

Carleton University

Department of Civil and Environmental Engineering

Fall 2022 | ENVE 3002: Environmental Engineering Systems Modelling

Instructor

Shoeleh Shams, shoeleh.shams@carleton.ca

Office Hours

TBD

Schedule

	Day	Time	Building/room
Lectures	Tuesday/Thursday	10:05 - 11:25	ME 3235
Tutorials	Wednesday (starting week 3)	2:35 - 3:25	SA 316
Labs	Schedule and details will be posted in a separate file		MC 1040

Course Objective

This course covers reaction kinetics and reactor design principles commonly used in chemical and biochemical systems and processes. It relies on an understanding of the conservation of mass principle applied to reacting systems and develops the capability to design and analyze systems governed by the rate of reactions. Natural or engineered systems where chemical/biochemical reactions play a major role are frequently encountered in environmental engineering and thus constitute a fundamental aspect of environmental engineering practice. The course is therefore a prerequisite for some key courses in the Environmental Engineering Program: ENVE3001 Water Treatment Principles and Design, ENVE3004 Contaminant Transport in the Environment, ENVE4005 Wastewater Treatment Principles and Design, ENVE4101 Waste Management.

Intended Learning Outcomes

Upon the completion of this course, you should be able to:

- Formulate reaction kinetics and identify and follow the techniques used for collecting kinetic data
- Compute the dependence of reaction rates on the concentration of species and temperature
- Analyze the fluid flow behavior in natural and engineered systems in idealized models
- Apply mass balance and kinetic data in ideal reacting systems/reactors to analyze their performance or to determine the required size for design
- Assess the effect of divergences from idealized models in terms of the expected performance or required size of reactors/systems

Graduate Attributes (GAs)

GAs are assessed in preparation for accreditation by Engineers Canada. It is to ensure that authorities recognize our graduates as meeting the academic requirements for licensure.

The following GAs will be assessed in this course:

- 3.1 - Complex problem assessment;
- 3.3 - Experimental procedure;
- 3.4 - Data reduction methods and results; and
- 3.5 - Interpretation of data (synthesis) and discussion.

Topic Summary

Week* (approximate)	Anticipated Topic*
1-2	Overview of environmental engineering and major environmental measurements
3	Review of mass balance
4-5	Chemical reaction kinetics: reaction rate, molecularity and order, rate constants, kinetic models, method of analysis for batch reactor
6-7	Introduction to transport phenomena: flux, advection, diffusion, dispersion, settling
8-10	Reaction engineering and design: ideal batch, plug flow and mixed flow reactors
11	Reaction engineering and design: residence time distribution and non-ideal flow
12	Biochemical reactors

* Subject to change

Lecture Notes

Lecture notes will be posted **periodically** on Brightspace. The notes are designed to supplement lectures, but do not represent the complete content of the course (for that you should attend the lectures). Some sections of the notes are left blank. We will fill them throughout lectures but filled notes will not be provided. Please be prepared to fill in your notes by hand, tablet, computer, or any approach you find works best for you.

Lectures will NOT be recorded by the instructor and students do NOT have permission to record lectures.

References

1. Levenspiel, O., Chemical Reaction Engineering, John Wiley & Sons, 1999.
2. Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice Hall, 2016.
3. William W. Nazaroff, Lisa Alvarez-Cohen, Environmental Engineering Science, Wiley 2001
4. Benjamin, M.M. and D.F. Lawler, Water Quality Engineering: Physical/Chemical Treatment Processes, 2013.

Marking Scheme

Your overall course grade will be determined using the following scheme:

Midterm	Labs (3)	Assignments (4)	Final
25%	15%	20%	40%

Homework Assignments

To aid your mastery of the course concepts, problems will be assigned as 4 assignments. You will see solutions to problems similar to the assignments as **tutorials**. Doing the homework will help prepare you for exams. Marks are awarded for a complete and proper writing of the solution (including units, assumptions, conclusion statements, etc.), not just the right answer. **ALL problem sets must be submitted to be eligible to pass this course.** Failing to submit one (or more) assignment(s) will result in disqualification from writing the final exam and passing the course. Assignments should be submitted on Brightspace in **1 file** in acceptable formats (pdf and word document).

Lab Reports

This course includes 3 lab experiments which provide important practical exposure to the material covered in the course. **Lab groups of 3-4 students** will be self-selected, or else randomly assigned. Attending lab sessions is **mandatory**. Lab groups will be required to submit 3 lab assignments (each includes a memo and a formal report) based on the experiments. Memos for each lab are due 1 week after the lab session and formal reports are due 2 weeks after the session. For students who registered in online lab groups, the deadlines (1/2 weeks) count from the day they have their online lab session and get access to videos and data. Students must have completed all laboratory work with a passing grade to be eligible to write the Final Exam.

Lab	Topic
1	Kinetics of Biochemical Oxygen Demand – BOD test
2	Flow Behaviour in a Tubular (Plug-Flow) Reactor
3	Flow Behaviour in Stirred (Continuous-Flow) Reactors

Late Submission Policy

Assignments and lab reports should be submitted by the due date. If you cannot meet a deadline, please make arrangements with the instructor **before** the deadline; otherwise a penalty of **10% per day** will be deducted from your grade up to 3 days or until the solution set (of assignment) is posted. **Late submissions are not accepted after solution set is posted and will result in a grade of zero**, unless appropriate documentation is provided. **If you miss an assignment (or lab report) due to extenuating circumstances, you are responsible for informing your instructor within 3 days of the deadline.** Documentation verifying the severity of the situation will be required to provide accommodations.

Midterm

Midterm will be held during the term (Week 7 or 8). It will be a closed book test that serves as formative assessments of your learning. The exam will be proctored by the teaching team. **To be eligible to pass the course, you must receive a minimum 40% of the midterm.** Marks are awarded for a complete and proper writing of the solution (including units, assumptions, conclusion statements, etc.), **not just the right answer.**

If you miss an exam due to extenuating circumstances, you are responsible for informing your instructor within 3 days of the test. Documentation verifying the severity of the situation will be required to provide accommodations.

Appeals

You should bring any grading appeals to your instructor's attention within 7 days of grades being posted. A brief description of your concern should be submitted in an email to your instructor. Teaching Assistants will not change any marks.

Final Exam

This course has a **two-hour** final exam (to be scheduled in final exam period) which will be an individual closed book test. The exam will be proctored by the teaching team. Marks are awarded for a complete and proper writing of the solution (including units, assumptions, conclusion statements, etc.), **not just the right answer**.

Those who have not submitted all the assignments (and/or lab reports) or have received below 40% (or missed) in the midterm, are not eligible to write the final exam.

Final Grades

Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean.

Course Material Copyright

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by instructor, guest lecturers, teaching assistants, and students, are copyright protected and remain the intellectual property of their respective author(s). **All course materials**, including PowerPoint presentations, outlines, and other materials, **are protected by copyright and remain the intellectual property of their respective author(s)**.

Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to record lectures on their own. Students are NOT permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).

Academic Integrity

Students are expected to know what constitutes **Academic Integrity**, to avoid committing academic offences, and to take responsibility for their actions. Students who are unsure whether an action constitutes an offence, or who need help in learning how to avoid offences (e.g., plagiarism, cheating, etc.) or about "rules" for group work/collaboration should seek guidance from the course instructor, advisor, or the Undergraduate Associate Dean. The "**Academic Integrity Policy**" can be found at: carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy.pdf.

Inclusivity in the classroom

We will strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space (virtual) which we work in will be safe for everyone. Please be considerate of everyone's personal beliefs, choices, and opinions.

Students Responsibilities

Specific student responsibilities for ENVE 3002 are:

- You must abide by Academic Integrity terms, including but not limited to:
 - You must complete and submit exams **as an individual using only the allowable aids**.
 - You must complete and submit assignments as an **individual** according to the given instructions.
- You must understand and abide by Copyright terms. Course content including are intellectual property of the instructor. **Sharing and posting any part of the course content** (lecture notes, assignments, tutorials, and exam questions) **on internet or any media outlet/platform is a copyright infringement** that can result in serious consequences.
- You must understand and abide by **Lab Safety** guidelines at any time that you are in the lab.
- Your behavior must be respectful and professional during the lectures, tutorials, labs, and office hours and also in email communication.
- **You are responsible for knowing** the course schedule and must monitor Brightspace and e-mails (sent by the instructor/TAs) for changes to the schedule and general announcements.
- **You are responsible for informing your instructor when you miss a test or assignment due to extenuating circumstances (within 3 days)**. Documentation verifying the severity of the situation will be required to provide accommodations.

Course Completion

Please take careful note of Section 5.1 of the Academic Regulations in the Undergraduate Calendar (<https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/grading/#credit>):

*“To obtain credit in a course, students **must satisfy the course requirements** as published in the course outline.”*

- You will **fail** the entire course if you do not obtain at least 40% on the midterm or do not submit all assignments and lab reports. Attending labs is mandatory to pass to complete/pass the course.
- Copyright and/or Academic Integrity offences will result in **failing** the course (instructor’s decision) and can result in suspension or expulsion from the University (Associate Dean’s decision).

Student Accommodations

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University.

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Accommodations for Students with Disabilities: The Paul Menton Centre for Students with If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. For more details, visit the [Paul Menton Centre website](#).

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the [Senate Policy on Accommodation for Student Activities \(PDF, 25KB\)](#).

Pregnancy Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Religious Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit the [Equity and Inclusive Communities website](#).

Addressing Human Rights Concerns:

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](#) at equity@carleton.ca.

Mental Wellness

If you find yourself suffering during this or any other term from anxiety, stress, or issues related to mental health, this is nothing to be ashamed of. It is highly recommended that you seek help; refer to [Counselling Services](#). You are also welcome to reach out to the instructor to discuss on-campus resources.

Special Information for Pandemic Measures

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are [a number of actions you can take](#) to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. *If you feel ill or exhibit COVID-19 symptoms do not come to class or campus.* If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's [symptom reporting protocols](#). Please note that reasonable accommodations will be made for those who are ill. It is best to stay home if not well.

Masks: Carleton has paused the [COVID-19 Mask Policy](#), but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.

Vaccines: Further, while proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in [cuScreen](#) as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the [University's COVID-19 website](#) and review the [Frequently Asked Questions \(FAQs\)](#). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.