

CHEM 326/ENCH 326: Environmental and Green Chemistry

Winter 2022

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Course delivery plan (as of Jan. 10, 2022) – NOTE: posted times are EST (Kingston) time
First 6 weeks (Jan 10 – Feb 18): on-line delivery

1. Live (synchronous) Zoom lecture sessions on Mondays at 9:30 am and Thursdays at 10:30 am.
-lecture sessions will cover core course material using pre-posted powerpoint slides, including some discussion time and working on sample problems
2. Live (synchronous) Q&A sessions on Zoom on Wednesdays at 8:30.
-Q&A sessions will be interactive time for general questions and discussion, along with more detailed review of sample problems and questions from previous assignments
3. Recorded (asynchronous) videos will be posted each week
- normally to be viewed between the Monday and Thursday Live lecture sessions
4. Weekly problem set assignments on onQ - due by 11:59 pm of the following Sunday
- these assignments will include calculation and written-answer questions, and will be good practice for the Midterm Exam which will use the same format
5. Additional readings and sample problems will be posted on onQ
- includes assigned readings and suggested practice problems from the Textbook

Note: all live (synchronous) sessions above will be recorded and posted for the use of students registered in the course.

Pending the University's decision to come in February, the last six weeks will either be in-person or maintain the remote schedule above.

Text: Environmental Chemistry, 5th Edition, Baird and Cann, Freeman & Company.
(Solutions manual is optional, 4th Edition is acceptable)

Other Literature: (Check for availability through Stauffer Library Circulation Desk)

Environmental Chemistry, 4th Ed., *Baird and Cann*

Environmental Chemistry, 8th Ed., *Stanley Manahan*

Green Chemistry and Catalysis, *R. A. Sheldon et al.*

Green Chemistry: An Introductory Text, *M. Lancaster*

Other references will be given throughout the course.

Marking: Problem Sets 10%; Assignments 40%; Midterm test 25%; Final exam 25%

UDL Consideration: The lowest mark of the problem sets for the first six weeks will be dropped.

Course Outline:

1. Overview: define Environmental Chemistry and Green Chemistry; context within chemistry discipline; outline of text; review concentrations and calculations.
2. Chemistry of the Atmosphere: review of gas-phase reactions; radical reactions and thermodynamics; chlorine radicals and the ozone 'layer', CFCs and other ozone-depleting contaminants, catalysis on condensed phases; hydroxyl radical, ozone production, proton abstraction, VOCs, NO_x, and photochemical smog.
3. Greenhouse effect and global warming: i.r. absorbance spectra and greenhouse effect; major greenhouse gases - CO₂, H₂O, CH₄, N₂O, aerosols, others; predicted effects; energy sources and alternatives.
4. Chemistry of contaminants: review of organic chemicals, classes and nomenclature; principles of toxicology, mechanism and dose-response; persistence, bioaccumulation and toxicity; pesticides - chlorinated, DDT and others; dioxins and furans; partition, fugacity and long-range transport.
5. Chemical contaminants: PCBs, PBDEs and others; PAHs; estrogenic contaminants; microplastics; environmental and health effects.
6. Water: natural waters - oxygen and redox chemistry, acid/base chemistry and carbonate system; drinking water - purification, disinfection, impact of chlorine; groundwater - contaminants and remediation; wastewater - phosphate, oxygen demand, fate of organic compounds, wastewater treatment.
7. Soil and sediments: major contaminants - behaviour, fate and transport; chemical and biological remediation methods; heavy metals, lead, arsenic
8. Introduction to Green Chemistry: history, goals and principles, economic and legislative drivers.
9. Measures and Metrics: E-factors and related measures, multi-variant assessment of impact, energy consumption.
10. Alternative Feedstocks and Reagents: biomass, waste polymers, CO₂.
11. Synthetic Methods and Strategies.
12. Solvents: solventless conditions, preferred organic solvents, water, supercritical fluids, expanded liquids, ionic liquids, and liquid polymers.

Handing in assignments

Assignments must be submitted through onQ on or before the due date. Late submissions will be given a penalty of 5% per day. Extensions will be granted only after an application for academic consideration (see below). Students seeking academic consideration must contact the Instructor **before the due date of the assignment**. For the lifecycle analysis assignment, no late assignments will be accepted after the first presentation by students.

Calculator Policy

Calculators will be required for problem sets, assignments, the midterm and final exams. For this purpose, the use of the **Casio 991** series calculator is required as it is the **only approved calculator for Applied Science and Arts and Science students**. Only this calculator will be permitted in the final exam, currently planned to be “in person”. This calculator sells for around \$25 at the Queen's Campus Bookstore, Staples and other popular suppliers of school and office supplies. It is recommended to use this even for problem sets and practice problems to be familiar with using this calculator.

<http://www.queensu.ca/artsci/help/topics/calculator-policy>

<http://my.engineering.queensu.ca/policy/Calculator.html>

Academic Integrity

Queen's students, faculty, administrators and staff all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility (see www.academicintegrity.org) and by the quality of courage. These values and qualities are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University. Students are responsible for familiarizing themselves with and adhering to the regulations concerning academic integrity. General information on academic integrity is available at Integrity@Queen's University (<http://www.queensu.ca/academicintegrity/home>), along with Faculty or School specific information. Departures from academic integrity include, but are not limited to, plagiarism, use of unauthorized materials, facilitation, forgery and falsification. Actions which contravene the regulation on academic integrity carry sanctions that can range from a warning, to loss of grades on an assignment, to failure of a course, to requirement to withdraw from the university.

Academic Accommodations

Queen's University is committed to achieving full accessibility for persons with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact Student Wellness Services (SWS) and register as early as possible. For more information, including important deadlines, please visit the Student Wellness website at: <http://www.queensu.ca/studentwellness/accessibility-services/>

Academic Consideration

The Senate Policy on Academic Consideration for Students in Extenuating Circumstances ([Queensu.ca-Academic Considerations for Extenuating Circumstances Policy Final.pdf](#)) was approved in April, 2017. Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and which have a direct and substantial impact on their ability to meet essential academic requirements. Each Faculty has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances. Arts and

Science undergraduate students can find the Faculty of Arts and Science protocol and the portal where they submit a request for academic consideration at:

<https://www.queensu.ca/artsci/undergrad-students/academic-consideration-for-students>.

Applied Sciences students can find the relevant information at

<https://engineering.queensu.ca/Current-Students/absences-accommodations/academic-consideration.html>.

Accessibility Statement

Queen's is committed to an inclusive campus community with accessible goods, services, and facilities that respect the dignity and independence of persons with disabilities. To discuss accessibility please contact either Professor Brown or Professor Boyd via email, phone, or in-person at your convenience.

Participation in On-line (Synchronous) Sessions

Portions of this course will be delivered the the Zoom video conferencing platform supported by the University. The University has taken steps to configure these platforms in a secure manner. The use of cameras and microphones during these sessions will be optional. These sessions will be recorded with video and audio (and in some cases transcription) and made available through onQ to all students registered in the course for the duration of the term. The recordings may capture a student's name, image or voice through the video and audio recordings, especially if they unmute or turn on their camera. By attending these live classes, you are consenting to the collection of this information for the purposes of administering the class and associated coursework. If you are concerned about the collection of your name and other personal information in the class, please contact the course instructor to identify possible alternatives. To learn more about how your personal information is collected, used and disclosed by Queen's University, please see the Notice of Collection, Use and Disclosure of Personal Information.

Course Announcements

Throughout the course, we will routinely post course news in the Announcements section of onQ. You should set onQ to forward Announcement notices by text message or to an e-mail address that you check daily. We will assume that all students are aware of each announcement withing 2-3 hours of it being posted. We will also use onQ announcements to post reminders and additional course information, as well as related activities at Queen's or elsewhere.

Copyright of Course Materials

All course material that is not from the textbook or other reference document is copyrighted by either Dr. R. Stephen Brown (first half of the course) or Dr. Alaina Boyd (second half of the course) and is for the sole use of students registered in CHEM 326 or ENCH 326. The material on the onQ website may be downloaded for a registered student's personal use, but shall not be distributed or disseminated to anyone other than students registered in CHEM 326 or ENCH 326. No posted material or screen-captures should be posted to any third-party websites of any kind. Failure to abide by these conditions is a breach of copyright, and may also constitute a breach of academic integrity under the University Senate's Academic Integrity Policy Statement.