ENVE4003/5101: Air Pollution and Emissions Control

Department of Civil and Environmental Engineering
Course Syllabus, Fall 2023

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Office Hours: TBD
TA Information: TBD

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1 Course Description and Requirements

1.1 Course Schedule

- Lectures are held Wednesdays and Fridays from 13:05 to 14:25 (EST)
- Tutorials are held Fridays from 14:35 to 15:25 (EST)
- Labs (undergraduate only) are held Fridays from 08:35 to 11:25 (EST)
  Labs run on alternate weeks:
  - Section A1O occurs on odd weeks (starting September 15).
  - Section A2E occurs on even weeks (starting September 22).

1.2 Course Description

Air pollutants, classification, sources, and effects. Ambient air quality objectives and monitoring. Pollutant formation mechanisms in combustion. Major pollutant categories and control methods. Indoor air quality. Laboratory procedures: emissions from boilers and IC engines, particulate size distribution and control, IAQ parameters.

1.3 Precluded Courses

ENVE4003 precludes ENVE5101 and vice versa.

1.4 Prerequisites

CHEM1000 or CHEM1101, MAAE2300, MAAE2400.

1.5 Learning Outcomes

At the end of this course, students will have learned about:

- Atmospheric motion and transport as related to air pollution;
- Air quality regulations, policy, health impacts of air pollution, air pollution and economics;

- Photochemical smog formation and associated details (atmospheric chemistry, isopleths)
- Particles, sources, modes, types, settling, and motion;
- Control of particles; and,
- Control of NO_x and SO_x from stationary sources.

1.6 Graduate Attributes

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 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
GA 1.9 Knowledge Base: Discipline-specific concepts	Overall grade

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

1.7 Accreditation Units

Math	Natural Science	Comp. Studies	Eng. Science	Eng. Design
-	-	-	50%	50%

1.8 Textbooks

This course draws from two textbooks, listed below. These are available through the library's Ares system.

- Jacob, D. J. *Introduction to Atmospheric Chemistry*. Princeton, NJ: Princeton University Press. 1999.
- Schnelle, K. B. et al. *Air Pollution Control Technology Handbook*. Boca Raton, FL: CRC Press, 2002.

1.9 Topics and Tentative Outline

The broad outline of topics is given below. Expect to spend approximately two to three lectures per topic.

Topic 1: The Atmosphere: Hydrostatic balance, temperature profile, buoyancy and small-scale flow.

Topic 2: Fundamentals of Atmospheric Chemistry: Concentration and mixing ratio, lifetime, chemical kinetics, box models.

Topic 3: Climate Change: Energy balance, radiative forcing, greenhouse gases, radiation and its interactions with the atmosphere.

Topic 4: Stratospheric Ozone Depletion: Chapman mechanism, catalytic destruction cycles, polar stratospheric clouds.

Topic 5: Pollution Transport: Continuity equation, advection-diffusion equation in Eulerian and Lagrangian form, non-local pollution sources.

Topic 6: Local Pollution Sources: Dispersion models, receptor models, measurements, standards and criteria pollutants.

Topic 7: Gas-phase Pollution: Hydroxyl cleansing, hydrocarbon oxidation, ozone formation.

Topic 8: Aerosols: Sources, size profile, composition, measurements, dynamics and partitioning, cloud effects.

Topic 9: Pollution Control: Particle removal, combustion, design of pollution control technologies.

Topic 10: Indoor Air Quality: Criteria pollutants, ventilation, sources, measurement, and remediation.

1.10 Evaluation and Marking Scheme

The grade for the undergraduate section of the course will comprise assignments, work during labs, a midterm, and a final exam. Details on the individual graded components will be released at a later time. Weightings for the undergraduate section are as follows:

Component	Weight
Assignments	15
Labs	15
Midterm	20
Final Exam	50

Graduate students do not participate in the lab portion of the course. Instead, graduate students will produce a written report that will make up that portion of the grade. Weightings for the graduate section are as follows:

Component	Weight
Assignments	15
Report	15
Midterm	20
Final Exam	50

1.10.1 Final Examination

- Final exams are for evaluation purposes only and will not be returned to students.
- Final exam will be open book, with written notes and a scientific calculator permitted.
- The final exam constitutes 50% of the course grade.
- Deferred final examinations: Students who are unable to write the final examination because of a serious illness/emergency or other circumstance beyond their control may apply for accommodation by contacting the Registrar's office. Consult Section 4.3 of the University Calendar.

1.10.2 Examination Format and e-Proctoring Statement

The final exam will be written in person.

1.10.3 Term Work Late Submission Policy

Work submitted late will be penalized at a rate of 10% per day.

1.10.4 Self-Declaration Form and Deferred Term Work

Students who claim illness, injury or other extraordinary circumstances beyond their control 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. 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.

1.11 Academic Dates

Students should be aware of the academic dates (e.g., last day for academic withdrawal) posted on the Registrar's office web site.

2 Academic Integrity and Plagiarism

- Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and procedures. 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.
- 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 or by a generative language model;
  - 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.

3 Copyright

The materials (including the course outline and any slides, posted notes, videos, labs, projects, 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).

4 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.

5 Academic Accommodations

Students with diverse learning styles and needs are welcome in this course. You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows.

5.1 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. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

5.2 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).

5.3 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).

5.4 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).

5.5 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 webpage.

6 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 to talk to someone from the department for more information and support with connecting to resources, you can contact the following faculty members, depending on your program.

ENVE: Prof. Shoeleh Shams
Email: shoeleh.shams@carleton.ca, Office: 4242 Mackenzie

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

1. **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/
2. Emergencies and Crisis and Emergency Numbers.
3. **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/
4. **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/
5. **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/

6. **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/
7. **Distress and Crisis Ontario**, Available for chat 2 pm – 2 am EST. For more information, see https://www.dcontario.org/
8. **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. For more information, see https://bouncebackontario.ca/