ENGG 2660 – Bioengineering Systems 1
Winter 2007

Bioengineering is a broad discipline that integrates engineering principles with biological sciences. Applications include biochemical and food engineering, biomedical engineering and bioresource engineering. Systems identification and analysis are common to all of these areas and form the foundation for engineering design.

This course uses techniques and tools developed in ENGG*2400 to analyse mass, energy and momentum components of biological systems. We will focus on systems containing biological catalysts (e.g. cells, enzymes) and/or other reacting species, or mechanical systems from the human body. A range of bio-system examples will be studied including those pertaining to the biomedical, food and bioprocessing industries.

Instructor Information

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Teaching Assistant*:* Angela Catford, Rm 319 Thornbrough Bldg. Email: acatford@uoguelph.ca

Website: Through University of Guelph course link (Web CT) webpage.

Course Description and Scheduling

Lecture Times: T, Th , 8:30-9:50 MACK 309
Tutorial Times: Th, 11:30-12:20 MACK 307
Exam: Monday, April 9, 8:30-10:30
Prerequisites*:* MATH*2270, MICRO*1020, ENGG*2400
Co-requisite*:* CHEM*2580, STAT*2120

Objectives:
Students who successfully complete this course will be able to:

1. Identify and analyse mass and energy transformations in biological systems
2. Develop mathematical models for biological systems and analyse their dynamic behaviour.
3. Integrate fundamental principles of microbiology and biochemistry with quantitative analysis to solve engineering problems.

Topics:

Review Topics

- Cell characteristics, physiology and growth requirements

Modelling examples from Bioprocess Engineering

- Mass balances - conservation of mass; process flow diagrams; mass balances with and without reaction; total mass vs. composition; steady state and dynamic systems
- Energy balances - conservation of energy; enthalpy; heats of reaction; energy of phase changes

- Reaction kinetics - kinetics of cell growth and product formation; enzyme kinetics; first-order kinetics; temperature effects

Modelling Examples from Biomedical Engineering

- Musculoskeletal System - Muscle anatomy, structure and function, active and sliding filament models, energy considerations, Hill's Model.
- Circulatory System - Overview of anatomy, function, blood properties, flow and resistance.

Recommended Textbook:

Bioprocess Engineering Principles P. M. Doran Academic Press, Toronto 1995.
Introduction to Biomedical Engineering M.M. Domach, Pearson Education Inc., 2004.

Assessment:

Quizzes and Assignments	35%
Term Report	20%
Final examination	45%
TOTAL	100 %

Weekly assignments will be handed out through webCT, students are encouraged to complete all of these assignments. **Quizzes** will be held biweekly beginning January 25 during tutorial sessions. The teaching assistant will provide a review and help with questions before the quiz during tutorial sessions. On off weeks without a quiz, one question will be chosen at random from the previous 2 assignments to be handed in. This will be announced at the end of the tutorial session. The question will be due at 8:30 Friday morning. Late assignments will receive a grade of 0. This question will be marked rigorously – i.e. solutions should be thoroughly and professionally presented.