & Sons, Inc. 2009

**Additional References:**

*Biochemical Engineering Fundamentals.* 2nd edition. James E. Bailey and David F Ollis.  
McGraw-Hill 1986.

*Basic Bioreactor Design.* K. van't Riet and J. Tramper. Marcel Dekker, Inc., New York  
1991.

*Bioprocess Engineering Basic Concepts* (2nd edition) 2002. Michael L. Shuler and Fikret  
Kargi, Prentice Hall, Upper Saddle River, NJ

*Bioprocess Engineering Principles* Pauline Doran, Academic Press, London, 1995.

**Evaluation:**

Assignments/short tests (quiz type)	40%
Design project	60%

All short tests will be held during tutorial hour. Last class week will be used to present project reports.

**University Policy on Academic Misconduct:**

Academic misconduct, such as plagiarism, is a serious offence at the University of Guelph. Please consult the Undergraduate Calendar 2012-2013 and School of Engineering programs guide, for offences, penalties and procedures relating to academic misconduct.

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

**Disclaimer:**

The instructor reserves the right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph Academic Regulations.