School of Civil and Environmental Engineering

UNSW Engineering

CVEN9887

Environmental Chemical Processes

Term 2, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Martin Andersen	m.andersen@unsw.edu.au	By appointment via Moodle	CE303	

School Contact Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

Course Details

Units of Credit 6

Summary of the Course

This course provides a theoretical background to chemistry in an environmental aquatic context including equilibrium, kinetics, acid-base reactions, alkalinity, carbonate chemistry, gas exchange, redox chemistry, complexes, solid precipitation and dissolution, surface chemistry and organic carbon chemistry. Students will have the opportunity to put lecture material into practise through computer labs.

Course Aims

The course aims to have students gain the following attributes:

· Knowledge of the fundamental and applied environmental chemistry as they may be encountered by environmental engineers,

· Ability to assess reports and data presented to them by specialists in the areas of inorganic and organic chemistry,

· Skills for effective communication and collaborative work,

· Capacity for analytical and critical thinking and for creative problem solving,

· Ability to engage independent and reflective learning,

· Information literacy.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Develop ability to critically and independently assess data relating to environmental chemistry	PE1.1, PE1.2, PE1.3
2. Describe the different types of chemical reactions that naturally occur	PE1.1, PE1.2, PE1.3
3. Use practical tools to solve environmental problems and quantify processes	PE2.1, PE2.2, PE3.1, PE3.2, PE3.4

Teaching Strategies

Each week, students will attend one 2-hour lecture followed by one 1-hour workshop and one 1-hour computer lab. Lectures will introduce students to the fundamentals of aquatic chemistry. During the workshop, students will work in teams to solve exam-style questions. The computer labs will provide hands-on coding to put the lecture material into practise. It is expected that students will spend an

additional 8-hours of private study per week.

Additional Course Information

Lectures, workshops and computer labs will be delivered face to face. The lectures will be recorded for the benefit of distance students and your subsequent revision of the lectures. The workshops and computer labs are designed for in-person attendance for maximum outcome, as they involve group work. However, for students who are unable to attend in person, one or more collaboration groups will be set up in BB Ultra (via Moodle) in real time and linked into the classroom.

Desired prerequisites: Students are expected to have a basic understanding of chemistry.

Assessment

The assessment of this course will be the 3 assignments and a final exam. Students who perform poorly in the assignments are recommended to discuss progress with the lecturer during the term. The formal exam scripts will not be returned to students. Note: The Course Coordinator reserves the right to adjust the final scores by scaling if agreed by the Head of School.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Assignment 1	10%	14/06/2022	2, 3
2. Assignment 2	20%	5/7/2022	2, 3
3. Assignment 3	20%	2/8/2022	1, 2, 3
4. Exam	50%	Not Applicable	1, 2, 3

Assessment 1: Assignment 1

Start date: 7/06/2022
Due date: 14/06/2022
Deadline for absolute fail: Submissions late by 5 days
Marks returned: Marks returned before census date

Assignment 1 will assess the student's conceptual understanding of equilibrium chemistry and ability to solve an aqueous equilibrium chemistry problem using the tableau method (LO 2 & 3).

Assessment 2: Assignment 2

Start date: 14/6/2022
Due date: 5/7/2022
Deadline for absolute fail: 5 days after submission date
Marks returned: 19/07/2022

Assignment 2 will assess the student's conceptual understanding of equilibrium chemistry, the student's ability to solve aqueous equilibrium chemistry problems, and the use the computer code PHREEQC. (LOs 2, 3)

Assessment 3: Assignment 3

Start date: 12/7/2022
Due date: 2/8/2022
Deadline for absolute fail: 5 days after the submission date
Marks returned: 12/8/2022

Assignment 3 will assess the student's ability to construct Eh-pH diagrams, construct balanced redox-reactions and evaluate ongoing redox-processes based on computer model simulations in PHREEQC. (LOs 1-3).

Assessment 4: Exam

Submission notes: TBD
Marks returned: Not Applicable

The exam will assess the students' conceptual understanding of aquatic chemistry equilibrium and kinetic processes, as well as their ability to find quantitative solutions to these processes (LOs 1-3). The exam will cover all material introduced in the course unless otherwise stated.

Hurdle requirement

A mark of at least 40% in the final examination is required before the class work is included in the final mark.

Additional details

The final examination for this course is a 2-hour online exam.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

View class timetable

Timetable

Date	Type	Content
Week 1: 30 May - 3 June	Lecture	Fundamentals of aquatic equilibrium chemistry (Lecture notes: Units 1 & 2).
	Laboratory	Computer lab exercise: Uranium in seawater
Week 2: 6 June - 10 June	Lecture	Acid-base reactions, alkalinity and the carbonate system (Lecture notes: Unit 3).
	Laboratory	Computer lab exercise: Carbonate Chemistry
Week 3: 13 June - 17 June	Lecture	Gas exchange (Lecture notes: Unit 4).
	Laboratory	Computer lab exercise: Photosynthesis
Week 4: 20 June - 24 June	Lecture	Fundamentals of kinetics (Lecture notes: Units 1 & 2).
	Laboratory	Computer lab exercise: Kinetics of quartz dissolution
Week 5: 27 June - 1 July	Lecture	Reduction-Oxidation (Redox) chemistry (Lecture notes: Unit 5).
	Laboratory	Computer lab exercise: Mixing and redox
Week 6: 4 July - 8 July	Lecture	***NON TEACHING WEEK***
Week 7: 11 July - 15 July	Lecture	Complexes in aqueous solutions (Lecture notes: Unit 6).
	Laboratory	Computer lab exercise: Metal complexation
Week 8: 18 July - 22 July	Lecture	Surface chemistry (Lecture notes: Unit 7).
	Laboratory	Computer lab exercise: common ion effect
Week 9: 25 July - 29 July	Lecture	Surface chemistry (Lecture notes: Unit 8).
	Laboratory	Computer lab exercise: Trace element adsorption on iron-oxide surfaces
Week 10: 1 August - 5 August	Lecture	Organic carbon chemistry (Lecture notes: none).

	Laboratory	Computer lab exercise: Organic carbon interaction with metals
Study Week: 8 August - 11 August	Lecture	***STUDY WEEK***

Resources

Prescribed Resources

Mandatory reading

The following pages in the CVEN9887 Aquatic chemistry course notes are mandatory reading:

- Week 1: Unit 1: Sections 1 to 4.1 (pages 1-18) and Unit 2: section 1 (pages 1-16); section 3.1 (page 29) and sections 4 - 6 (in-unit exercises 1-6 and workshop exercises 1-5, so excluding kinetic exercises).
- Week 2: Unit 3: Sections 1 - 8 (pages 1-25).
- Week 3: Unit 4: Sections 1 - 6 (pages 1-18).
- Week 4: Unit 1: Sections 4.1- onwards (pages 17-28) and Unit 2: Sections 3.2-3.3 (page 29-30) and sections 4-6 (in-unit exercises 7-9 and workshop exercises 7-8).
- 1- 6 (pages 1-18).
- Week 5: Unit 5: Sections 1 - 8 (pages 1-27).
- Week 7: Unit 6: Sections 1 - 5 (pages 1-33).
- Week 8: Unit 8: Sections 1 - 5 (pages 1-17).
- Week 9: Unit 7: Sections 1 - 6 (pages 1-18).

Additional materials such as lecture slides and lecture recordings are provided on Moodle.

Recommended Resources

Recommended reading

Morel, F.M.M. & Hering, J.G., *Principles and Applications of Aquatic Chemistry*, Wiley Interscience, New York, 1993. ISBN 0-471-54896-0.

Reading guide to the textbook by Morel & Hering (M&H):

- Chapter 1: Sections 1 to 5 (p. 1-31).
- Chapter 2: All of the chapter up to section 5.7 (p. 40-87) and ignore sidebar 2.2
- Chapter 3: Sections 1 and 2 (p. 98-138) read cursorily !!!.
- Chapter 4: Sections 1, 2, 3, 4, 5 (p. 157-195), 7 (203-210) and 9 (to section 9.5) (p. 218-227).
- Chapter 5: All of Chapter 5 apart from Example 5 (p. 236-314).
- Chapter 6: Sections 2, 3, 4 (to section 4.3) (p. 345-375) and 5 (p. 395-404).
- Chapter 7: Sections 1, 2, 3, 4 (p. 421-477) and 6 (p. 491-502).
- Chapter 8: Sections 2 (p. 513-519), 3 (p. 519-521) and 6 (p. 563-567).

NOTE that these recommendations are optional and not required to do the assessments or prepare for the exam.

Other useful textbooks (Recommended only – not mandatory)

- Appelo, C.A.J., Postma, D., 2005. Geochemistry, Groundwater, and Pollution. 2nd ed. A.A. Balkema, Rotterdam. 649 pp. ISBN: 04 1536 428 0. It can be ordered via website www.crcpress.com **(NOTE: This textbook have useful worked examples for PHREEQC)**

- Stumm, W. and Morgan, J.J., Aquatic Chemistry, 2nd Edition, Wiley, New York, 1981.

Course Evaluation and Development

We are always looking for ways to improve the course. If you have ideas for improvement, please raise these on the Moodle forum, via email to the course coordinator or, if you would like to be annonymous, via the MyExperience survey. We alway carefully analyse the results of the MyExperience to incorporate your feedback where possible and sensible.

Submission of Assessment Tasks

Please refer to the Moodle page of the course for further guidance on assessment submission.

UNSW has a standard late submission penalty of:

- 5% per day, for all assessments where a penalty applies, capped at five days (120 hours), after which a student cannot submit an assessment, and no permitted variation.

Academic Honesty and Plagiarism

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

https://student.unsw.edu.au/plagiarism

Academic Information

Final Examinations:

Final exams in T2 2022 will be held online between 12th - 25th August 2022 inclusive, and supplementary exams between 5th - 9th September 2022 inclusive. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

ACADEMIC ADVICE

- Key Staff to Contact for Academic Advice (log in with your zID and password): https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw
- Key UNSW Dates - eg. Census Date, exam dates, last day to drop a course without academic/financial liability etc.
- CVEN Student Intranet (log in with your zID and password): https://intranet.civeng.unsw.edu.au/student-intranet
- Student Life at CVEN, including Student Societies: https://www.unsw.edu.au/engineering/civil-and-environmental-engineering/student-life
- Special Consideration: https://student.unsw.edu.au/special-consideration
- General and Program-Specific Questions: The Nucleus: Student Hub
- Book an Academic Advising session: https://app.acuityscheduling.com/schedule.php?owner=19024765

Disclaimer

This course outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up to date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

Photo, Martin Andersen

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	✓
PE3.2 Effective oral and written communication in professional and lay domains	✓
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	✓
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	