CVEN2701

Water and Atmospheric Chemistry

Term 2, 2023

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
T. David Waite	d.waite@unsw.edu.au		Room 114 (H22 – Vallentine Annexe)	9385 5060
A. Ninh Pham	anninh.pham@unsw.edu.au		Room 108 (H22 – Vallentine Annexe)	9385 5102

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 aims to provide an introduction to water chemistry and atmospheric chemistry, as a foundation for understanding both the natural processes in these environments and the effects of pollution on them. It will build on the basic chemical concepts learned in CHEM1011 and will develop additional concepts as required, in order to describe the chemical processes occurring in aquatic and atmospheric systems.

Course Aims

To provide students with fundamental concepts of water chemistry that may be encountered by environmental engineers.
To provide a basis for more advanced courses in later years in water quality, water and wastewater treatment, contaminant fate and transformation and waste management.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Demonstrate understanding of the basic concepts in water and atmospheric chemistry. including chemical equilibrium and thermodynamics, chemical reaction kinetics, acids and bases, alkalinity, solid dissolution and precipitation, complexation reactions, redox reactions and reactions on solid surfaces	
2. Predict the behaviour and/or estimate the concentrations of various environmentally important chemicals in aquatic and atmospheric systems.	PE1.2, PE1.5, PE2.1, PE2.2
3. Describe the various chemical processes that occur in rivers, lakes, groundwater, marine and atmospheric environments.	PE1.3, PE2.1, PE2.2
4. Explain and solve complex, real world water and atmospheric chemistry problems	

Teaching Strategies

Please refer to the information in Moodle

Additional Course Information

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

Assessment

All assessments are individual.

The online census-quiz, which accounts for 5% of the overall grade, will be made available on UNSW Moodle one week before the aforementioned due date. Students can take this quiz at their convenience within that one-week period, with only one attempt allowed. The in-class mid-term quiz carries a weight of 17% and can only be taken during the scheduled workshop time in week 7. The weekly pre-lecture quizzes (1% each) have unlimited attempts, but they need to be completed before the lecture and a perfect score is required before the marks can be awarded.

Both the census-quiz and the weekly pre-lecture quizzes may include short-answer, multiple choice, true-false, fill in the blanks, and/or calculation-based questions. Please ensure that your computer is UNSW Moodle compatible before attempting the quizzes. Please check the following link for system requirement for UNSW Moodle and other information on UNSW Moodle.

https://moodle.telt.unsw.edu.au/

Please inform the course coordinator/lecturer immediately regarding any computing problems or if you are not able to take the quiz in the allotted time.

Assignments are to be submitted to the designated assignment box located on Level 1, Building H20 (under the name CVEN2701 Waite/Pham). Students are responsible for keeping spare copies of their submitted assignments.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Online Census Quiz	5%	18/06/2023 11:00 PM	1, 2
2. In-class mid-term quiz	17%	14/07/2023 01:15 PM	1, 2, 3, 4
3. Pre-lecture quizzes	8%	Not Applicable	1, 2
4. Assignment	20%	06/08/2023 11:00 PM	1, 2, 3, 4
5. Final Exam	50%	TBD	1, 2, 3, 4

Assessment 1: Online Census Quiz

Start date: 12/06/2023 12:00 AM
Submission notes: This is an online submission.
Due date: 18/06/2023 11:00 PM

Online Quiz: 5%

The online census quiz is an individual, online assessment that evaluates the material taught in lectures 1 and 2. The quiz will be released during week 2 and due in late week 3 (Sunday 18th June 2023, at 11 pm). Please note that only **ONE** attempt is allowed for this quiz, so make sure to prepare accordingly.

This is not a Turnitin assignment

Assessment 2: In-class mid-term quiz

Start date: 14/07/2023 12:15 PM
Due date: 14/07/2023 01:15 PM

The in-class mid-term quiz is an individual, closed book assessment that examines the material taught from lectures 1 to 5. This quiz is scheduled during the workshop time in week 7 (Friday 14th July 2023) from 12:15 to 1:15 pm.

This is not a Turnitin assignment

Assessment 3: Pre-lecture quizzes

There are a total of 8 weekly pre-lecture quizzes, and each quiz accounts for 1% of the total grade. These quizzes are individual, online, open-book assessment with unlimited attempts that evaluate the lecture materials from weeks 2 to 10. The main objective of these quizzes is to encourage the students to come to class prepared for the lecture. To earn marks for each quiz, students must achieve a perfect score on at least one attempt before the due date.

The pre-lecture quizzes are due at 11pm on the night before the corresponding lecture.

Assessment 4: Assignment

Start date: During week 7
Submission notes: Please deliver it to the assignment box located on Level 1 of Building H20 (under the name "CVEN2701 Waite/Pham"). Students are responsible for keeping spare copies of their submitted assignments.
Due date: 06/08/2023 11:00 PM

The assignment is an **individual** written assessment which evaluates the material taught in lectures 7 to 10. It will be released in week 7 and is due in week 10 (Sunday 06th, Aug 2023 at 11 pm).

To submit the assignment, please deliver it to the assignment box located on Level 1 of Building H20 (under the name "CVEN2701 Waite/Pham"). Students are responsible for keeping spare copies of their submitted assignments.

Assessment 5: Final Exam

Start date: TBD
Due date: TBD

The final exam is an in-class, 2-hour closed book examination which assesses the material taught from week 1 to week 10. It will be scheduled during the exam period. The exact date and time of the exam will be communicated to you by the course instructor.

Hurdle requirement

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

mark.

Attendance Requirements

For courses with Workshops and/or Labs, attendance for those classes is a necessary part of the course. You must attend at least 80% of the workshop/lab in which you are enrolled for the duration of the session.

Course Schedule

Units of Credit	**6**	
Contact hours	6 hours per week	
Class	Mon 2:00PM - 4:00PM	VA 121
	Thu 9:00AM - 11:00AM	VA 121
Workshop	Fri 12:00PM - 2:00PM	MAT 307

View class timetable

Timetable

Date	Type	Content
Week 1: 29 May - 2 June	Lecture	***PART 1: Introductory matters*** • Nature and scope of water chemistry • Unique properties of water • Unit concentrations • Major types of chemical reactions ***PART 2: Inorganic chemical composition of natural waters*** • Major and minor constituents and their chemistry • Water quality significance of major and minor constituents • Source of major and minor constituents
Week 2: 5 June - 9 June	Lecture	***PART 1: Thermodynamic basis for equilibrium chemistry*** • Thermodynamic basis • Thermodynamics and chemical equilibria

		• Activity-concentration relationships ***PART 2: Fundamentals of chemical kinetics*** • Basic concepts of chemical kinetics • Simple rate equations and their solutions • More complicated reactions • Effect of temperature, ionic strength, and pH on reaction rate constants
Week 3: 12 June - 16 June	Lecture	***PART 1: Principles of acid□base equilibria*** • Properties of acids and bases • Equations used to define and constrain ionic equilibria • Henderson-Hasselbalch equation and the concept of buffers • Titrations of acids and bases ***PART 2: Solving acid□base equilibria and the carbonate system*** • Algebraic approaches • Graphical methods • Computer-based solutions • The carbonate system
Week 4: 19 June - 23 June	Lecture	***Complexation reactions and metal ion speciation*** • Basic concepts of complexation • Types and structures of complexes • Factors affecting the strength of metal-ligand interactions • Complexation equilibrium constants • Solving complexation equilibria • Role of complexation in the speciation of cations and anions in natural waters
Week 5: 26 June - 30 June	Lecture	***Solubility: Reactions of solid phases with water*** • Thermodynamics of solubility and the ion activity product • Solubility of sulfides, carbonates (and water softening), metal oxides, and hydroxides • Effects of ligands on solubility • Coexistence of solids and the phase rule • Kinetics of precipitation and dissolution

Week 6: 3 July - 7 July	Reading	***Non Teaching Week. Use this time to catch up on your work.***
Week 7: 10 July - 14 July	Lecture	***Redox equilibria and kinetics*** • Fundamentals of redox equilibria • Constructions and uses of redox equilibrium diagrams • Redox kinetics
	Assessment	In-class mid-term quiz
Week 8: 17 July - 21 July	Lecture	***Surface chemistry and sorption*** • Basic concepts of surface chemistry • Structures of major class of sorbents • Surface charge and forces at interfaces • Empirical and semi-empirical sorption models • Surface complexation models
Week 9: 24 July - 28 July	Lecture	***Part 1: Chemistry of chlorine and other oxidants/disinfectants*** • Inorganic chemistry of aqueous chlorine and kinetics of chlorination • Reactions of chlorine with organic compounds • Other disinfectants/oxidants: Ozone and advanced oxidation processes ***Part 2: The minor elements – Fe, Mn and Al*** • Fe and Mn equilibria and redox cycling • Fe and Mn concentrations in natural waters • Aluminium: Sources, significance, hydrolysis equilibria, complex formation, and distribution in natural waters
Week 10: 31 July - 4 August	Lecture	***Part 1: Nutrient cycles and the chemistry of nitrogen and phosphorus*** • Nutrient cycles • Chemistry and biochemistry of N and P • Seasonal, spatial and landscape patterns of N and P cycling in aquatic systems • Engineering controls on nutrients in natural waters ***Part 2: Natural organic matter (NOM)***

		• NOM fractions and terminology • Structural characteristics of DOM • Redox properties and metal complexation behaviour of DOM

Resources

Prescribed Resources

- Prescribed text: *Brezonik, P.L. and Arnold, W.A. (2022) Water Chemistry: The Chemical Processes and Composition of Natural and Engineered Aquatic Systems, Oxford University Press* – An eBook version of this text is available at the UNSW Library. You can access it electronically for your convenience.

Recommended Resources

- Additional materials provided on Moodle.

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 2023 will be held on campus between Friday 11th and Thursday 24th August (inclusive), and Supplementary Exams between Monday 4th and Friday 8th September (inclusive). You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

For students enrolled in the distance offering of a postgraduate course, and who reside further than 100km from UNSW Kensington campus, will be contacted regarding sitting an external exam. The school's External Exam Policy can be found on the Intranet.

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://unswengacademicadvising.as.me/schedule.php

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

Mike Gal.

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	