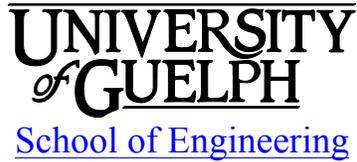


ENGG\*3160  
Biological Engineering Systems II  
Fall 2015



(Revision 0, September 10, 2015)

---

## 1 INSTRUCTIONAL SUPPORT

### 1.1 Instructor

Instructor: Ashutosh Singh, Ph.D.  
Office: THRN 2342, ext. 53048  
Email: [asingh47@uoguelph.ca](mailto:asingh47@uoguelph.ca)  
Office hours: Open door or by appointment

### 1.2 Lab Technician

Technician: Ryan Smith  
Office: THRN 1114, ext. 53278  
Email: [rsmith17@uoguelph.ca](mailto:rsmith17@uoguelph.ca)

### 1.3 Teaching Assistants

<b>GTA</b>	<b>Email</b>	<b>Office Hours</b>
Erika Fiedler	<a href="mailto:efiedler@uoguelph.ca">efiedler@uoguelph.ca</a>	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 to the ENGG\* 3160 [CourseLink](#) site.

## 2.3 Recommended Resources

1. Fournier, Ronald AL: Basic Transport Phenomena in Biomedical Engineering, CRC Press 2012.
2. Cussler EL: Diffusion: Mass transfer in fluid systems. Cambridge University Press 2009 (3rd Edition)
3. 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 will be posted on [CourseLink](#) as they are finalized (prior to lectures).

**Lab Information:** Information for the course labs will be posted within the lab section of the CourseLink page. All other 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](#) site.

## 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 <mail.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 %	October 9, 2015
Assignment 2	5 %	October 30, 2015
Assignment 3	5 %	November 20, 2015
Lab Report 1	10%	Oct. 14 (Sec 01, 03), Oct .19 (Sec 02)
Lab Report 2/3	10%	Oct. 26 (Sec 01, 03), Oct. 30 (Sec 02)
Lab Report 2/3	10%	Nov. 2 (Sec 01, 03), Nov. 6 (Sec 02)

Distribution	Grades	Due Date
Lab Report 4	5%	Nov. 9 (Sec 01, 03), Nov. 13 (Sec 02)
Presentation	10%	Nov. 16 – Nov. 20, 2015
Final Exam	40%	Dec. 7, 2015 (8:30 AM – 10:30 AM)

### 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. Similarly, students must obtain a grade of 50% or higher on the laboratory write-up portion of the course in order for the exam portion to count towards the final grade. If a student fails both portions of the course, then the grade will be the lower of the two.

**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

## 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.

To fulfil the course objective it is expected that the students can solve a first order differential equation and that they understand boundary conditions.

## 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:

<b>Graduate Attribute</b>	<b>Learning Objectives</b>	<b>Assessment</b>
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, Presentations
7. Individual and Teamwork	1,2	Labs, Presentations
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

<b>Lectures:</b>			
Monday		10:30 AM – 11:20 AM	MCKN 116
Wednesday		10:30 AM – 11:20 AM	MCKN 116
Friday		10:30 AM – 11:20 AM	MCKN 116

<b>Laboratory:</b>			
Monday	Sec 01	08:30 AM - 10:20 AM	THRN 1104
Friday	Sec 02	01:30 PM - 03:20 PM	THRN 1104
Monday	Sec 03	11:30 AM - 01:20 PM	THRN 1104

<b>Exam:</b>			
Monday		08:30 AM - 10:30 AM	TBD

## 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 hemodialysis (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
4	Lab Safety Orientation, Introduction to Lab Equipment and Safety Training & Laboratory 1
5	Thanksgiving (No Labs)
6 and 7	Laboratory 2 and Laboratory 3
8 and 9	Laboratory 4
10	Presentations
11, 12	Review

## 5.4 Other Important Dates

Thursday, September 10, 2015: First day of class

Monday, October 12, 2015: Thanksgiving holiday

Tuesday, October 13, 2015: Fall study day, no classes

Friday, November 6, 2015: 40th class day, last day to drop classes

Friday, December 4, 2015: last day of class

---

## 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.

If the laboratory rules are not followed, consequences will include removing student's access to the lab. If this results in lab work not being completed, the student will receive a grade of 0.

---

## 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](tel:519-824-4120) ext. 56208 or email [csd@uoguelph.ca](mailto:csd@uoguelph.ca) or see the website: <http://www.uoguelph.ca/csd/>

---

## 9 RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

---

## 10 RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:

<http://www.uoguelph.ca/registrar/calendars/index.cfm?index>