# Fall 2024 | ENVE 3002: Environmental Engineering Systems Modelling
# Carleton University
# Department of Civil and Environmental Engineering

## Teaching Team

### Instructor:

Dr. Shoeleh Shams, shoelehshams@cunet.carleton.ca

Office: Mackenzie 4242

### Office Hours

Tuesdays 2-3 pm

### TAs:

Information to be announced on Brightspace

## Course Description and Requirements

### 1. Schedule

| | Day | Time | Building/room |
|---|---|---|---|
| **Lectures** | Tuesday/Thursday | 4:05 - 5:25 pm | ME 4332 |
| **Tutorials** | Friday (starting week 3) | 11:35 am - 1:25 pm | TB 236 |
| **Labs** | Schedule and details will be posted separately | | MC 1040 |

### 2. Course Description

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, ENVE3004, ENVE 4005, and ENVE4101.

### 3. Prerequisites and recommended knowledge

Prerequisites: CHEM 1002/1101, MATH 2004 (or concurrent), and 2$^{nd}$ year. Recommended: ENVE 2001

### 4. Intended Learning Outcomes

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

- Formulate reaction kinetics and follow the techniques used for collecting kinetic data
- Identify and compare transport mechanisms in fluids
- Analyze the fluid flow behavior in natural and engineered systems in ideal models
- Apply mass balance and kinetic data in different ideal reactors (reacting systems with different transport) to analyze their performance or determine the required size for design
- Assess the effect of divergences from ideal systems in terms of the expected performance or required size of reactors

## 5. Graduate Attributes (GAs)

The Canadian Engineering Accreditation Board (CEAB) requires graduates of undergraduate engineering programs to possess 12 attributes. Courses in all four years of our programs evaluate students' progress towards acquiring these attributes. Aggregate data (typically, the data collected in all sections of a course during an academic year) is used for accreditation purposes and to guide improvements to our programs. Some of the assessments used to measure GAs may also contribute to final grades; however, the GA measurements for individual students are not used to determine the student's year-to-year progression through the program or eligibility to graduate. This following list provides the GAs that will be measured in this course, along with the Learning Outcomes that are intended to develop abilities related to these attributes.

| GA - Indicator | Assessment Tool |
|---|---|
| 3.1 - Complex problem assessment | Assignment question |
| 3.3 - Experimental procedure | Lab reports |
| 3.4 - Data reduction methods and results | |
| 3.5 - Interpretation of data (synthesis) and discussion | |

For information on GAs and continual curriculum improvement, visit the Accreditation section of Engineers Canada website.

## 6. Accreditation Units

| Math/Stats | Natural Science (chemistry) | Complementary Studies | Engineering Science | Engineering Design |
|---|---|---|---|---|
| - | 25% | - | 25% | 50% |

## 7. References

### Recommended Textbooks

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.

### 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.

## 8. Topics and Tentative Plan

| **Week*** (approximate) | **Anticipated Topic*** | **Assessment*** |
|---|---|---|
| 1-2 | Chapter 1: Overview of environmental engineering and major environmental measurements | -Biosheet, Sept. 9<br>-A 1 (CH 1&2), Oct. 7 |
| 3 | Chapter 2: Review of mass balance | |
| 4-5 | Chapter 3: Chemical reaction kinetics: reaction rate, molecularity and order, rate constants, kinetic models, method of analysis for batch reactor | A2 (CH 3&4), Oct. 21 |
| 6-7 | Chapter 4: Introduction to transport phenomena: flux, advection, diffusion, dispersion, settling | |
| 8-10 | Chapter 5: Reaction engineering and design: ideal batch, plug flow and mixed flow reactors | A3 (CH5-1), Nov. 4<br>MIDTERM**<br>A4 (CH5-2), Nov. 18 |
| 11 | Chapter 6: Reaction engineering and design: residence time distribution and non-ideal flow | A5 (CH 6&7), Dec. 6 |
| 12 | Chapter 7: Bioreactors and Review | |

* Subject to change

** Midterm will be between November 7 to November 14. The exact date will be decided based on the most popular date determined by survey results.

## 9. Evaluation and Marking Scheme

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

| **Assignments (5)** | **Biosheet** | **Lab Reports (3)** | **Midterm** | **Final** | **Bonus - Academic Resilience Modules** |
|---|---|---|---|---|---|
| 15% | - | 15% | 30% | 40% | Up to 4% |

## 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. Assignments should be submitted on Brightspace in **1 file** in acceptable formats (pdf and word document).

## Biosheet

Provide a **one-page** Biosheet with the following components:

A photo of yourself, your name and preferred name (if applicable), hometown, reason for choosing your discipline of engineering, your favorite course so far, work experience, and career Aspiration. The format is up to you.

## 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. 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 Continuous-Flow Stirred Tank Reactors |
| 3 | Flow Behaviour in a Plug Flow (Tubular) Reactor |

## Midterm

Midterm will be held during a class. It will be a closed book test that serves as formative assessments of your learning. 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**.

## 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 lab reports are not eligible to write the final exam**.

## Bonus - Academic Resilience Modules

Students registered in ENVE 3002 will have the opportunity to earn up to 4% bonus marks for completing modules related to academic resilience. All students will be automatically registered in this course (**"Rethinking Resilience"**) on Brightspace. This course consists of interactive, highly engaging videos and activities that are designed to teach students about the importance of stress, coping, and resilience. We have designed this course so that students can build skills toward academic resilience, and reduce stress associated with university life. There are four modules to complete; each completed module (which should take about ~1-2 hours to complete) will earn you 1% bonus. A module will be considered "complete" and you will be awarded the bonus on the basis of completed knowledge checks and detailed responses on our reflection activities. You have until December 4th (last day of class) to complete all the modules. These marks will be downloaded on the last day of term and added to the final grade.

## 10. Policies

**a) Final Examination**

i. Final exams are for evaluation purpose and will not be returned to students.

i. **Deferred Final Examinations:** Students who are unable to write the final examination because of extenuating circumstances, as defined in the Academic Consideration Policy, may apply for accommodation by contacting the Registrar's office. Consult the Section 4.3 of the University Calendar

**b) Assignment Late Submission Policy**

Assignments 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 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.

**c) Deferred Term-work and late submission policy (Assignments and Midterm)**

Students who claim extenuating circumstances defined in the Academic Consideration Policy, as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases. This must occur **no later than three (3) days after the term work was due** or **Midterm date**. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult Section 4.4 of the University Calendar..

**d) Appeals**

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

## 11. Academic Dates

Students should be aware of the academic dates (eg. last day for academic withdrawal) posted on the Registrar's office web site https://carleton.ca/registrar/registration/dates/academic-dates/

## Academic Integrity and Plagiarism

a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: https://carleton.ca/engineering-design/current-students/fed-academic-integrity Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or, expulsion.

b) One of the main objectives of the Academic Integrity Policy is to ensure that **the work you submit is your own.** As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source.

   Examples of violations of the policy include, but are not limited to:

   - any submission prepared in whole or in part, by someone else;
   - using another's data or research findings without appropriate acknowledgement;
   - submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own; and
   - failing to acknowledge sources of information through the use of proper citations when using another's work and/or failing to use quotations marks.

## Copyright

The materials (including the course outline and any slides, posted notes, videos, labs, project, assignments, quizzes, exams and solutions) created for this course and posted on this web site are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s), during and after the semester.

## Learning and Working Environment

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

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

## Academic Accommodations

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

**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.

You should request your academic accommodations in the Ventus Student Portal, for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm. For final exams, the deadlines to request accommodations are published in the University academic calendars for both undergraduate and graduate students.

**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).

**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).

**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).

**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 Sexual Violence Prevention & Survivor Support.

## Engineering Academic Advising

The Engineering Academic Support Service assists undergraduate engineering students with course selection, registration, and learning support from first-year through to graduation.
Academic Advisors Contact can be found here: https://carleton.ca/engineering-design/current-students/undergrad-academic-support/undergraduate-advisors/.

## Student Mental Health and Wellness

As a university student you may experience a range of mental health challenges that can significantly impact your academic success and overall well-being. Carleton's Wellness Services Navigator is designed to help students connect with mental health and wellness resources.
If you need more information and support with connecting to resources, you are welcome to contact me (shoelehshams@cunet.carleton.ca) or the department at CEEUGChair@cunet.carleton.ca.

Here is a list of on-campus and off-campus recourses:

1. **Carleton's Wellness Desk**: Located at 204A MacOdrum Library, is a space for students to learn about resources, connect with our Wellness Coordinator, and decompress during stressful times of the year. You can pop into the Wellness Desk any time during its hours of operation – no appointments necessary! https://wellness.carleton.ca/mental-health/wellness-desk/

2. **Carleton's Health and Counselling Services:** To book an appointment contact the main clinic by calling (613) 520-6674. If urgent, let the Patient Care Coordinator know or go in person to the main clinic (2500 Carleton Technology and Training Centre Building) and indicate that they are in crisis and need to speak to someone right away. For more information, please see https://carleton.ca/health/

3. **Residence Counselling and Wellness Service:** Counselling services specifically for students in residence. https://carleton.ca/health/residence-counselling/

4. **Therapy Dogs:** Carleton's therapy dogs are around campus with their owners (who are Carleton University staff and faculty) to comfort and provide support to help you thrive as a university student. https://carleton.ca/wellness/dogs/

5. Emergencies and Crisis and Emergency Numbers

6. **Good2Talk (1-866-925-5454):** Good2Talk is a free, confidential helpline providing professional counselling and information and referrals for mental health, addictions and well-being to post-secondary students in Ontario, 24/7/36 https://good2talk.ca/

7. **Empower Me:** Undergraduate students have access to free counselling services in the community through Empower Me, either in person, by telephone, video-counselling or e-counselling. **This free service is accessible 24/7, 365 days per year.** Call **1-844-741-6389 (toll free)** to make an appointment with a counsellor in the community. More information is available https://students.carleton.ca/services/empower-me-counselling-services/

8. **The Walk-In Counselling Clinic (off-campus community resource):** The walk-in Counselling Clinic have offices in various locations across Ottawa and the greater Champlain region that are open 7 days a week. Individuals will be assisted, with no appointment, on a first-come, first-serve basis during the Walk-in Counselling Clinic hours. The Walk-in Counselling Clinic **offers services in many languages** and is free and confidential. More information can be found at: https://walkincounselling.com/

9. **Distress Centre of Ottawa and Region**: Available 10am-11pm, 7 days/week, 365 days/year. **Distress Line:** 613-238-3311, **Crisis Line:** 613-722-6914 or 1-866-996-0991, **Text:** 343-306-5550. https://www.dcottawa.on.ca/

10. **Distress and Crisis Ontario**, Available for chat 2 pm – 2 am EST. https://www.dcontario.org/

11. **BounceBack Ontario** (Toll-Free: 1-866-345-0224) is a free skill-building program managed by the Canadian Mental Health Association (CMHA). It is designed to help adults and youth 15+ manage low mood, mild to moderate depression and anxiety, stress or worry. Delivered over the phone with a coach and through online videos, you will get access to tools that will support you on your path to mental wellness. https://bouncebackontario.ca/.