



UNSW Course Outline

CEIC6714 Hydrogen Systems Engineering and Economics - 2024

Published on the 02 Sep 2024

General Course Information

Course Code : CEIC6714

Year : 2024

Term : Term 3

Teaching Period : T3

Is a multi-term course? : No

Faculty : Faculty of Engineering

Academic Unit : School of Chemical Engineering

Delivery Mode : In Person

Delivery Format : Standard

Delivery Location : Kensington

Campus : Sydney

Study Level : Postgraduate, Undergraduate

Units of Credit : 6

Useful Links

[Handbook Class Timetable](#)

Course Details & Outcomes

Course Description

Hydrogen is considered to be a key enabler in decarbonisation of our fossil fuel dependent energy system. Of course, here are challenges to developing a global hydrogen economy including technological, economic, social license, safety issues and regulatory barriers.

In this 6 unit of credit course, you will learn about current and disruptive hydrogen technologies, associated safety protocols, cradle-to-cradle systems, and its economics. Complemented by industry guest lectures on real world hydrogen application and case studies, you will learn to design hydrogen systems, establish frameworks for economic and environmental assessments and apply safety protocols for the emerging hydrogen economy. The course is taught in blended mode with all staff-student and student-student interactions occurring through a combination of technology-enabled and face-to-face teaching and learning activities.

By the end of the course, you will be equipped with skills and understanding required for Australia's next biggest job market.

Course Aims

This course aims to train Australia's next generation of chemical engineers with skills and understanding required for Australia's growing hydrogen economy.

Relationship to Other Courses

CEIC2005 and CEIC3005 are pre-requisites for the course

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Describe the role of hydrogen and the key technologies across its value chain as a key driver of future sustainable energy infrastructure.
CLO2 : Identify safety issues and protocols in place to minimise risks from hydrogen application.
CLO3 : Apply open-access and open-source environmental assessments (including embedded emissions) and techno-economic costing frameworks to tackle industry questions on hydrogen application across a wide range of markets: aerospace, mining, chemical manufacturing, fossil-fuel substitution, transportation.
CLO4 : Compare and prioritise technologies according to local context, economics, resource availability and situational factors.
CLO5 : Applying knowledge from the course, the student would be able to design simple hydrogen systems for targeted end-use.

Course Learning Outcomes	Assessment Item
CLO1 : Describe the role of hydrogen and the key technologies across its value chain as a key driver of future sustainable energy infrastructure.	• Quiz
CLO2 : Identify safety issues and protocols in place to minimise risks from hydrogen application.	• Quiz
CLO3 : Apply open-access and open-source environmental assessments (including embedded emissions) and techno-economic costing frameworks to tackle industry questions on hydrogen application across a wide range of markets: aerospace, mining, chemical manufacturing, fossil-fuel substitution, transportation.	• Industry case studies
CLO4 : Compare and prioritise technologies according to local context, economics, resource availability and situational factors.	• Industry case studies
CLO5 : Applying knowledge from the course, the student would be able to design simple hydrogen systems for targeted end-use.	• Design Portfolio Project

Learning and Teaching Technologies

Moodle - Learning Management System

Other Professional Outcomes

Engineers Australia, Professional Engineer Stage 1 Competencies

This course contributes to your development of the following EA Professional Engineer

competencies:

- PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin 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
- PE2.2 Fluent application of engineering techniques, tools and resources
- PE2.3 Application of systematic engineering synthesis and design processes
- PE3.6 Effective team membership and team leadership

<https://www.unsw.edu.au/engineering/student-life/student-resources/program-design>

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Quiz Assessment Format: Individual	20%	Due Date: Week 1, Week 2, Week 3, Week 4
Industry case studies Assessment Format: Individual	40%	Due Date: Week 5, Week 7
Design Portfolio Project Assessment Format: Group	40%	Due Date: Week 12

Assessment Details

Quiz

Assessment Overview

Online quizzes covering understanding of lecture content, problem-solving skills, and outside pre-and/or post-lecture activities. The four quizzes are of equal value and will be completed individually.

Course Learning Outcomes

- CL01 : Describe the role of hydrogen and the key technologies across its value chain as a key driver of future sustainable energy infrastructure.
- CL02 : Identify safety issues and protocols in place to minimise risks from hydrogen application.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

Industry case studies

Assessment Overview

Two case study assessments will require students to apply in-class lectures to solve industry provided problems relating to hydrogen application. Both assessments will involve three problems with one solved during lecture and clues provided for second, and students independently completing the third problem. Students will hand in the report at the end of that week, with 4 bullet points to justify their answers and 1 bullet point on reflection on learning.

Course Learning Outcomes

- CL03 : Apply open-access and open-source environmental assessments (including embedded emissions) and techno-economic costing frameworks to tackle industry questions on hydrogen application across a wide range of markets: aerospace, mining, chemical manufacturing, fossil-fuel substitution, transportation.
- CL04 : Compare and prioritise technologies according to local context, economics, resource availability and situational factors.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

Design Portfolio Project

Assessment Overview

This assessment requires students to apply knowledge gained through the course to design a complete independent hydrogen value chain for a real-world application. This may be in mining, aerospace, transportation and manufacturing field. Students are encouraged to come up with a unique and novel application. The outcomes of the project will be a detailed system with consideration on environmental and financial feasibility for the relevant market scenario. Students will work in teams of 5 and will be paired with an industry partner involved in hydrogen projects in Australia. The deliverables will include a design report (20%), a peer-reviewed presentation (10%) and a public informational video (10%) on social media explaining key findings tailored towards general public. Team marks will be moderated by use of team evaluation.

Course Learning Outcomes

- CL05 : Applying knowledge from the course, the student would be able to design simple hydrogen systems for targeted end-use.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

General Assessment Information

Grading Basis

Standard

Requirements to pass course

Achieve a composite mark of at least 50 out of 100

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Lecture	Lecture and workshop on course introduction and overview of hydrogen. In-class Activity.
	Assessment	Quiz 1
Week 2 : 16 September - 22 September	Lecture	Lecture and workshop on hydrogen production methods. In-class Activity.
	Assessment	Quiz 2
Week 3 : 23 September - 29 September	Lecture	Lecture and workshop on hydrogen safety and economics. In-class Activity.
	Assessment	Quiz 3
Week 4 : 30 September - 6 October	Lecture	Lecture and workshop on hydrogen storage, transport, and utilisation. In-class Activity.
	Assessment	Quiz 4
Week 5 : 7 October - 13 October	Assessment	Case Study 1: Ammonia Tool
Week 6 : 14 October - 20 October	Other	Flexibility Week
Week 7 : 21 October - 27 October	Assessment	Case Study 2: Methanol Tool
Week 8 : 28 October - 3 November	Group Work	Lecture on Hydrogen Economics, Mini Design Project Inception, Methodology, BFD Development. Industry Speaker Visit.
Week 9 : 4 November - 10 November	Group Work	Refresher on Multi Criterion Analysis Structure, Environmental Assessment. Industry Speaker Visit. Mini Design Project.
Week 10 : 11 November - 17 November	Group Work	Industry Speaker Visit. Mini Design Project.

Attendance Requirements

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

Course Resources

Recommended Resources

Tools

<https://www.globh2e.org.au/hysupplyammoniatool>

<https://nswp2xtool.pages.dev/>

Textbooks

Sinnott, R. K. Coulson and Richardson's Chemical Engineering Volume 6, Chemical Engineering Design. (1999).

Towler, G. & Sinnott, R. Chemical engineering design: principles, practice and economics of plant and process design. (Elsevier, 2012).

Peters, M. S., Timmerhaus, K. D. & West, R. E. Plant Design and Economics for Chemical Engineers. (2003).

Course Evaluation and Development

The MyExperience survey will be opened towards the end of the course for students to provide their feedback. Students are also encouraged to reach out to the course convenor or any staff member if any issues or problems arise.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Rahman Daiyan		349 Tyree Level 3	0406187805	Friday 10-12 in person or by email	No	Yes
	Rose Amal					No	No
	Muhammad Haider Ali Khan					No	No
	Josh Leverett					No	No

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 policies. 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 Plagiarism

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

Course Workload

Course workload is calculated using the Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations. Most 6 UoC courses will involve approximately 10-12 hours per week of work on your part. If you're not sure what to do in these hours of independent study, the resources on the [UNSW Academic Skills](#) pages offer some suggestions including: making summaries of lectures, read/

summarise sections from the textbook, attempt workshop problems, reattempting workshop problems with some hints from the solutions, looking for additional problems in the textbook.

Full-time enrolment at university means that it is a *full-time* occupation for you and so you would typically need to devote 35 hours per week to your studies to succeed. Full-time enrolment at university is definitely incompatible with full-time employment. Part-time/casual employment can certainly fit into your study schedule but you will have to carefully balance your study obligations with that work and decide how much time for leisure, family, and sleep you want left after fulfilling your commitments to study and work. Everyone only gets 168 hours per week; overloading yourself with both study commitments and work commitments leads to poor outcomes and dissatisfaction with both, overtiredness, mental health issues, and general poor quality of life.

On-campus Class Attendance

Most classes at UNSW are "In Person" and run in a face-to-face mode only. Attendance and participation in the classes is expected. As an evidence-driven engineer or scientist, you'll be interested to know that education research has shown students learn more effectively when they come to class, and less effectively from lecture catch-up recordings. If you have to miss a class due to illness, for example, we expect you to catch up in your time, and within the coming couple of days.

For most courses that are running in an "in person" mode:

- Lectures are normally recorded to provide an opportunity to review material after the lecture; lecture recordings are not a substitute for attending and engaging with the live class.
- Workshops/tutorials are not normally recorded as the activities that are run within those sessions normally cannot be captured by a recording. These activities may also include assessable activities in some or all weeks of the term.
- Laboratories are not recorded and require in-person attendance. Missing laboratory sessions may require you to do a make-up session later in the term; if you miss too many laboratory sessions, it may be necessary to seek a Permitted Withdrawal from the course and reattempt it next year, or end up with an Unsatisfactory Fail for the course.
- Assessments will often require in-person attendance in a timetabled class or a scheduled examination.

Submission of Assessment Tasks

In the School of Chemical Engineering, all written work will be submitted for assessment via Moodle unless otherwise specified. Attaching cover sheets to uploaded work is *not* required

unless specifically requested for an individual assessment task; when you submit work through Moodle for assessment you are agreeing to uphold the Student Code.

Some assessments will require you to complete the work online and it may be difficult for the course coordinator to intervene in the system after the due date. You should ensure that you are familiar with assessment systems well before the due date. If you do this, you will have time to get assistance before the assessment closes.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect. Please make it easy for the markers who are looking at your work to see your achievement and give you due credit.

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Academic Integrity

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage (International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013). At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity and plagiarism can be located at:

- The [Current Students site](#)
- The [ELISE training site](#)

The Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: <https://student.unsw.edu.au/conduct>.

To help describe what we are looking for, here are some things that we consider to be quite acceptable (even desirable!) actions for many assessments, and some that we consider to be unacceptable in most circumstances. Please check with the instructions for your assessments and your course coordinator if you're unsure. As a rule of thumb, if you don't think you could look

the lecturer in the eye and say "this is my own work", then it's not acceptable.

Acceptable actions

- ☒ reading/searching through material we have given you, including lecture slides, course notes, sample problems, workshop problem solutions
- ☒ reading/searching lecture transcripts
- ☒ reading/searching resources that we have pointed you to as part of this course, including textbooks, journal articles, websites
- ☒ reading/searching through your own notes for this course
- ☒ all of the above, for any previous courses
- ☒ using spell checkers, grammar checkers etc to improve the quality of your writing
- ☒ studying course material with other students

Unacceptable actions

- ☒ asking for help completing an assessment from other students, friends, family
- ☒ asking for help on Q&A or homework help websites
- ☒ searching for answers to the specific assessment questions online or in shared documents
- ☒ copying material from any source into your answers
- ☒ using generative AI tools to complete or substantially complete an assessment for you
- ☒ paying someone else to do the assessment for you

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism. Further information about referencing styles can be located at <https://student.unsw.edu.au/referencing>.

For assessments in the School of Chemical Engineering, we recommend the use of referencing software such as [Mendeley](#) or [EndNote](#) for managing references and citations. Unless required

otherwise specified (i.e. in the assignment instructions) students in the School of Chemical Engineering should use either the APA 7th edition, or the American Chemical Society (ACS) referencing style as canonical author-date and numbered styles respectively.

Artificial intelligence tools such as ChatGPT, CodePilot, and built-in tools within Word are modern tools that are useful in some circumstances. In your degree at UNSW, we're teaching you skills that are needed for your professional life, which will include how to use AI tools responsibly plus lots of things that AI tools cannot do for you. AI tools already are (or will soon be) part of professional practice for all of us. However, if we were only teaching you things that AI could do, your degree would be worthless, and you wouldn't have a job in 5 years.

Whether the use of AI tools in an assessment is appropriate will depend on the goals of that assessment. As ever, you should discuss this with your lecturers – there will certainly be assessments where the use of AI tools is encouraged, as well as others where it would interfere with your learning and place you at a disadvantage later. Our goal is to help you learn how to ethically and professionally use the tools available to you. To learn more about the use of AI, [see this discussion we have written](#) where we analyse the strengths and weaknesses of generative AI tools and discuss when it is professionally and ethically appropriate to use them.

While AI may might provide useful tools to help with some assessments, UNSW's policy is quite clear that taking the output of generative AI and submitting it as your own work will never be appropriate, just as paying someone else to complete an assessment for you is serious misconduct.

Asking Questions

Asking questions is an important part of learning. Learning to ask good questions and building the confidence to do so in front of others is an important professional skill that you need to develop. The best place to ask questions is during the scheduled classes for this course, with the obvious exception being questions that are private in nature such as special consideration or equitable learning plans. Between classes, you might also think of questions – some of those you might save up for the next class (write them down!), and some of them you might ask in a Q&A channel on Teams or a Q&A forum on Moodle. Please understand that staff won't be able to answer questions on Teams/Moodle immediately but will endeavour to do so during their regular working hours (i.e. probably not at midnight!) and when they are next working on this particular course (i.e. it might be a day or two). Please respect that staff are juggling multiple work responsibilities (teaching more than one course, supervising research students, doing

experiments, writing grants, ...) and also need to have balance between work and the rest of their life.

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.