

CVEN2701 WATER AND ATMOSPHERIC CHEMISTRY

COURSE DETAILS

| | | |
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| Units of Credit | 6 | |
| Contact hours | 6 hours per week | |
| Class | Thu 10:00AM - 12:00PM | Online |
| | Fri 12:00PM - 2:00PM | Online |
| Workshop | Fri 2:00PM - 4:00PM | Hybrid (Online + Face to Face): Mathews 104 |

Course Coordinator and Lecturer Prof. T. David Waite
 Email: d.waite@unsw.edu.au
 Office: Room 114 (H22 – Vallentine Annexe)
 Phone: 9385 5060

Lecturer Dr. A. Ninh Pham
 Email: anninh.pham@unsw.edu.au
 Office: Room 108 (H22 – Vallentine Annexe)
 Phone: 9385 5102

INFORMATION ABOUT THE COURSE

This course will provide an introduction to water chemistry as a foundation for understanding chemical processes in both natural and engineered systems. It will build on the basic chemical concepts taught in CHEM1011/1031 and will develop additional concepts required to describe the chemical processes occurring in rivers, lakes, groundwater, marine and atmospheric environments.

HANDBOOK DESCRIPTION

See link to virtual handbook:

<https://www.handbook.unsw.edu.au/undergraduate/courses/2021/CVEN2701/>

OBJECTIVES

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.

TEACHING STRATEGIES

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

The approaches to learning are:

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| Private Study | <ul style="list-style-type: none"> • Review lecture material and textbook • Do set problems and assignments • Join Moodle discussions of problems • Reflect on class problems and assignments • Download materials from Moodle • Keep up with notices and find out marks via Moodle |
| Lectures | <ul style="list-style-type: none"> • Find out what you must learn • See methods that are not in the textbook • Follow worked examples • Hear announcements on course changes |
| Workshops | <ul style="list-style-type: none"> • Be guided by Demonstrators • Practice solving set problems • Ask questions |
| Assessments | <ul style="list-style-type: none"> • Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving |

EXPECTED LEARNING OUTCOMES

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.

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

| Learning Outcome | | EA Stage 1 Competencies |
|------------------|--|-----------------------------------|
| 1. | <p><i>Demonstrate understanding of the basic concepts in water and atmospheric chemistry including:</i></p> <ul style="list-style-type: none"> a) <i>chemical equilibrium and thermodynamics,</i> b) <i>chemical reaction kinetics</i> c) <i>acids and bases,</i> d) <i>alkalinity,</i> e) <i>solid dissolution and precipitation,</i> f) <i>complexation reactions,</i> g) <i>redox reactions and</i> h) <i>reactions on solid surfaces</i> | PE1.1, PE1.2, PE1.3 |
| 2. | <i>Predict the behaviour and/or estimate the concentrations of various environmentally important chemicals in aquatic and atmospheric systems.</i> | PE1.2, PE1.5, PE2.1, PE2.2 |
| 3. | <i>Describe the various chemical processes that occur in rivers, lakes, groundwater, marine and atmospheric environments.</i> | PE1.3, PE2.1, PE2.2 |
| 4. | <i>Extend skills and knowledge of a specific system to explain/solve complex, real world type problems</i> | PE2.1, PE2.2, PE2.4, PE3.1, PE3.3 |

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

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| COURSE PROGRAM |
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TERM 2 2021

| Date | Topic | Lecture Content | Lecturer |
|-------------------------|--|--|------------|
| 31/05/2021 (Week 1) | Foundation considerations | <ul style="list-style-type: none"> • Global carbon cycle • Concentration units • Tableau method: properties of components, mole balance equations • Electroneutrality condition | Waite/Pham |
| 07/06/2021 (Week 2) | Chemical equilibrium and energetics Tools for problem-solving | <ul style="list-style-type: none"> • Thermodynamics of chemical systems: equilibrium and mass law equations • Solution of chemical equilibrium problems: Trial and error and graphical method (LogC-pH diagram) • Effect of ionic strength in non-ideal systems | Waite/Pham |
| 14/06/2021 (Week 3) | Kinetics of chemical reactions | <ul style="list-style-type: none"> • Types and orders of reactions • Reaction mechanisms, rates, rate constants and half-life | Waite/Pham |
| 21/06/2021 (Week 4) | Acids and bases: pH and alkalinity | <ul style="list-style-type: none"> • Major acid/base systems and acidity constants • Alkalinity concept • Equilibrium with the gas phase • Acid rain | Waite/Pham |
| 28/06/2021 (Week 5) | Acids and bases: Effects of biological processes | <ul style="list-style-type: none"> • Mixing of two waters • Effects of biological processes on pH and alkalinity | Waite/Pham |
| 05/07/2021 (Week 6) | <i>Non-teaching week for all courses</i> | | |
| 12/07/2021 (Week 7) | Solid dissolution and precipitation | <ul style="list-style-type: none"> • Solubility of metal hydroxides ($\text{Fe}(\text{OH})_3(\text{s})$) • Solubility of carbonates (CaCO_3) • Acquisition of alkalinity in freshwaters | Waite/Pham |
| 19/07/2021 (Week 8) | Complexation | <ul style="list-style-type: none"> • Aqueous complexes: fundamental concepts • Ion association among major aquatic constituents • Inorganic complexation of trace elements • Organic complexation | Waite/Pham |
| 26/07/2021 (Week 9) | Oxidation – Reduction | <ul style="list-style-type: none"> • Fundamental concepts of redox reactions • Energetics of microbial processes • pe-pH diagrams | Waite/Pham |
| 02/08/2021 (Week 10) | Reactions on solid surfaces Revision | <ul style="list-style-type: none"> • Coordinative properties of surfaces and adsorption isotherms • Complexation model of adsorption: Adsorption of lead on alumina example • Adsorption kinetics, particle settling & aggregation | Waite/Pham |

ASSESSMENT

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. The Final Examination is worth 50% of the Final Mark and the class work is worth 50% of the Final Mark. The formal exam scripts will not be returned but you are permitted to view the marked script.

Students who perform poorly in the online quizzes and workshops are recommended to discuss progress with the lecturer(s) during the term.

Note: The lecturer reserves the right to adjust the final scores by scaling if agreed by the Head of School.

Details of each assessment component, the marks assigned to it, the criteria by which marks will be assigned, and the dates of submission are set out below.

Supplementary Examinations for Term 2 2021 will be held on Monday 6th – Friday 10th September 2021 (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.

Special consideration can be applied at:

<https://student.unsw.edu.au/special-consideration>

ASSESSMENT OVERVIEW

| Item | Length | Weighting | Learning outcomes assessed | Assessment Criteria | Due date and submission requirements | Deadline for absolute fail | Marks returned |
|----------------------|--------|-----------|----------------------------|---|---|----------------------------|----------------|
| Online census-quiz | 45 min | 5% | LO1, LO2 | Materials in Unit 1 to be assessed | Sun 20/06/2021, 11 pm Online submission (open book) | Thu 24/06/2021, 11 pm | Fri 25/06/2021 |
| Online mid-term quiz | 1 hr | 20% | LO1, LO2, LO3, LO4 | Materials in Units 1 and 2 to be assessed | Fri 16/07/2021, 4-5 pm Online submission (open book) | Fri 16/07/2021, 5 pm | Sun 25/07/2021 |
| Assignment | | 25% | LO1, LO2, LO3, LO4 | Materials in Units 3, 4 and 5 to be assessed (calculation-based written assignment) | Wed 04/08/2021, 11 pm Turnitin submission | Sun 08/08/2021, 11 pm | Sun 15/08/2021 |
| Final exam | 2 hrs | 50% | LO1, LO2, LO3, LO4 | Materials in Units 1-6 to be assessed | During the exam period Online, open book exam | N/A | TBA |

All assessments are individual.

The online census-quiz (5%) will be uploaded on UNSW Moodle one week prior to the due date mentioned above. Students can attempt this quiz in their own time within that one-week period once. The online mid-term quiz (20%) however, will only be available at the designated time as mentioned above.

Both census-quiz and mid-term quiz may have 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 if you are not able to take the quiz in the allotted time or regarding any computing problems.

Assignments are to be submitted via Turnitin. Students are responsible to keep spare copies of their submitted assignments.

RELEVANT RESOURCES

- Prescribed text: Morel, F.M.M. and Hering, J.G. (1993) Principles and Applications of Aquatic Chemistry, Wiley Interscience, New York
- Additional materials provided on Moodle.

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

(Formerly known as Common School Information)

For information about:

- Notes on assessments and plagiarism,
- School policy on Supplementary exams,
- Special Considerations: student.unsw.edu.au/special-consideration
- Solutions to Problems,
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC.

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 |
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| 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 |