

Ch.E. 672 Graduate Course
Air Pollution Control
Winter 2021

Instructor: William A. Anderson, P.Eng., wanderson@uwaterloo.ca. Contact me via email or through LEARN to arrange an online meeting outside of the scheduled weekly meetings.

T.A.: TBD will assist with assignment grading. The instructor will grade research work.

Course Notes: ChE 572 Course Notes, available in hard copy from the Bookstore or a PDF on LEARN. The notes are designed to be used in hard-copy, so ordering from the Bookstore or printing the PDF is recommended.

Recommended Text: "Air Pollution Control: A Design Approach"; 4th edition, Cooper, C.D. and Alley, F.C., Waveland Press Inc., Prospect Heights, Illinois, 2011. A copy of the 3rd and 4th editions is on 1 day loan reserve in Davis library if you have physical access. ***The text is highly recommended for additional insights, but not required to be successful in this course.***

Online resources: LEARN course website. This is the primary source for all due dates, assignments, solutions, quizzes, additional resources, etc., which will be posted as the term progresses.

Classes: All lectures will be pre-recorded and posted each week. Two online class sessions are scheduled live each week (1:30-2:20 Tuesdays, 10:30 – 11:20 Fridays) with the instructor on LEARN for an overview of the week's materials and key points, Q&A, worked examples and discussion about the material or any questions about activities or assignments. These will be recorded for viewing afterwards. A separate class meeting may be arranged from time to time to discuss specific CHE 672 items. If there are questions of a more personal nature, contact the instructor for a separate meeting time.

Grading: Quizzes 15%, Weekly Tasks and Discussions 10%, Assignments 25%, Research Project 50%.

Course Learning Objectives: To encourage an understanding of the sources and effects of air pollution, its atmospheric transport, and the selection, design and cost of air pollution control systems. At the end of the course you should be able to recognize air emission issues and the rationale for their regulation and control, know how transport of emissions occurs and how it can be modelled, be able to select appropriate technologies for a given emission problem, and be able to do preliminary process design and cost estimation for the selected technology, using generally accepted engineering principles and design practices. You will also practice the identification and review of current trends in a topic related to air pollution control or air quality, and will learn methods for drafting a research proposal related to this topic.

Research Project Work:

A significant portion of the course weight is devoted to research trends in air pollution/quality. The research requirements include: 1) identification of a relevant research topic; 2) preparation of a literature review on recent trends and needs related to that topic; 3) preparation of a short research proposal that would address some of the needs; 4) presentation and defence of the research proposal. This research work will mimic the tasks required of a new faculty member when developing their research program. Further details will be available on LEARN. ***Master's students who are not looking for this research experience should register in CHE 572.***

Assignments: There will be several assignments given out during the term designed to reinforce or expand on material presented in classes. Solutions will be made available after grading. These are to be submitted individually, online through LEARN dropboxes. Late submissions will not be credited, unless prior arrangements were made. You are permitted and encouraged to discuss approaches to assignment solutions with others, but the submitted material must be your own original work. One or two assignments may take the form of a design problem, providing an opportunity for more open-ended problem solving. Design problem(s) will be marked in detail and will have a higher course grade weight than the other assignments. CHE 672 students may opt out of the design problem(s) if desired, to focus more on the research work.

Weekly Tasks and Discussions: Each week a small practice problem or other activity will be posted. After completing the activity, you are expected to post a discussion topic to comment on the problem and your approach. Participation in the discussions will be graded. Each week's activity and discussion are only available for that week and no late

submissions will be accepted. There will also be a very small weekly quiz to check your knowledge on key concepts after completing lectures and other tasks each week, so you can verify that you've understood important points.

Quiz: There will be 3 (tentatively) online review quizzes on general knowledge and concepts covered during the course, towards the end of each major section of the course.

Final Exam: There will be no formal final exam.

Tentative Lecture Topics, Homework, and Quiz Schedule:

Small modifications to this schedule may be made to accommodate holidays and other factors. See LEARN for official final due dates for Assignments etc. "Activity" means small exercise and online discussion.

Week	Lecture Topic	Notes	Requirements
1 Jan 11	Introduction, structure & composition of the atmospheres	Section 1	Activity 1
2 Jan 18	Meteorology and Pollutant Transport	Section 2	Activity 2, research topic identification
3 Jan 25	Dispersion modelling	Section 2	Activity 3, Assignment 1; research review outline
4 Feb 1	Particulate Emissions: Sources, measurements, and effects of particulates	Section 3	Activity 4; Quiz 1;
5 Feb 8	Particulate control using cyclones, electrostatic precipitators	Sections 4, 5	Activity 5, Assignment 2; research review draft
Feb 15	Reading week		
6 Feb 22	Particulate control with fabric filters, particulate scrubbers	Sections 6, 7	Activity 6,
7 Mar 1	Volatile Organic Compound (VOC) Emissions. Sources, measurements, and effects	Section 8	Activity 7, Quiz 2; Assignment 3, final research review
8 Mar 8	Control using oxidation (thermal, catalytic and biological)	Section 8, 9	Activity 8, research proposal outline
9 Mar 17	Adsorption (short week)	Section 11	Activity 9
10 Mar 22	Absorption	Section 10	Activity 10, Assignment 4; final research proposal
11 Mar 29	Indoor air quality & investigations. Infection transmission control methods.	Section 12	Activity 11, Quiz 3
12 Apr 5	Special topics: Overview of NO _x and SO _x control, Hg control, etc.	Section 13	Activity 12, Research proposal presentation
Apr 12	Buffer space: TBD		Assignment 5

Academic Integrity:

Individual work is required and expected for all submissions. The following levels of collaboration on assignments are acceptable:

1. Discussing the general principles or approaches to the problem, including relevant equations, data, etc.
2. Comparing answers and discussing reasons for differences

The following levels of collaboration are not acceptable:

1. Copying solutions or content from another student or any other source, in whole or in part.
2. Copying any material for use in research reviews or proposals.
3. Quoting written materials without citation.

See the instructor if there are any questions or concerns before submitting any work. Turnitin plagiarism detection software will be made available and used for research work submissions so that students can check their work.

The following statements are presented, as required by the UW Senate. Please review and contact the instructor if there are any questions or concerns.

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity [check www.uwaterloo.ca/academicintegrity/] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs 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, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for Students with Disabilities: AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with them at the beginning of each academic term.

Turnitin

Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin® in this course.

It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit the alternate assignment.

Intellectual Property

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo.

Intellectual property includes items such as:

- Lecture content, spoken and written (and any audio/video recording thereof);
- Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides);
- Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and

- Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).

Course materials and the intellectual property contained therein, are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (e.g., to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).