

Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9642– Environmental Water Chemistry (with CEE 4428a)

COURSE OUTLINE Fall 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.

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students in Civil Engineering, as well as any student that has obtained permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program.

The course requires undergraduate-level chemistry knowledge.

CONTACT INFORMATION

Dr. Sabina Rakhimbekova
srakhimb@uwo.ca

Administrative Support: ceeresearchgrad@uwo.ca

COURSE FORMAT

This course will be delivered **in-person**.

“In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online at the discretion of the course instructor”.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1	Introduction to water chemistry	<ul style="list-style-type: none">• In-person lecture• Independent learning	Week 1
2	Thermodynamics and chemical equilibrium	<ul style="list-style-type: none">• In-person lecture• Independent learning• Practice problem set	Week 2
3	Acids and bases	<ul style="list-style-type: none">• In-person lecture• Independent learning• Assignment 1• Laboratory Experiment	Weeks 3-6
4	Aqueous-gas phase reactions	<ul style="list-style-type: none">• In-person lecture• Independent learning• Practice problem set• Literature review for the project	Week 9
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 Fall Reading Week (October 30- November 5, 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• Awareness of important environmental engineering challenges related to water chemistry• Understanding of computational methodologies and tools to solve water chemistry problems
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
Application of knowledge	30%	<ul style="list-style-type: none">• Assignments• Project• Examinations• Laboratory	<ul style="list-style-type: none">• Ability to apply knowledge and theory to analyze and solve problems
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

COURSE MATERIAL

Prepared class notes will be made available through the course website on OWL at <http://owl.uwo.ca/>, along with other useful reference material and data for assignments.

REQUIRED TEXTBOOK

A Problem-Solving Approach to Aquatic Chemistry, Jensen, Second Edition (Wiley, 2023)

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/)

UNITS

SI units will be used in lectures and examination

ASSESSMENTS

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
Laboratory	Topic 3	10%	
Midterm Quiz	Topics 1-4	20%	Week 8
Project	All	15%	Week 13-14
Final Examination	All	30%	Week 14

Activities in which collaboration is permitted:

- Practice problems
- Homework assignments
- Laboratory activity
- Group project

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

- Final solutions for assignments
- Midterm Quiz
- Final Examination

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.

USE OF ENGLISH

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

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 the information above and ask the 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 at the following

website:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

CONDUCT

Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/WELLNESS SERVICES

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 graduate 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. Faculty of Engineering has a Student Wellness Counsellor. Information on how to schedule an appointment with the counsellor is available at: <https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/Student-Wellness-Counselling.html>

Students who are in emotional/mental distress should refer to Mental Health@Western: <http://www.uwo.ca/uwocom/mentalhealth/> for a complete list of options about how to obtain help.

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.

Students who are not able to meet certain academic responsibilities due to medical, compassionate, or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at:

<https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html>

ACCESSIBLE EDUCATION WESTERN (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions,

mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): http://academicsupport.uwo.ca/accessible_education/index.html

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction