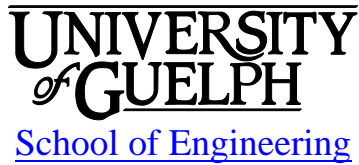


ENGG*3160 Biological Engineering Systems II

Fall 2013



(Revision 0, August 2013)

1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Dr. Suresh Neethirajan, PhD., P.Eng
Office: THRN 2505, ext. 53922
Email: sneethir@uoguelph.ca
Office hours: TBA on Courselink or by appointment

1.2 Lab Technician

Technician: Carly Fennell
Office: THRN 1104, ext. 56676
Email: genc@uoguelph.ca

1.3 Teaching Assistants

GTA	Email	Office Hours
Carlos Torres	ctorres@uoguelph.ca	TBA on Courselink

2 LEARNING RESOURCES

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*3160 Courselink site. You are responsible for checking the site regularly.

2.2 Required Resources

None. Lecture materials and notes will be posted in the course outline.

2.3 Recommended Resources

Fournier, Ronald AL: Basic Transport Phenomena in Biomedical Engineering, CRC Press 2012.

Cussler EL: Diffusion: Mass transfer in fluid systems. Cambridge University Press 2009 (3rd Edition)

Transport Phenomena in Biological Systems (Second Edition) George A. Truskey, Fan Yuan, David Katz. Pearson Prentice Hall, ISBN 0-13-156988-0.

2.4 Additional Resources

Lecture Information: All the lecture notes are posted on the web page (week #1-#12).

Lab Information: The handouts for all the lab sessions are within the lab section. All types of resources regarding tutorials, links to web pages can be found in this section.

Assignments: Download the assignments according to the schedule given in this handout. All the solutions will be posted as indicated.

Miscellaneous Information: Other information related to the laboratory experiments are also posted on the courselink web page.

2.5 Communication & Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. It is your responsibility to check the course website regularly. As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its student.

3 ASSESSMENT

3.1 Dates and Distribution

Distribution	Grades	Due Date
Assignment 1	5%	September 30, 2013
Assignment 2	10%	October 30, 2013
Assignment 3	10%	November 13, 2013
Lab Report 1	10%	Oct 15 (Sec 01), Oct 17 (Sec 02)
Lab Report 2/3	10%	Oct 22 (Sec 01), Oct 24 (Sec 02)
Lab Report 2/3	10%	Oct. 29 (Sec 01), Oct. 31(Sec 02)
Lab Report 4	5%	Nov 12 (Sec 01), Nov 14 (Sec 02)
Presentation	10%	Nov 18 – Nov 27, 2013
Final Exam	30%	Dec 12, 2013 (11:30 am to 13:30 pm)

3.2 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:

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

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

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

Passing grade: In order to pass the course, you must pass both the laboratory and exam course portions. Students must obtain a grade of 50% or higher on the exam portion of the course in order for the laboratory write-up portion of the course to count towards the final grade.

Missed midterm tests: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of the missed test will be added to the final exam. There will be no makeup midterm tests.

Lab Work: You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab.

Late Lab Reports: Late submissions of lab reports will not be accepted.

4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 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.

Prerequisite(s): ENGG*2230, ENGG*2660

The objective of this course is to introduce mass transfer processes of biological and medical importance and the methods used to model them. It is expected that the students can solve a first order differential equation and that they understand boundary conditions.

4.2 Course Aims

The objective of this course is to introduce mass transfer processes of biological and medical importance and the methods used to model them.

4.3 Learning Objectives (LO)

- 1) Understand the process of diffusion and diffusive mass transport across biological membranes
- 2) Understand the basic mass transfer models in applications such as hemodialysis, capillaries, lungs and relevant biological systems

4.4 Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1, 2	Exams, Labs
2. Problem Analysis	1,2	Exams, Labs
3. Investigation	1,2	Exams, Labs
4. Design	1,2	Exams, Labs
5. Use of Engineering Tools	1,2	Exams, Labs
6. Communication	1,2	Exams, Labs
7. Individual and Teamwork	1,2	Labs
8. Professionalism	1,2	-
9. Impact of Engineering on Society and the Environment	1,2	Assignment
10. Ethics and Equity	1,2	-
11. Environment, Society, Business, & Project Management	1,2	Assignment
12. Life-Long Learning	1,2	-

Learning Outcomes:

- 1) Demonstrate the ability to apply the engineering fundamentals of energy and mass transfer to biological systems.
- 2) Develop an understanding of the transport phenomena occurring in biological systems, especially the human body.

4.5 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink/D2L but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and project.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

4.7 Relationships with other Courses & Labs

Previous Courses:

ENGG*2660

Fundamental understanding and knowledge of analysis of mass, energy and momentum components learned in ENGG*2660 is essential to be able to solve differential equation based problems in ENGG*3160.

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Monday		10:30 AM – 11:20 AM	MACK 225
Wednesday		10:30 AM – 11:20 AM	MACK 225
Friday		10:30 AM – 11:20 AM	MACK 225

Laboratory:

Tuesday	Sec 01	11:30AM - 13:20 PM	THRN 1104
Thursday	Sec 02	11:30 AM - 13:20 PM	THRN 1104

5.2 Lecture Schedule

Week	Topic
1 & 2	Transport Phenomena - Hemoperfusion Example - Units and Dimensions - Review of significant digits, Example problems – LO 1, 2
2	Principles of diffusion. Fick's law. Steady state diffusion in one dimension
3	Mass balances for the ideal type reactors - mass balance equations for a continuously stirred tank reactor, batch, flow or tubular reactors - LO 1, 2
4	Phase equilibrium in mixtures, physical properties of the body fluids and cell membrane - LO 1, 2
5	Solute transport, capillary properties, solute diffusion, Fick's law, Solute diffusion through

	heterogeneous media - LO 1, 2
6	Diffusion in blood and tissue, solute permeability, transport of solute across capillary wall - LO 1, 2
7	Thermodynamics, Fundamental relationships, phase equilibrium in mixture introduction - LO 1, 2
8 & 9	Mass transfer in haemodialysis (Artificial kidney) - LO 1, 2
10	Oxygen transport in biological systems, Pharmacokinetic analysis - LO 1, 2
11	Mass transfer across the skin. Drug Delivery problems. Transfer of drugs or toxins across the skin - LO 1, 2
12	Slow release devices, implants, Review, Student Presentations

5.3 Lab Schedule

Week	Topic
1,2,3	Review of Concepts, Lab Safety Orientation
4	Introduction to Lab Equipment and Safety Training
5	Laboratory 1
6 and 7	Laboratory 2 and Laboratory 3
8	Documentary Movie
9 and 10	Laboratory 4
11, 12	Review, Presentations

5.4 Other Important Dates

Thursday, 5 September 2013: First class

Monday, 14 October 2013: Thanks giving holiday

Thursday, 31 October 2013: drop date – 40th class

Thursday, 28 November 2013: last class (Monday Schedule in effect)

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.

6 LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

7 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

A tutorial on Academic Misconduct produced by the Learning Commons can be found at: <http://www.academicintegrity.uoguelph.ca/>

Please also review the section on Academic Misconduct in your [Engineering Program Guide](#).

The School of Engineering has adopted a Code of Ethics that can be found at: <http://www.uoguelph.ca/engineering/undergrad-counselling-ethics>

8 Accessibility:

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or

accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: <http://www.csd.uoguelph.ca/csd/>