CHM210F Chemistry of Environmental Change Fall 2021

I. Teaching Team

Instructor: Professor Jennifer Murphy
Email: jen.murphy@utoronto.ca
Student hours: Monday (12:00 – 13:00), Thursday (15:00 – 16:00)

TAs: Matthew Davis (mg.davis@mail.utoronto.ca)
Carolyn Liu-Kang (carolyn.liukang@mail.utoronto.ca)

Please contact Professor Murphy or a TA if you have any questions or problems. Email is fine for short questions, but conceptual issues are best handled in student hours or by appointment. The teaching team will endeavour to respond to emails within 24 hours on weekdays.

II. Course Overview

Course description This course examines the fundamental chemical processes of the Earth's natural environment, and changes induced by human activity. Topics related to the atmosphere: urban air pollution, stratospheric ozone depletion, acid rain, climate change; the hydrosphere: water resources and pollution, wastewater analysis; biogeochemistry and inorganic metals in the environment. The primary goal of this class is to describe the workings of a complex chemical system using concepts such as chemical kinetics, thermodynamics and oxidation/reduction. The secondary goal is to develop a detailed understanding of a number of important environmental phenomena, such as urban smog and heavy metal pollution.

Student learning outcomes Upon completion of this course, students will be able to:

1) describe the workings of a complex chemical system using concepts such as chemical kinetics, thermodynamics, and oxidation/reduction
2) understand the chemical aspects of important environmental issues such as urban smog, climate change, and heavy metal pollution
3) perform data analysis and visualization of environmental monitoring data accessible on public databases
4) access and critically evaluate scientific information in the literature and provide a plain language synopsis

Tutorial objectives The tutorial is a critical element of this course, and weekly attendance is expected. The tutorial will provide an opportunity for guided group problem-solving, discussion of news stories related to class material, and will enhance what is covered in the class notes and textbook readings. In addition to the problems tackled during the tutorial, practice problems from the textbook and the solutions to weekly quizzes will also be discussed. A TA is present to guide discussions and answer questions, but active participation from all students is expected.

Pre-requisite courses CHM135H/CHM151Y, (MAT135H, MAT136H)/MAT137Y/MAT157Y)

This course assumes you have a basic understanding of kinetics, thermodynamics and electrochemistry from first year chemistry courses, and a basic understanding of calculus from first year math courses.

This course is a pre-requisite for CHM415 – Atmospheric Chemistry.

Required textbook *Environmental Chemistry*, 5th edition, Colin Baird and Michael Cann, W.H. Freeman and Company (new or used at UofT bookstore, digital copy: https://uoftbookstore.vitalsource.com/products/environmental-chemistry-baird-colin-v9781464129001). Practice problems at the end of the assigned chapters are a good way to evaluate your understanding.

Course website is on Quercus: https://q.utoronto.ca (use your UTORID). You are responsible for checking this site regularly for announcements and content. Skeletal class notes are posted 24 hours prior to each class. Assignments and quizzes will be submitted electronically via Quercus.

III. Course Organization

Grading (maximum of Scheme 1 or Scheme 2 for each student)	Scheme 1	Scheme 2
Assignments (due Sep 20, Oct 4, Oct 18, Nov 1, Nov 22, Dec 6)	30 %	40 %
Press Release (due Nov 18)	10 %	10 %
Pre-tutorial Quizzes	10 %	10 %
Term test (in-class on Oct 21 (tentative))	15 %	10 %
Final assessment (online, cumulative, during finals period)	35 %	30 %

Assignments (due Sep 20, Oct 4, Oct 18, Nov 1, Nov 22, Dec 6 at 5:00 pm ET)

The assignments include a mix of qualitative and quantitative questions following the topics covered in Class. Completion of the assignments should not only further your understanding of the course material but also teach you some basics of scientific computing, data visualization and analysis. You do not need pre-existing knowledge of R or computer programming (these assignments can be completed from wherever you access the internet currently).

Press Release (due Nov 18 at 5:00 pm ET)

You will write a press release (450-550 words) about a 2021 journal article from *Environmental Science and Technology* (ES&T). The selected article should have an environmental chemistry theme and ideally be related to a topic covered in this course. Specific guidelines will be provided on Quercus and discussed in Class.

Quizzes (due by 10 am ET Friday on most weeks)

Quizzes will be administered via Quercus and consist of a few questions that evaluate your understanding of the class material and related problems from the previous week. Reviewing your course notes, completing the practice problems from the textbook, and actively participating in tutorials are the best way to prepare.

Late Penalties

Submitted work (Assignments and Press Release) will be penalized 10 % per day of lateness, to a maximum of 5 days past the deadline. Quizzes cannot be submitted late but your lowest quiz grade will be dropped.

Technology requirements

Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here: https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/

Advice for students more broadly regarding online learning is available here: https://onlinelearning.utoronto.ca/getting-ready-for-online/

Accommodations

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability or health consideration that may require accommodations, please feel free to approach Professor Murphy and/or Accessibility Services at (416) 978 8060; http://www.studentlife.utoronto.ca/as

Absences

Students who miss classes are responsible for making up the missed material. Class recordings will be posted online to allow for asynchronous viewing. Students who require consideration for missed academic work for any reason (e.g., COVID, other illness or injury, family situation) should report their absence through the online absence declaration. The declaration is available on ACORN under the Profile and Settings menu. Students should also advise Professor Murphy of their absence.

Academic Integrity

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:

1. Using or possessing unauthorized aids.
2. Looking at someone else's answers during an exam or test.
3. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required by the University.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see https://www.academicintegrity.utoronto.ca/).

Use of plagiarism detection software

Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (https://uoft.me/pdt-faq)

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Class Schedule

Class 1 Overview, syllabus, earth system and residence time concepts (pages xix-xxv, 216-219)

Atmospheric Chemistry (Part I of Baird and Cann, page numbers refer to 5th edition)

Class 2 Stratospheric chemistry, Chapman cycle (pages 1-20)
Class 3 Stratospheric chemistry, catalytic ozone destruction (pages 20-33)
Class 4 Stratospheric chemistry, ozone hole (pages 37-64)
Class 5 Tropospheric chemistry, VOC oxidation (pages 69-76 and 755-771)
Class 6 Tropospheric chemistry, smog and NOx (page 76-83)
Class 7 Air pollution, sulphur emissions and oxidation (pages 109-118, 771-772 and Appendix 1)
Class 8 Air pollution, particulate matter (pages 118-130)
Class 9 Tropospheric chemistry, smog control strategies (pages 84-101)
Class 10 Consequences of air pollution: acid rain and human health (pages 135-152)
Class 11 Biogeochemical cycle of nitrogen and redox review (Appendix (AP1-AP2) and pages 193-195)

Energy and Climate Change (Part II of Baird and Cann, page numbers refer to 5th edition)

Class 12 Greenhouse effect and Earth's energy balance (pages 165 – 177)
Class 13 Major greenhouse gases (pages 177 – 197)
Class 14 Climate impacts of aerosol and SRM geoengineering (pages 197 – 216)
Class 15 Energy use and carbon emissions (pages 223 - 249)
Class 16 Carbon cycle and CRM geoengineering (pages 252 - 267)

Water Chemistry and Water Pollution (Part III of Baird and Cann, page numbers refer to 5th edition)

Class 17 Natural waters and dissolved oxygen (pages 409-417)
Class 18 Dissolved organic matter, sulfur and acid mine drainage (pages 419-424)
Class 19 Redox chemistry and the pE scale (pages 424-430)
Class 20 Water in equilibrium with carbon dioxide and carbonate (pages 431-442)
Class 21 Water in equilibrium with carbon dioxide and carbonate, continued (pages 431-442)
Class 22 Ions in water (calcium and aluminum) (pages 442-450)
Class 23 Mercury biogeochemistry (pages 519-536)
Class 24 Lead pollution in the environment (pages 537-552)