School of Civil and Environmental Engineering

Term 2, 2021

CVEN9887 ENVIRONMENTAL CHEMICAL PROCESSES

COURSE DETAILS

Units of Credit	**6**		
Contact hours	5 hours per week		
Class	Tuesday (weeks 1-5, 7-10)	11:00 – 13:00	Online delivery
Workshop	Friday (weeks 1-5, 7-10)	12:00 – 14:00	Face to Face CE701 and online delivery
Computer Labs	Friday (weeks 1-5, 7-10)	10:00 – 11:00	Face to Face CE201
		11:00 – 12:00	Online delivery
Course Coordinator & Lecturer	A/Prof Martin Andersen m.andersen@unsw.edu.au		
Lecturer	Dr Helen Rutlidge h.rutlidge@unsw.edu.au		

INFORMATION ABOUT THE COURSE

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

Part 1: Introduction to principles of the chemistry of natural waters and polluted systems covering basic processes of acidity and alkalinity, mineral precipitation, complexation, oxidation/reduction and surface and colloid chemistry. Tools developed include both equilibrium thermodynamic and kinetic approaches enabling solution of realistic water chemistry problems including introduction to the use of chemical speciation computer code PHREEQC.

HANDBOOK DESCRIPTION

See link to virtual handbook:

https://www.handbook.unsw.edu.au/postgraduate/courses/2021/CVEN9887

OBJECTIVES

To familiarise the student with the fundamentals of water chemistry as they may be encountered in both natural and engineered systems by Public Health, Waste Management and Environmental Engineers and hence enable a knowledgeable assessment of reports and data presented to them by specialists in these areas.

List of programme attributes:

- An in-depth engagement with the relevant disciplinary knowledge in its inter-disciplinary context
- Capacity for analytical and critical thinking and for creative problem solving
- Ability to engage independent and reflective learning
- Information literacy
- Skills for collaborative and multi-disciplinary work
- A respect for ethical practice and social responsibility
- Skills for effective communication

TEACHING STRATEGIES

Private Study	• Read suggested sections in the textbook and review lecture material • Do set problems and assignments • Reflect on class problems and workshops when doing assignments and preparing for the exam • Download materials from Moodle • Keep up with notices via Moodle and Teams • Keep up with notices via university email
Lectures	• Online Lectures will be available via Moodle and delivered using Blackboard Ultra • Come prepared (read course material beforehand) • Identify beforehand where you may have problems with parts of the course material • See methods that are not in the textbook • Follow worked examples • Hear announcements on course changes
Workshops	• Be guided by demonstrators • Get involved in workshops • Practice solving set problems • Don't be afraid to ask questions – this is how you learn ! • Note: workshops for Microbial Processes will take place on Microsoft Teams
Assessments	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving • Note: assessments for Microbial Processes will be on Microsoft Teams
Laboratory Work	• Hands-on work, to set studies in context

For each hour of contact it is expected that a student will put in at least 1.5 hours of private study.

EXPECTED LEARNING OUTCOMES

To enable the student, by in-depth process understanding, in critically and independently assessing data related to aquatic chemistry. Furthermore, to provide the student with practical tools for solving environmental problems.

Learning Outcome		EA Stage 1 Competencies
1.	*Carry out independent critical assessment of aquatic chemistry data*	*PE1.1, PE1.2, PE1.3*
2.	*Carry out independent critical assessment of microbiology data*	*PE1.1, PE1.2, PE1.3*
3.	*By the conclusion of this course the student will be able to solve environmental problems using the practical tools delivered.*	*PE2.1, PE2.2, PE3.2, PE3.4*

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

COURSE PROGRAM

TERM 2 2021

Week	Date	Lecture note unit	Topic	Lecturer	Assessments Due
1	1st of June	1+2	Fundamentals of aquatic equilibrium chemistry + computer lab exercise: Uranium in seawater	M. Andersen	
2	8th of June	3	Acid-base reactions, alkalinity and the carbonate system + computer lab exercise: Carbonate Chemistry	M. Andersen	
3	15th of June	4	Gas exchange + computer lab exercise: Photosynthesis	M. Andersen	Assignment 1
4	22nd of June	1+2	Fundamentals of kinetics + Computer lab exercise: Oxidation of iron	M. Andersen	
5	29th of June	5	Reduction-Oxidation (Redox) chemistry + computer lab exercise: Mixing and redox	M. Andersen	
6	6th of July	***NON-TEACHING WEEK (Field course week)***			
7	13th of July	6	Complexes in aqueous solutions + computer lab exercise: Metal complexation	M. Andersen	Assignment 2
8	20th of July	8	Solid precipitation and dissolution +computer Lab: Pyrite oxidation	M. Andersen	
9	27th of July	7	Surface chemistry + computer lab exercise: Trace element adsorption on iron-oxide surfaces	M. Andersen	
10	3rd of August	9	Organic carbon chemistry + computer lab exercise: Organic carbon interaction with metals	Guest lecture	Assignment 3

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 session. A mark of 30% or higher must be achieved in the final exam for the assignments to be counted toward the final mark for the course. 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.

ASSIGNMENTS

Assessment item	Weight	Issue date	Due date/time	Deadline for absolute fail	Marks returned	Assessment criteria	Learning outcomes assessed
Assignment 1	10%	Tuesday 8/06	Tuesday 15/06 11:00	Thursday 17/06 17:00	Before 27/06	Assignment 1 will assess the student's ability to solve an aqueous equilibrium chemistry problem using the tableau method. Some sub-questions will test the student's conceptual understanding of equilibrium chemistry.	*PE1.1, PE1.2, PE3.2, PE3.4*
Assignment 2	20%	Tuesday 15/06	Tuesday 13/07 11:00	Thursday 15/07 17:00	Tuesday 27/07	This assignment will further assess the student's ability to solve aqueous equilibrium chemistry problems and use the computer code PHREEQC. Some sub-questions will further test the student's conceptual understanding of equilibrium chemistry.	*PE1.1, PE1.2, PE2.1, PE2.2, PE3.2, PE3.4*
Assignment 3	20%	Tuesday 13/07	Friday 6/08 17:00	Monday 9/08 17:00	Monday 16/08	This assignment 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.	*PE1.1, PE1.2, PE1.3, PE2.1, PE2.2, PE3.2, PE3.4*
Final Exam	50%	**Online exam TBD**				The exam will assess the student's knowledge of, and ability to solve, aqueous equilibrium and kinetic chemistry problems. The exam will cover all material introduced in the course unless otherwise stated.	*PE1.1, PE1.2, PE2.1, PE2.2, PE3.2, PE3.4*

NOTES:

1) *Feedback will be given for Assignment 1 before census date 27th of June.*
2) *The final examination for this course is a 2-hour online exam.*
3) *Supplementary Examinations for Term 2 2021 will be held on Monday 6th September – Friday 10th September (inclusive) should you be required to sit one. You are required to be available during these dates. Please do not to make any personal or travel arrangements during this period.*

PENALTIES

Late work will be penalised at the rate of 10% per day after the due time and date have expired.

RELEVANT RESOURCES

Mandatory reading
CVEN9887 Aquatic chemistry course notes (formerly the CVEN9884 Lecture Notes). Following pages 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 reading

Morel, F.M.M. and 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 Dispersed throughout the Aquatic chemistry lecture notes there are guides to when various sections in M&H may be useful reading.

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

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

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

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 ADVICE

For information about:

- Notes on assessments and plagiarism;
- Special Considerations: student.unsw.edu.au/special-consideration;
- General and Program-specific questions: The Nucleus: Student Hub
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC/SURVSOC/CEPCA

Refer to Key Contacts on the Faculty website available at:
https://www.unsw.edu.au/engineering/student-life/student-resources/key-contacts

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex 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
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (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