ENGG*3470 Mass Transfer Operations

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Winter 2020
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - January 05, 2020

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1 Course Details

1.1 Calendar Description

Application of mass transfer principles in natural and engineered systems. Mass transport in the multi-media fate of contaminants in and between air, water and land. Design and analysis of separation processes for emission and pollutant prevention.

Pre-Requisites: ENGG*2230, ENGG*3260, MATH*2270
Co-Requisites: ENGG*3430

1.2 Course Description

This course introduces students to the theories of the mass transfer and operations. The main goals of this course are to: (1) teach students the approaches to solving environmental engineering related mass transfer problems; and (2) introduce the methods for process analysis and design of mass transfer operations.

1.3 Timetable

Lectures:

11:30 AM - 12:50 PM; Tuesday & Thursday

GRHM, Room 2310

Tutorials:

7:00 PM - 7:50 PM Monday, ROZH Room 109

Labs:

Lab times: There are two two-hour lab sections for the semester. Students are required to form their lab groups and sign their lab time slots within the lab runing period:

Lab 1: Feburary 4 to 15, THRN 1116

Lab 2: March 4 to 11, THRN 1116

Midterm: Time: 11:30 AM to 12:50 PM, Thursday, February 13th; GRHM, Room 2310

Midterm exam will be closed-book but a formula sheet will be provided. Midterm time and location is subject to change. Please see Couselink for the latest information.

1.4 Final Exam

Final Exam: 2:30 PM to 4:30 PM (2020/04/08), **Location: TBD**

Final exam will be closed-book but a formula sheet will be provided. Final exam time and location is subject to change. Please see Webadviser for the latest information.

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2 Instructional Support

2.1 Instructional Support Team

Instructor:	Sheng Chang Ph.D., P.ENG
Email:	schang01@uoguelph.ca
Telephone:	+1-519-824-4120 x56619
Office:	RICH 2519
Office Hours:	Tuesday 2:00 PM -3:00 PM , THRN 2519

Instructor:	Cameron Farrow Ph.D
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Telephone:	+1-519-824-4120 x53838
Office:	RICH 1515
Office Hours:	Open door policy and by appointment.

Lab Technician:	Joanne Ryks
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Lab Technician:	Ryan Smith
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2.2 Teaching Assistants

Meiying Wang mwang15@uoguelph.ca
Justin Donatelli jdonatel@uoguelph.ca

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3 Learning Resources

3.1 Required Resources

Course Website (Website)
ENGG*3470 Courselink site will provide copies of lecture slides, project/laboratory descriptions and assignments.

3.2 Recommended Resources

Principles and Modern Applications of Mass Transfer Operations (Textbook)
Jaime Benítez, 3rd Edition, Wiley, 2016.

Mass Transfer Operations for the Practicing Engineer (Textbook)
Louis Theodore and Francesco Ricci, Wiley AIChE, 2010.

3.3 Additional Resources

Additional Resources (Other)
All lecture slides, lab instructions, project instructions, and practice questions will be posted on Courselink.

3.4 Course Contact Hours (Lectures, Labs, & Tutorials)

The lectures, labs and tutorials are the primary means to be used to support your learning in this course.

Lectures will be the primary means for course news and announcements in addition to provision of course materials. Lecture attendance is expected.

Tutorials will be the primary means for the instructional team to coach you. Tutorials start from Week 2 (7:00 PM to 7:50 PM, ROZH ROOM109). Assignment questions will be given during the tutorial time on Week 3, Week 5, Week 7, Week 8, and Week 10). The week following the reading week counts as week 7.

Labs will be the primary means to be used for "hands-on" skills training. Lab attendance is required.

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4 Learning Outcomes

4.1 Course Learning Outcomes

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

1. Apply mass transfer theory to analyze interface mass transfer mechanisms and solve one-dimensional steady state mass transfer problems.
2. Utilize adsorption theory to analyze adsorption equilibrium and kinetic problems, and design fixed bed adsorption columns for water or air purification.
3. Apply absorption theory to analyze and design packed absorption/stripping equipment for environmental pollutant removal.
4. Apply membrane filtration theory to analyze and design membrane filtration process for water purification.
5. Use box models to solve environmental mass transfer problems.

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	Learning Outcome
1	Knowledge Base	1, 2, 3, 4, 5
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1, 2, 3, 4, 5
1.2	Recall, describe and apply fundamental principles and concepts in natural science	1, 2, 3, 4, 5
1.3	Recall, describe and apply fundamental engineering principles and concepts	1, 2, 3, 4, 5
1.4	Recall, describe and apply program-specific engineering principles and concepts	1, 2, 3, 4, 5
2	Problem Analysis	1, 2, 3, 4, 5
2.1	Formulate a problem statement in engineering and non-engineering terminology	1, 2, 3, 4, 5
2.2	Identify, organize and justify appropriate information, including assumptions	1, 2, 3, 4, 5
2.3	Construct a conceptual framework and select an appropriate solution approach	1, 2, 3, 4, 5
2.4	Execute an engineering solution	1, 2, 3, 4, 5

#	Outcome	Learning Outcome
4	Design	2, 3, 4
4.3	Create a variety of engineering design solutions	2, 3, 4
4.4	Evaluate alternative design solutions based on problem definition	2, 3, 4

5 Teaching and Learning Activities

5.1 Lecture

Topics:

Lectures 1-3: Molecular diffusion

Lectures 4-8: Interphase mass transfer

Lectures 9-11: Adsoprtion

Lecture 12 - Midterm

Lectures 13-15: Absorption/stripping operation

Lecture 16-18: Other separation processes

Lectures 19-23: Environmental transport phenomena

Lecture 24: Final review

Learning Outcome: 1, 2, 3, 4, 5

5.2 Lab

Topics: **Lab1**: Aeration and Oxygen Transfer.

Learning Outcome: 1

Topics: **Lab 2:** Ion Exchange/Column Adsorption

Learning Outcome: 1, 2

Topics: Design Project: Report due on April 2 in class

Learning Outcome: 1, 2, 3

5.3 Note

Laboratory reports and final projects are required to be submitted electronically through the Courselink dropbox.

5.4 Other Important Dates

Monday, January 6: Classes commence
Monday, February 17 – Friday, February 21: Reading Week
Friday, April 3: Classes concluded

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6 Assessments

6.1 Marking Schemes & Distributions

In-tutorial quizzes: 7.5%

In-class -clicker quizzes: 7.5%

Project: 10%

Lab 1: 7.5%

Lab 2: 7.5%

Midterm: 25%

Final Exam: 35%

6.2 Assessment Details

In-tutorial quizzes (7.5%)
Date: Weeks 3, 5, 8, and 10, ROZH ROOM 109
Learning Outcome: 1, 2, 3, 4, 5
In-tutorial quizzes will be held in the tutorial sections in weeks 3, 5, 8 and 10, starting from 7:00 PM. The top 3 grades of the four in-tutoral quizzes will be counted towards the final grade of this course.

In-class i-clicker quizzes (7.5%)
Date: in class
Learning Outcome: 1, 2, 3, 4, 5
I-clicker quizzes will be given in the first 10 minutes of the Thursday class from week 2 to week 11. The top five grades of the ten quizzes will be counted towardes the final grade of

this course.

Laboratory (15%)
Learning Outcome: 1, 2
7.5% - Aeration and Oxygen Transfer – February 4 to 15, THRN 1116

7.5% - Ion Exchange/Column Adsorption – March 4 to 11, THRN 1116

Group Project: Mass transfer operation process design (10%)
Date: Mon, Jan 21 - Fri, Mar 29
Learning Outcome: 1, 2, 3

Midterm (25%)
Date: Thu, Feb 13, 11:30 AM - 12:50 PM, GRHM, Room 2310
Learning Outcome: 1, 2
Midterm exam is closed-book exam. A formula sheet will be provided for the exam.

Final Exam (35%)
Date: Wed, Apr 8, 2:30 PM - 4:30 PM, TBD
Learning Outcome: 1, 2, 3, 4, 5
The final exam is closed-book but a formula sheet will be provided for the final exam.

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7 Course Statements

7.1 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: To pass the course students must obtain a grade of 50% or higher.

In-tutorial quizzes: If you miss three in-tutorial quizzes due to grounds for granting academic consideration or religious accommodation, the weight of your in-tutoral quizzes will be reduced to 3%. If you miss more than three in-tutorial quizzes due to grounds for granting academic consideration or religious accommodation, the entire weiht of your in-tutoral quizzes will be added to the final exam. There will be no makeup for the in-tutorial quizzes.

In-class quizzes: If you miss six in-tutorial quizzes due to grounds for granting academic consideration or religious accommodation, the weigth of your in-class quiz'zes will be reduced to 3%. If you miss more than six in-class quizzes due to grounds for granting academic consideration or religious accommodation, the entire weight of your in-class quizzes will be added to the final exam. There will be no makeup for the in-class quizzes.

Missed midterm: 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.

Lab Work: You must attend and complete the hands on laboratory in order to be eligible to complete the required written laboratory report. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the Lab technician to complete a makeup lab.

Late Lab Reports: Late submissions (without instructor permission based on suitable grounds and documentation) will not be accepted.

Teamwork: Teamwork is required for the completion of the laboratory component of this course. It is expected that you are an active member of the team and provided an approximately equal contribution to the submitted work. If it becomes apparent that this is not the case then the instructor may assign a substantially different (lower) grade for a member of the team.

7.2 Relationships with other Courses & Labs

Previous Courses:

ENGG*2230: Fluid Mechanics: mass and energy conservation of fluid systems and the concept of boundary layers.
ENGG*3260: Thermodynamics: thermodynamic principles of the chemical equilibrium and kinetics.
MATH*2270: Applied Differential Equations: Mathematics employed to solve mass transfer problems.

Co-current Courses:

ENGG*3430: Heat and Mass Transfer: Heat and mass transfer analogies.

Follow-on Courses:

ENGG*4260: Water and Wastewater Treatment Design: mass transfer mechanisms and design principles of unit operations used for water and wastewater treatment.

ENGG*4330: Air Pollution Control: Mass transfer and design methods of air purification.

8 School of Engineering Statements

8.1 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.

8.2 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.

8.3 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.

9 University Statements

9.1 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.

9.2 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 grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

9.4 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.

9.5 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.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website

https://www.ridgetownc.com/services/accessibilityservices.cfm

9.6 Academic Integrity

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 encourages academic integrity. 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.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

9.7 Recording of Materials

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

9.8 Resources

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

Academic Calendars
https://www.uoguelph.ca/academics/calendars
