

Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9642/CEE 4428a – Environmental Water Chemistry

COURSE OUTLINE Winter 2023

DESCRIPTION

The objective of this course is to develop an understanding of the field of environmental water chemistry and in particular the behavior of inorganic species in natural waters. The course focuses on the application of thermodynamics to understand chemical speciation and transformations in aquatic systems including aqueous, solid, and gas phase transformations. The geochemical modeling program, *phreeqcI*, will be used to simulate a variety of thermodynamic reactions. The course has applicability to a broad range of areas including water and wastewater treatment, and groundwater and surface water quality.

Prerequisite:

This course is intended for graduate and 4th year students enrolled in the Civil, Environmental, and Chemical Engineering. The course requires undergraduate-level chemistry knowledge.

CONTACT INFORMATION

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Office SEB 3041
Office hours: Mondays 1:30-2:30 PM

COURSE FORMAT

The course material is planned to be delivered in person, following public health guidelines.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1	Introduction to water chemistry	<ul style="list-style-type: none">In-person lectureIndependent learning	Week 1
2	Thermodynamics and chemical equilibrium	<ul style="list-style-type: none">In-person lectureIndependent learning.Practice problem set.	Week 2
3	Acids and bases	<ul style="list-style-type: none">In-person lectureIndependent learning.Assignment 1	Weeks 3-6
4	Aqueous-gas phase reactions	<ul style="list-style-type: none">In-person lecture	Week 9

		<ul style="list-style-type: none"> • Independent learning. • Practice problem set. • Literature review for the project 	
5	Metal complexation reactions	<ul style="list-style-type: none"> • In-person lecture • Independent learning. • Practice problem set. • Assignment 2 	Week 10
6	Aqueous-solid phase reactions	<ul style="list-style-type: none"> • In-person lecture • Independent learning. • Practice problem set. 	Week 11
7	Oxidation-reduction reactions	<ul style="list-style-type: none"> • In-person lecture • Independent learning. • Practice problem set. • Practice presentation skills. 	Week 12

*** There will be no class during Week 7 Reading Week (February 18-26, 2023)

SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	40%	<ul style="list-style-type: none"> • Assignments • Project • Examinations 	<ul style="list-style-type: none"> • Understanding of advanced concepts and theories [KB2] • Awareness of important environmental engineering challenges related to water chemistry [KB3, KB4] • Understanding of computational methodologies and tools to solve water chemistry problems [ET1, ET2]
Research & scholarship	15%	<ul style="list-style-type: none"> • Project 	<ul style="list-style-type: none"> • Ability to conduct critical evaluation and synthesize current literature around a specific water chemistry topic [I1, PA3]
Application of knowledge	30%	<ul style="list-style-type: none"> • Assignments • Project • Examinations 	<ul style="list-style-type: none"> • Ability to apply knowledge and theory to analyze and solve problems [PA1, PA2, I3]
Communication skills	15%	<ul style="list-style-type: none"> • Project 	<ul style="list-style-type: none"> • Ability to communicate (oral and/or written) ideas, issues, and conclusions clearly and effectively [CS2, CS3]

ASSESSMENTS (CEE 9642)

Assessment Type	Material Covered	Weight	Tentative Week
Participation		5%	All classes
Homework Assignments (two)	Topics 1-3, and topics 4-6	20%	Week 4, Week 10
Midterm Quiz	Topics 1-4	20%	Week 8
Project	All	20%	Week 13-14
Final Examination	All	35%	Week 15

ASSESSMENTS (CEE 4428a)

Assessment Type	Material Covered	Weight	Tentative Week
Participation		5%	All classes
Homework Assignments (two)	Topics 1-3, and topics 4-6	20%	Week 4, Week 10
Midterm Quiz	Topics 1-4	30%	Week 8
Final Examination	All	45%	Week 15

Activities in which students must work alone (collaboration is not permitted):

- Final solutions for assignments
- Final examination
- Quizzes
- Project

REQUIRED TEXTBOOK

A Problem-Solving Approach to Aquatic Chemistry, Jensen (Wiley, 2003)

OPTIONAL COURSE READINGS

Appelo and Postma, Geochemistry, Groundwater and Pollution, (A.A. Balkema Publishers, 2007)

Benjamin, Water Chemistry (McGraw-Hill, 2002)

Langmuir, Aqueous Environmental Geochemistry (Prentice Hall, Inc , 1997).

Morel and Hering, Principles & Applications of Aquatic Chemistry (Wiley, 1993)

Stumm and Morgan, Aquatic Chemistry (Wiley, 1996)

COMPUTING

The geochemical modeling program, phreeqcI, will be used to simulate a variety of thermodynamic reactions. This software is free to download and use (available at: https://wwwbrr.cr.usgs.gov/projects/GWC_coupled/phreeqci/)

PARTICIPATION

As part of the course mark breakdown, 5% will be allocated to student participation. Participation is an important component of this course and will be assessed by attendance and interaction in the lectures.

CHEATING, PLAGIARISM/ACADEMIC OFFENCES

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above under “Assessments” and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are

directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence (see Western's scholastic discipline regulations for graduate students).

CONDUCT

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Late comers may be asked to wait outside the classroom until being invited in by the Instructor. Please turn off your cell phone audio or motion notifications (calls, texts, alerts, etc.) before coming to a class. Students are expected to participate in class discussions.

On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct: <https://www.uwo.ca/univsec/pdf/board/code.pdf>

HEALTH/WELLNESS

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services to help you achieve optimum health and engage in healthy living while pursuing your degree. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Campus mental health resources may be found at http://www.health.uwo.ca/mental_health/resources.html
<https://www.uwo.ca/health/psych/index.html>

SICKNESS

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

ACCESSIBILITY

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at 661-2111 x 82147 or http://academicsupport.uwo.ca/accessible_education/index.html, for any specific question regarding an accommodation.