ENGG*3160 Biological Engineering Systems II

Fall 2017

Sections(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - September 06, 2017

---

1 Course Details

1.1 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.

Pre-Requisite(s): ENGG*2230, ENGG*2660

1.2 Course 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.

1.3 Timetable

Lectures:
Monday 11:30 AM – 12:20 PM ALEX 218
Wednesday 11:30 AM – 12:20 PM ALEX 218
Friday 11:30 AM – 12:20 PM ALEX 218

Tutorials (Weeks: 1-3 & 10-12):

Sec 01: Friday 02:30 PM - 04:20 PM THRN 1104

Sec 02: Thursday 10:30 AM - 12:20 PM THRN 1104

Laboratory Experiments (Weeks: 4-9):

Sec 01: Friday 02:30 PM - 04:20 PM THRN 1104

Sec 02: Thursday 10:30 AM - 12:20 PM THRN 1104

Midterm Exam: October 20, 2017 TBA
Final Exam: December 08, 2017, 11:30 AM to 01:30 PM, Location TBA

1.4 Final Exam

December 08, 2017, 11:30 AM to 01:30 PM, Location TBA

---

2 Instructional Support

2.1 Instructor(s)

Ashutosh Singh

Email:	asingh47@uoguelph.ca
Telephone:	+1-519-824-4120 x52902
Office:	RICH 3525
Office Hours:	Open door or by appointment

2.2 Instructional Support Team

Lab Technician:	Jacqueline Fountain
Email:	fountain@uoguelph.ca
Telephone:	+1-519-824-4120 x56676
Office:	THRN 1102

2.3 Teaching Assistant(s)

Name	Details
Harjeet Singh Brar	brarh@uoguelph.ca TBA

---

3 Learning Resources

3.1 Required Resources(s)

Course Website (Website)

https://www.courselink.uoguelph.ca
Course material, news, announcements, and grades will be regularly posted to the ENGG*3160 Courselink site. You are responsible for checking the site regularly.

Biological and Bioenvironmental Heat and Mass Transfer (Textbook)

A. K. Datta, CRC Press, Taylor & Francis Group, Boca Raton, FL, 2002

3.2 Recommended Resources(s)

Transport Processes and Separation Process Principles (Textbook)

Christie john Geankoplis, Fourth Edition, Prentice Hall, ISBN 0-13-101367-X

Transport Phenomena in Biological Systems (Textbook)

George A. Truskey, Fan Yuan, David Katz, Second Edition. Pearson Prentice Hall, ISBN 0-13-156988-0.

3.3 Additional Resources(s)

Lecture Information (Notes)

A summary of lecture notes will be posted on Courselink as they are finalized (prior to lectures).

Lab Information (Notes)

The lab manuals and lab schedule will be posted on the Courselink. You are responsible for printing the lab manuals and having them with you during the laboratory sessions.

Home Assignments (Other)

There will be approximately 11 problem sets posted in Courselink during the term. These problem sets will not be graded, but it is recommended that you do each problem set, as practice problems are the best way to learn the course. All solutions will be posted.

Miscellaneous Information (Other)

Other information related to the ENGG 3160 course will be posted on the Courselink site.

3.4 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. You are encouraged to use [ENGG*3160] in the subject line while emailing your GTA and instructor.

---

4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Identify important biological heat and mass transfer processes, and derive the basic expressions for them based on mass conservation.
2. Understand and apply the process of diffusion and diffusive mass transport across biological systems
3. Determine steady state, transient and convective mass transfer in various geometries of practical importance
4. Evaluate the basic mass transfer models in applications such as hemodialysis, capillaries, lungs and relevant biological systems.

5. Conduct Mass Transfer in Biological Systems laboratory experiments through collecting and analyzing data using the appropriate instruments and write clear, concise and professional laboratory reports.
6. Demonstrate effective skills in teamwork during group activities; demonstrate respectful interactions with peers, lab technician, teaching assistants, and instructor, and also develop self-assessment skills.

4.2 Engineers Canada - Graduate Attributes

Successfully completing this course will contribute to the following:

#	Outcome Set Name	Course Learning Outcome
1	Knowledge base	1, 2, 3, 4
1.3	Comprehend and apply fundamental engineering concepts	3
1.4	Comprehend and apply program-specific engineering concepts	1, 2, 3, 4
2	Problem analysis	1, 2, 3, 4
2.1	Formulate a problem statement in engineering and nonengineering terminology	3
2.2	Construct a conceptual framework	1, 2, 3, 4
2.3	Identify, organize and justify appropriate information	3
2.4	Execute an engineering solution	1, 2, 3, 4
2.5	Critique and appraise results	3
3	Investigation	5
3.3	Analyze and interpret experimental data	5
3.4	Assess validity of conclusions within limitations of data and methodologies	5

---

5 Teaching and Learning Activities

5.1 Lecture Schedule

Date	Topics(s)	References	Details
Weeks 1-2	Introduction to mass and energy conservation and transport phenomenon in biological systems; Introduction to modes of heat transfer and governing equations;	Chapters 1-4	- Introduction to mass and energy conservation and transport phenomenon in biological systems (Chapter 1)

Date	Topics(s)	References	Details
	Conduction: Steady state		- Introduction to modes of heat transfer and governing equations (Chapter 2-3) - Conduction: Steady state (Chapter 4)
Weeks 3-4	Conduction: Unsteady State; Introduction to convective heat transfer; Introduction to mass transfer, mass conservation and kinetics	Chapters 5-9	- Conduction: Unsteady State (Chapter 5) - Introduction to convective heat transfer (Chapter 6-7). - Introduction to mass transfer, mass conservation and kinetics (Chapter 9)
Weeks 4-5	Modes of mass transfer, fluid properties (viscosity, density, kinematic and dynamic viscosity), Phase equilibrium in mixtures, physical properties of the body fluids and cell membrane	Chapter 10	- Modes of mass transfer, fluid properties (viscosity, density, kinematic and dynamic viscosity), Phase equilibrium in mixtures, physical properties of the body fluids and cell membrane (Chapter 10)
Weeks 6-7	Governing equations, boundary conditions of mass transfer; Diffusion mass transfer, steady state diffusion; Mass transfer through biofilms, membrane, capillary transport, mass transfer through porous	Chapters 11-12	- Governing equations, boundary conditions of mass transfer (chapter 11). - Diffusion mass transfer, steady state diffusion (Chapter 12). - Mass transfer through biofilms, membrane, capillary transport, mass transfer through porous media (Chapter 12).
Week 7	Hemodialysis, oxygen transport in human tissues	Chapter 12	- Hemodialysis, oxygen transport in human tissues (Chapter 12).
Week 8	Introduction to unsteady state diffusion mass transfer	Chapter 13	- Introduction to unsteady state diffusion mass transfer (Chapter 13)
Weeks 9-10	Mass transfer across the skin. Drug Delivery problems. Transfer of drugs or toxins across the skin	Chapter 14 + Notes	- Mass transfer across the skin. Drug Delivery problems. Transfer of drugs or toxins across the

Date	Topics(s)	References	Details
			skin (Chapter 14 + Notes).
Week 12	Oxygen uptake by microorganisms (fermentation process); Heat (energy) transfer and analogies to mass transfer; Introduction to Pharmacokinetics	Chapter 14 + Notes	- Oxygen uptake by microorganisms (fermentation process) (Chapter 14). - Heat (energy) transfer and analogies to mass transfer (Chapter 14). (Industrial Visit / Tutorial: TBD) - Introduction to Pharmacokinetics (Instructional notes will be provided).

5.2 Laboratory Schedule

Date	Topics(s)
Weeks 1-3	Tutorial/Quiz
Weeks 4	Laboratory 1
Week 5	Thanksgiving (No Classes and Lab)
Weeks 6-9	Laboratory 2, 3, 4
Weeks 10-12	Tutorial/Quiz/Review

5.3 Other Important Dates

Thursday, September 7, 2017: First day of class
Monday, October 9, 2017: Thanksgiving holiday
Tuesday, October 10, 2017: Study break, no classes
Friday, November 3, 2017: 40th class day, last day to drop classes
Friday, December 1, 2017: last day of class

5.4 Note

In order to explain the concepts of mass transfer in its most practical form this course has been tailored to provide very basic introduction to heat transfer. This will help students to draw analogies between heat and mass transfer. The contents discussed in week 1-4 will be later elaborated in the course ENGG* 3430 (Heat and Mass Transfer).

---

6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Assignments	0.00

Name	Scheme A (%)
Tutorials and Quizzes	10.00
Labs	20.00
Midterm Exam (Open Book)	25.00
Final Exam (Open Book Exam)	45.00
Total	100.00

6.2 Assessment Details

Assignments

Date:

Approximately 11 Problem Sets. These are take-home problem sets and would be made available on the Courselink site every week. Students are encouraged to solve them and practice as much as possible.

Tutorials and Quizzes

Date:

6 tutorial sessions. Each tutorial will cover two parts. In the first part, your GTA will solve and discuss 1 problem and in the second part, you will be asked to solve a problem. At the end of the tutorial, you will submit your solution to the GTA for grading. You are encouraged to attend the tutorial section regularly. If you miss a tutorial, you won't be allowed to write it in any other section and you will receive an immediate **Zero** as the grade.

Labs

Date:

The purpose of performing the Lab of this course is to verify the concepts learned during the lectures. Four tutorial classes (Week 4-9) will be reserved for the ENGG*3160 Labs. The detailed schedule will be posted on Courselink. You need to make groups of 3 students (including yourself) for performing the lab experiments. The lab reports will be due one week after completion of the lab experiments. Each student will submit an individual lab report.

Midterm Exam (Open Book)

Date: Friday, October 20, TBA

TBA

Final Exam (Open Book Exam)

Date: Friday, December 8, TBA

11:30AM to 01:30PM

6.3 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

Missed Midterm Exam: If you miss the midterm due to grounds for granting academic consideration or religious accommodation, the weight of the missed midterm 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 only be accepted with the approval of the course instructor, and will be subject to penalties.

Passing grade: The passing grade of this course is 50%.

6.4 Note

An Open Book exam means that you are allowed to bring the course textbook but not your notes and problem set solutions (If you copy solutions to the problem sets into your textbook, you will not be allowed to use it during the exams). You are also allowed to use a non-programmable calculator during the exams.

---

7 School of Engineering Statements

7.1 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 but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. 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 labs.

7.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. 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.

7.3 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.

8 University Statements

8.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

8.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar.

8.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

8.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

8.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

8.6 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 or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

8.7 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, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

8.8 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.
