SCHOOL OF ENGINEERING
UNIVERSITY OF GUELPH

Course Description and Outline 2007

Course No.	Name	Semester	Hours
ENGG*3160	Biological Engineering Systems II	Fall	(3-2) [0.50]

Prerequisites: ENGG*2230, ENGG*2660

Faculty:	H.R.Salsali,	Room XXXX, Thornbrough Building, Ext. XXXXX.
Lab Technician:	M. Leunissen,	Room 227, Thornbrough Building, Ext. 56141.
Teaching Assistants:	O. Mullings,	Room XXX, Thornbrough Building, Ext.XXXXX.

Calendar Description: Mass transfer in biological systems: concepts; gas-liquid mass transfer; membrane transport processes; and heterogeneous reactions. Applications may include fermenter aeration, tissue perfusion, mass transfer limitations in biofilms, microbial flocs and solid tumours, protein recovery and drug delivery.

Learning Objectives: Students who successfully complete this course will be able to:
a) develop conceptual models of biological systems;
b) with engineering principles use these concepts to develop mathematical descriptions; and
c) use these quantitative descriptions in equipment design.

Textbook: The text for this course is Transport Phenomena in Biological Systems by Truskey, Yuan and Katz (Pearson, 2004, ISBN 0-13-042204-5). There are a lot of other references that can be used as well, for example, Biochemical Engineering Fundamentals by J.E. Bailey and D.F. Ollis is one worth looking at. The lecture material will be drawn from other sources to supplement the text. I don't intend to repeat the text orally but will aim at the methodology and tools rather than creating a cookbook full of miscellaneous facts. I will make my lecture notes available.

Laboratory: The laboratory component will consist of three mass transfer experiments. These are to be done by groups of three students. One member of the group will prepare a "formal" report and the other two will write "memo" reports for a particular experiment. Each member will be responsible for one "formal" and two "memo" reports.

Tutorials: Tutorial sessions will be held in the lab times when no labs are scheduled (starting in the second week of classes). These will generally be consultation and help sessions.

Evaluation:		
	Assignments:	20%
	Lab Reports: Formal Report (1 x 20%)	25%
	Memo Reports (2 x 5%)	10%
	In Class Quizzes:	15%
	Final Exam:	30%

Notes:
-Please refer to the calendar regarding academic misconduct. The School is operating on a zero-tolerance policy in these matters.
-The laboratory reports will be graded for both their technical content and for their grammar and writing style.

ENG3160 Material To Be Covered:

Biological Mass Transfer Introduction
- -Growth requirements
- -Membrane Transport

Mass Transfer Fundamentals
- -Diffusion, mass balances and Fick's law
- -Convection ,boundary layer flow and Navier-Stokes equations
- -Lumped approximation models and mass transfer correlations

Bubble Mechanics
- -Surface tension, Laplace's law and bubble formation
- -Drag forces, terminal velocities and holdup correlations (**a**)
- -Bubble surface mass transfer coefficients ($\mathbf{k_L}$)
- -$\mathbf{k_L a}$ correlations and measurement
- -Applications in aerobic culture operations

Agitation
- -Impellers, mixing and flow patterns
- -Power correlations for mass transfer

Membrane Processes
- -Diffusion through membranes
- -Dialysis, Pervaporation and Ultrafiltration
- -Tissue perfusion
- -Applications in oxygenation, biological product recovery and drug delivery

Heterogeneous Reactions
- -Diffusion through porous solids with chemical reaction
- -Convection to membrane surfaces
- -Rate limitations and Thiele modulus
- -Applications in pellet fermentations, tumor necrosis and bio-films

Sterilization Operations
- - Steam sterilization
- - Chemical sterilization and disinfection
- - Depth and porous membrane filtration
- - Bio-containment