UNSW Course Outline

CVEN2701 Water and Atmospheric Chemistry - 2024

Published on the 27 May 2024

General Course Information

Course Code : CVEN2701
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Civil and Environmental Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course aims to provide an introduction to water and atmospheric chemistry as a foundation for comprehending chemical processes in both natural and engineered systems. It will build on the basic chemical concepts covered in CHEM1011/1031 and will develop additional concepts

required to describe the chemical processes occurring in rivers, lakes, groundwater, marine and atmospheric environments.

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.

Relationship to Other Courses

- CVEN3502: Water and Wastewater Engineering (Water Quality Standards and Analysis + Treatment Processes)
- CVEN4504: Advanced Water Treatment Processes (with emphasize on non-traditional/ emerging contaminants)
- CVEN4703: Advanced Water Quality Principles and Application
- CVEN9884/CVEN9886/CVEN9887: Environmental Chemical and Biological Processes
- CVEN9855: Water and Wastewater Quality Analysis
- CVEN9856: Water Treatment

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain 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
CLO2 : Predict the behaviour and/or estimate the concentrations of various environmentally important chemicals in aquatic and atmospheric systems.
CLO3 : Describe the various chemical processes that occur in rivers, lakes, groundwater, marine and atmospheric environments.
CLO4 : Explain and solve complex, real world water and atmospheric chemistry problems

Course Learning Outcomes	Assessment Item
CLO1 : Explain 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	• Quizzes • Assignment • Final Exam • In-class Mid-term quiz
CLO2 : Predict the behaviour and/or estimate the concentrations of various environmentally important chemicals in aquatic and atmospheric systems.	• Quizzes • Assignment • Final Exam • In-class Mid-term quiz
CLO3 : Describe the various chemical processes that occur in rivers, lakes, groundwater, marine and atmospheric environments.	• Assignment • Final Exam • In-class Mid-term quiz
CLO4 : Explain and solve complex, real world water and atmospheric chemistry problems	• Assignment • Final Exam • In-class Mid-term quiz

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Learning and Teaching in this course

The teaching strategies that will be used in this course are traditional lecture teaching combined with workshop and independent study.

Additional Course Information

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

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Quizzes Assessment Format: Individual	13%	Start Date: Not Applicable Due Date: Not Applicable
Assignment Assessment Format: Individual	20%	Start Date: Not Applicable Due Date: 02/08/2024 05:00 PM Post Date: 11/08/2024 11:00 PM
Final Exam Assessment Format: Individual	50%	Start Date: During the exam period Due Date: During the exam period
In-class Mid-term quiz Assessment Format: Individual	17%	Start Date: 12/07/2024 02:00 PM Due Date: 12/07/2024 03:00 PM Post Date: 21/07/2024 11:00 PM

Assessment Details

Quizzes

Assessment Overview

Online census quiz (5%): Materials from weeks 1 and 2 to be assessed. Marks and feedback will be returned before the census date.

Online, weekly pre-lecture quizzes (8%): Lecture contents of each week to be assessed prior, starting from week 2. Eight quizzes in total, 1% each.

Course Learning Outcomes

- CLO1 : Explain 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
- CLO2 : Predict the behaviour and/or estimate the concentrations of various environmentally important chemicals in aquatic and atmospheric systems.

Detailed Assessment Description

Cencus quiz (1 hr) is due on Sunday 16 Jun 2024 at 11 pm.

Weekly pre-lecture quizzes (20 min, unlimited attempts) are due at 11 pm on the night before the corresponding lecture. Students must achieve a perfect score on at least one attempt before the

due date to earn marks for each quiz.

Submission notes

This is an online submission.

Assignment submission Turnitin type

This is not a Turnitin assignment

Assignment

Assessment Overview

Materials from weeks 7-10 to be assessed (calculation-based written assignment)

Course Learning Outcomes

- CLO1 : Explain 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
- CLO2 : Predict the behaviour and/or estimate the concentrations of various environmentally important chemicals in aquatic and atmospheric systems.
- CLO3 : Describe the various chemical processes that occur in rivers, lakes, groundwater, marine and atmospheric environments.
- CLO4 : Explain and solve complex, real world water and atmospheric chemistry problems

Submission notes

Assignments are to be submitted to the designated assignment box outside room 108, Building H22 – Vallentine Annexe. Students are responsible for keeping spare copies of their submitted assignments.

Assignment submission Turnitin type

This is not a Turnitin assignment

Final Exam

Assessment Overview

Materials from weeks 1-5 and 7-10 to be assessed

Course Learning Outcomes

- CLO1 : Explain 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
- CLO2 : Predict the behaviour and/or estimate the concentrations of various environmentally

important chemicals in aquatic and atmospheric systems.
- CLO3 : Describe the various chemical processes that occur in rivers, lakes, groundwater, marine and atmospheric environments.
- CLO4 : Explain and solve complex, real world water and atmospheric chemistry problems

Assessment Length

2 hr

Submission notes

In-class, closed book exam.

Assignment submission Turnitin type

This is not a Turnitin assignment

Hurdle rules

Your marks for the class work component of this course will only be included in your Final Mark if you obtain > 40% in the Final Examination.

In-class Mid-term quiz

Assessment Overview

Materials from weeks 1 to 5 to be assessed.

Course Learning Outcomes

- CLO1 : Explain 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
- CLO2 : Predict the behaviour and/or estimate the concentrations of various environmentally important chemicals in aquatic and atmospheric systems.
- CLO3 : Describe the various chemical processes that occur in rivers, lakes, groundwater, marine and atmospheric environments.
- CLO4 : Explain and solve complex, real world water and atmospheric chemistry problems

Assessment Length

1 hr

Submission notes

In class (during workshop time in week 7), closed book

Assignment submission Turnitin type

This is not a Turnitin assignment

General Assessment Information

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.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 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 : 3 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 : 10 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 : 17 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 : 24 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 : 1 July - 7 July	Other	Non-teaching week
Week 7 : 8 July - 14 July	Lecture	Redox equilibria and kinetics: • Fundamentals of redox equilibria • Constructions and uses of redox equilibrium diagrams • Redox kinetics
Week 8 : 15 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 : 22 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 : 29 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

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.

General Schedule Information

Units of Credit 6

Contact hours 6 hours per week

Class

- Wed 5:00PM - 6:00PM (VA 121)
- Thu 1:00PM - 2:00PM (Civil Eng. G6)
- Fri 1:00PM - 2:00 PM (Civil Eng. G6)

Workshop

- Wed 6:00PM - 7:00PM (VA 121)
- Thu 2:00PM - 3:00PM (Civil Eng. G6)
- Fri 2:00PM - 3:00 PM (Civil Eng. G6)

Course 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.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	T. David Waite		Room 114 (H22 ? Vallentine Annexe)	9385 5060		No	No
	A. Ninh Pham		Room 108 (H22 ? Vallentine Annexe)	9385 5102		No	Yes

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning

environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the 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 or your primary learning management system (LMS) 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/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific 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)

School-specific Information

Final Examinations

Final Exams in T2 2024 will be held on campus between the 9th - 22nd August, and Supplementary Exams between the 2nd - 6th September 2024. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative matters, please see the Nucleus: Student Hub. They are located inside the Library – first right as you enter the main library entrance. You can also contact them via http://unsw.to/webforms or reserve a place in the face-to-face queue using the UniVerse app.

For course administration matters, please contact the Course Coordinator.

Questions about the this course should normally be asked during the scheduled class so that everyone can benefit from the answer and discussion.