

Carleton University

Department of Civil and Environmental Engineering

Fall 2021 | ENVE 3002: Environmental Engineering Systems Modelling

Instructor

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Office Hours

Tuesdays, 8:30 am– 9:30 am, starting Tuesday September 14th

TA office hours: TBD

Schedule

	Day	Time
Lectures	Tuesday/Thursday	1:05 - 2:25
Tutorials	Thursday (starting week 3)	5:35 - 6:25
Labs	Schedule and details will be posted in a separate file	

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:

- Understand the techniques used for collecting kinetic data to determine the dependence of reaction rates on temperature and the concentration of species
- Apply kinetic data in different types of reactors/systems to analyze the performance of the reactors/systems or to determine the required size for design
- Analyze the fluid flow behavior in natural and engineered systems in idealized models
- Evaluate the effect of divergences from idealized models in terms of the expected performance or required size of reactors/systems

Graduate Attributes (GAs)

This course is used to assess the following GAs:

- 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
8-11	Reaction engineering and design: ideal batch, plug flow and mixed flow reactors, residence time distribution and non-ideal flow.
12	Biochemical reactors

* Subject to change

Lecture Notes and Recordings

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 synchronous lectures).

Recordings of the lectures will be made available to students who are **currently living in a different time zone** or **do not have access to high-speed and reliable internet**, as well as **PMC students**. Recordings will be made available for **48 hours** after the end of lecture. If you need access to recordings, you should inform the instructor before **September 7th**. If a student misses a lecture due to **technical/connection issues**, they can request access to recordings for that specific lecture. Students who request/get access to recordings must sign an **Affidavit** (confidentiality agreement), stating that they will not share the recordings nor post them on any media outlet.

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. 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 (approximately Week 7). 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.

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.

Student Responsibilities

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) 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.

Specific student responsibilities for ENVE 3002 are:

- Course content including recordings, lecture notes, and all examples (assignments, tutorials, and exam questions) are intellectual property of the instructor. **Recording lectures without permission and sharing/posting any part of the course content on internet/any media outlet is a copy-right offence that can result in serious consequences.**
- Your behavior must be respectful and professional in the virtual environment of lectures and tutorials and also in email communication.
- You must complete and submit exams as an individual using only the allowable aids.
- You must complete and submit assignments according to the given instructions.
- Lab reports handed in for credit must be completed by the lab group. Sources from outside your lab group must be acknowledged. If you are in doubt, contact your instructor.
- **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.

Student Accommodations

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

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, visit [the Equity Services website](#).

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, visit [the Equity Services website](#).

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 carleton.ca/sexual-violence-support.

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your **Letter of Accommodation** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). **Requests made within two weeks will be reviewed on a case-by-case basis.** After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

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 policy](#).

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](#).